C O U R S E S Y L L A B U S

MMVR15 CONFERENCE

MEDICINE MEETS VIRTUAL REALITY 15

DESIGNING THE NEXT

in vivo

in vitro

IN MEDICINE

in silico

ORGANIZING COMMITTEE

Michael J. Ackerman PhD
Ian Alger MD
David C. Balch MA
Steve Charles MD
Patrick C. Cregan FRACS
Henry Fuchs PhD
Walter J. Greenleaf PhD
Randy S. Haluck MD FACS
David M. Hananel
Wm. LeRoy Heinrichs MD PhD
Helene M. Hoffman PhD
Heinz U. Lemke PhD
Alan Liu PhD
Greg T. Mogel MD
Kevin N. Montgomery PhD
Makoto Nonaka MD PhD
Roger Phillips PhD CEng FBCS CIPT
Carla M. Pugh MD PhD
Richard A. Robb PhD
Jannick P. Rolland PhD
Richard M. Satava MD FACS
Rainer M.M. Seibel MD
Steven Senger PhD
Ramin Shahidi PhD
Don Stredney
Julie A. Swain MD
Robert M. Sweet MD
Kirby G. Vosburgh PhD
Dave Warner MD PhD
Suzanne J. Weghorst MA MS
Mark D. Wiederhold MD PhD FACP
Patricia Youngblood PhD

CADUCEUS ART BY JOYCE CUTLER SHAW

IN EDUCATIONAL PARTNERSHIP WITH

TATRC/USAMRMC
www.tatrc.org

METI
www.meti.com

Art Center College of Design
www.artcenter.edu

Biodesign Inst & Decision Theater/ASU
www.biodesign.asu.edu
dt.asu.edu

CIMIT
www.cimit.org

Federation of American Scientists
www.fas.org

NCA Medical Simulation Center
www.simcen.usuhs.mil

SUMMIT
summit.stanford.edu

ORGANIZER

Aligned Management Associates, Inc.
www.amainc.com
www.nextmed.com/mmvr_virtual_reality.html
MMVR15@NextMed.com

MMVR turns vision into proficy.™

FEBRUARY 6 – 9, 2007

THE HYATT REGENCY LONG BEACH
LONG BEACH, CALIFORNIA

Table of Contents MMVR15

MMVR 15 Organizing Committee

Michael J. Ackerman PhD *
Office of High Performance Computing & Communications,
National Library of Medicine

Ian Alger MD
New York Presbyterian Hospital;
Weill Medical College of Cornell University

David C. Balch MA *
DCB Consulting LLC

Steve Charles MD *
MicroDexterity Systems;
University of Tennessee

Patrick C. Cregan FRACS *
Nepean Hospital,
Wentworth Area Health Service

Henry Fuchs PhD
Dept of Computer Science,
University of North Carolina

Walter J. Greenleaf PhD *
Greenleaf Medical Systems

Randy S. Haluck MD FACS *
Dept of Surgery,
Penn State College of Medicine

David M. Hananel *
Surgical Programs,
Medical Education Technologies Inc.

Wm. LeRoy Heinrichs MD PhD
Medical Media & Information Technologies/
Gynecology & Obstetrics,
Stanford University School of Medicine

Helene M. Hoffman PhD *
School of Medicine,
University of California, San Diego

Heinz U. Lemke PhD
Institute for Technical Informatics,
Technical University Berlin

Alan Liu PhD *
National Capital Area Medical Simulation Center,
Uniformed Services University

Greg T. Mogel MD *
Keck School of Medicine/Viterbi School of Engineering,
University of Southern California

Kevin N. Montgomery PhD *
National Biocomputation Center,
Stanford University

Makoto Nonaka MD PhD *
Foundation for International Scientific Advancement

Roger Phillips PhD CEng FBCS CIPT *
Dept of Computer Science,
University of Hull (UK)

Carla M. Pugh MD PhD *
Center for Advanced Surgical Education,
Northwestern University

Richard A. Robb PhD *
Mayo Biomedical Imaging Resource,
Mayo Clinic College of Medicine

Jannick P. Rolland PhD *
College of Optics and Photonics,
University of Central Florida

Richard M. Satava MD FACS
Dept of Surgery,
University of Washington

Rainer M.M. Seibel MD *
Inst of Diagnostic & Interventional Radiology,
University of Witten/Herdecke

Steven Senger PhD *
Dept of Computer Science,
University of Wisconsin - La Crosse

Ramin Shahidi PhD *
Image Guidance Laboratories,
Stanford University School of Medicine

Don Stredney
Interface Laboratory,
OSC

Julie A. Swain MD *
Cardiovascular and Respiratory Devices,
U.S. Food and Drug Administration

Robert M. Sweet MD *
Dept of Urology,
University of Minnesota

Kirby G. Vosburgh PhD *
CIMIT/Brigham & Women's Hospital/
Harvard Medical School

Dave Warner MD PhD
Biodesign Institute/Decision Theater,
Arizona State University;
MindTel LLC; Inst for Interventional Informatics

Suzanne J. Weghorst MA MS *
Human Interface Technology Lab,
University of Washington

Mark D. Wiederhold MD PhD FACP
The Virtual Reality Medical Center

Patricia Youngblood PhD *
Medical Media & Information Technologies,
Stanford University School of Medicine

*** Abstract Review Committee member**

Conference Information

WELCOME

Welcome to the 15th annual **Medicine Meets Virtual Reality** conference. This year's program includes nearly 260 presentations, representing countless hours of hard work and creativity. We hope you find much here that is useful and inspiring.

In vivo, in vitro, in silico: Designing the Next in Medicine. This year's theme acknowledges our growing capacity to design our own health. Through the interaction of informational, biological, and physical technologies, we are creating novel tools to look inside our bodies and reconfigure what we find. Many presenters will explore the design issues that will shape medicine in the years to come.

Thank you for joining us here at MMVR15.

COURSE DESCRIPTION & OBJECTIVES

MMVR15 is designed as a forum for encouraging and sharing innovative research on information-based tools for clinical care and medical education. The program consists of two half-day general sessions, seven half-day parallel sessions, two poster sessions, seven independently organized special activities, exhibits and exhibitor reception, and one adjunct full-day program.

Presentations are chosen to educate participants on:

- State-of-the-art for biomedical simulation and its enabling technologies: haptics, tissue modeling, and simulation
- Emerging tools for clinical diagnosis and therapy: imaging tools, data visualization and fusion techniques, and robotics
- Intelligence networks for medical decision-making and patient care

TARGET AUDIENCE

MMVR15 is designed to educate and inform:

- Physicians, surgeons, and other healthcare professionals interested in emerging and future tools for diagnosis and therapy
- Educators responsible for training the next generation of doctors and scientists
- Computer technologists designing systems for collecting, processing, and networking medical intelligence
- I T and medical device engineers who develop and market state of the art imaging, simulation, robotics, and communication tools
- Military medicine specialists addressing the challenges of warfare and defense health needs
- Biomedical futurists and investors who need to understand where medicine is headed

ACKNOWLEDGMENTS

We thank our colleagues at TATRC/USAMRC for their continuing participation in MMVR. All conference participants benefit from TATRC's enthusiasm for the research done by the MMVR community.

We thank this year's educational partners—organizations that have contributed special portions to the program: Art Center College of Design, Biodesign Institute & Decision Theater of Arizona State University, CIMIT, Federation of American Scientists, National Capital Area Medical Simulation Center, and Stanford University Medical Media and Information Technologies.

We thank Medical Education Technologies, Inc. (METI) for another year of generously sponsoring the Satava Award.

We are always deeply grateful to our colleagues and friends on the Organizing Committee for their continuing encouragement and guidance. We especially acknowledge committee members who review abstracts and, in doing so, contribute an extra portion of energy and critical judgment to MMVR. We give additional thanks to the Proceedings editors for their time and expertise.

Finally, we sincerely thank **all** of you who are presenting their work here at MMVR15. You make this conference possible.

POSTER JUDGING

You are invited to vote for the best poster presentations. Please complete your ballot and submit it at the ballot box at the registration desk. The ten winning posters will be displayed on Friday and their presenters will receive prizes.

EVALUATION

We welcome the input of all conference participants. Please complete your conference evaluation before you leave. We carefully take note of your criticism and suggestions when we create next year's program. Please take a few minutes to write down your reactions, negative and positive, to this year's conference.

DISCLAIMER

The information provided at this conference is intended for general medical education purposes only. All physicians should fully investigate any new product or device before implementing it in their practice. In no event will the conference organizer, Aligned Management Associates, Inc., assume responsibility for any decision made or action taken as a result of the information provided through this activity.

ORGANIZER CONTACT INFO

Medicine Meets Virtual Reality c/o
Aligned Management Associates, Inc.
793-A Foothill Blvd, PMB #119
San Luis Obispo, CA 93405 USA
Phone +1 805 534 0300 Fax +1 805 534 9030
mmvr15@nextmed.com
http:// www.nextmed.com/mmvr_virtual_reality.html

THE SATAVA AWARD

The 13th annual Satava Award will be presented at MMVR15. Established in 1995, the award acknowledges the work of Dr Richard M. Satava, its first recipient. It is presented each year to an individual or research group that demonstrates unique vision and commitment to the improvement of medicine with advanced technology. Previous recipients are:

Nigel W. John PhD (2006)
Brenda Wiederhold PhD MBA (2005)
Steven Dawson MD (2004)
Richard Robb PhD (2003)
SUMMIT Lab, Stanford University (2002)
HIT Lab, University of Washington (2001)
Dave Warner MD PhD (2000)
Faina Shtern MD (1999)
Gerhard Buess MD (1998)
Henry Fuchs PhD (1997)
Victor Spitzer PhD & Michael Ackerman PhD for the Visible Human (1996)
Richard Satava MD FACS (1995)

Medical Education Technologies, Inc. (www.meti.com) is sponsoring the 13th annual Satava Award with a prize of $2500.

Tuesday, February 6

ALL DAY

TATRC'S 7TH ANNUAL ADVANCED MEDICAL TECHNOLOGY REVIEW

PARTNERING TO ENABLE TECHNOLOGY: FROM BASIC RESEARCH TO DEPLOYMENT

Note: TATRC Day is organized by TATRC/USAMRMC. Please see the separate TATRC Agenda for program details.

Wednesday, February 7

WEDNESDAY MORNING

POSTER SESSION – GROUP 1

(Posters are taken down following the afternoon breakout sessions)

7:15 – 8:15AM **Summary Page#**

INFORMATION GUIDED THERAPY

MEDICAL EDUCATION & TRAINING

SURGICAL SIMULATION—TECHNOLOGY & LEARNING

WEDNESDAY MORNING

GENERAL SESSION

DESIGNING THE NEXT IN MEDICINE

Moderator:
Walter J. Greenleaf

8:25 Karen S. Morgan & James D. Westwood
Aligned Management Associates, Inc. [US]
Welcome & Introduction

8:30 Rainer M.M. Seibel 65
Inst Diagnostic & Interventional Radiology, Univ Witten/Herdecke [DE]
Designing the Next in Medicine

8:55 Patrick C. Cregan.....36
Nepean Hosp, Wentworth Area Health Service [AU]
Simulation and the Quality and Safety Agenda—Realistic Expectations

9:20 Dave Warner.....73
Biodesign Inst/Decision Theater, Arizona State Univ; MindTel LLC; Inst Interventional Informatics [US]
Designing the Future: Unnatural Selection in the Emerging Bio-Verse

9:45 **Panel Discussion - DESIGNING THE NEXT IN MEDICINE**

Additional Panelists:

Walter J. Greenleaf (Moderator)
Greenleaf Medical Systems [US]

Carla M. Pugh
Ctr for Adv Surgical Educ, Northwestern Univ [US]

Greg T. Mogel
Keck Sch Medicine/Viterbi Sch Eng, Univ Southern California [US]

Richard M. Satava
Surgery, Univ Washington [US]

10:15 Break [Exhibits open]

GENERAL SESSION *continued*

Please see Special Activity summary 25

10:45 – 12:00Noon

Panel Discussion-
AMERICAN COLLEGE OF SURGEONS (ACS) ACCREDITED EDUCATION INSTITUTES: WHERE ARE WE NOW? WHERE ARE WE GOING?

Panelists:

Kathy Johnson (Chair)
ACS Program for the Accreditation of Education Institutes and Experiential Learning Programs, Div Education, American Coll Surgeons [US]

Karim Qayumi
Ctr Excellence for Surgical Education and Innovation, Univ British Columbia [CA]

Robert B. Stanley, Jr.
Otolaryngology/Head and Neck Surgery, Harborview Med Ctr, Univ Washington [US]

Maria L. Terry
Minimally Invasive Surgery/Surgical Simulation, Univ New Mexico [US]

WEDNESDAY AFTERNOON

SESSION A

MEDICAL EDUCATION & TRAINING

Moderator:
Patricia Youngblood

1:25 Moderator's Welcome

1:30 Fátima Gutierrez 43
Ctr Telehealth and Cybermedicine Research, Univ New Mexico [US]
The Impact of the Degree of Immersion Upon Learning Performance in Virtual Reality Simulations for Medical Education

1:45 Olivier M. Lepage 54
Equine Dept, Ecole Natl Vétérinaire de Lyon [FR]
From Stimulation to Virtual Reality Environments: An Example of Integration into a Traditional Equine Surgery Education Program

2:00 Sowmya Ramachandran 61
Software Development, Stottler Henke Associates, Inc. [US]
From Simulations to Automated Tutoring

2:15 Chang Ha Lee 52
Natl Capital Area Med Simulation Ctr, Uniformed Services Univ [US]
Towards an Immersive Virtual Environment for Medical Team Training

2:30 Eileen B. Entin 40
Aptima, Inc. [US]
Web-Based Teamwork Skills Training for Emergency Medical Teams

2:45 Derek Alan Gould ……43
Radiology, Royal Liverpool Univ Hosp [UK]
Interventional Radiology Simulation for Training: Development of an Implementation Strategy by a Joint International Simulation Task Force

3:00 Tianyun Ni ……59
Comp Info and Sci and Eng, Univ Florida [US]
A Haptic-Enabled Toolkit for Illustration of Procedures in Surgery

3:15 Break

Moderator:
Helene M. Hoffman

3:30 Bruce E. Jarrell ……46
Surgery, Univ Maryland [US]
An Interactive, Cognitive Simulation of Gastroesophageal Reflux Disease

3:45 Daniel M. Becker ……33
Ctr Humanism in Medicine, Univ Virginia Sch Medicine [US]
Painful Conversations, A Game-Based Simulation: How to Learn to Say What No One Wants to Hear

4:00 Thomas M. Nosek ……60
Physiology and Biophysics, Case Western Reserve Univ Sch Medicine [US]
Next Generation Computer Assisted Instruction: A Serious Gaming/Immersion Environment For Medical Education

4:15 Patricia Youngblood ……74
SUMMIT, Stanford Univ Sch Medicine [US]
Virtual Worlds for Teaching the New CPR to High School Students

4:30 Robert Furberg ……41
RTI Intl [US]
Simulation-Enhanced Triage Training for Iraqi Medical Personnel

4:45 Dale E. Olsen ……60
SIMmersion, LLC [US]
Virtual Standardized Patients for Training Health Professionals on Biological Agent Exposures

5:00 Discussion

5:15 Adjourn

WEDNESDAY AFTERNOON

SESSION B

INFORMATION GUIDED THERAPY

Moderator:
Richard A. Robb

1:25 Moderator's Welcome

1:30 Jennifer A. McDonald ……55
Engineering, Daniel Webster Coll [US]
Ultrasound-Guided, Robotic Cannulation of Central Veins: Mating Medical Imaging, Machine Vision and Haptic Robotics

1:45 Mathias Hofer ……45
Innovation Ctr Comp Assisted Surgery, Univ Hosp Leipzig [DE]
Surgery on the Lateral Skull Base with the Navigated Controlled Mill Employed for a Mastoidectomy (Pre-Clinical Evaluation)

2:00 Bernd Hentschel ……45
Virtual Reality Group, RWTH Aachen Univ [DE]
Virtual Reality Based Comparison of Nasal Airflows

2:15 Mingui Sun ……69
Neurosurgery, Univ Pittsburgh [US]
Computer Simulation of Corticospinal Activity During Transcranial Electrical Stimulation in Neurosurgery

2:30 Caroline Villard ……71
LSIIT, Univ Louis Pasteur Strasbourg [FR]
Precise Determination of Regions of Interest for Hepatic RFA Planning

2:45 John T. Moore ……56
Imaging Research Laboratories, Robarts Research Inst [CA]
2D Ultrasound Augmented by Virtual Tools for Guidance of Interventional Procedures

3:00 Kirby G. Vosburgh ……72
CIMIT; Brigham & Women's Hosp; Harvard Med Sch [US]
Natural Orifice Translumenal Endoscopic Surgery (NOTES): An Opportunity for Augmented Reality Guidance

3:15 Break

IGT—REGISTRATION & NAVIGATION

Moderator:
Jannick P. Rolland

3:30 Mathias Markert ……55
Micro Tech and Med Device Tech, Technical Univ Munich [DE]
Manual Registration of Ultrasound with CT/Planning Data for Hepatic Surgery

3:45 Gregory Scott Fischer ……41
Eng Research Ctr Comp Integrated Surgery, Johns Hopkins Univ [US]
Validation System of MR Image Overlay and Other Needle Insertion Techniques

4:00 Georg Eggers ……39
Oral and Cranio-Maxillofacial Surgery, Heidelberg Univ [DE]
Automated Registration of Intraoperative Computer Tomography Image Data

4:15 Rudy J. Lapeer ……51
Sch Computing Sci, Univ East Anglia [UK[
Intra-Operative Registration for Image Enhanced Endoscopic Sinus Surgery Using Photo-Consistency

4:30 Raj Shekhar ……66
Diagnostic Radiology, Univ Maryland [US]
Development of Continuous CT-Guided Minimally Invasive Surgery

4:45 Gregory D. Hager ……44
Ctr Comp-Integrated Surgical Sys and Tech, Johns Hopkins Univ [US]
Stereoscopic Video Overlay with Deformable Registration

5:00 Discussion

5:15 Adjourn

WEDNESDAY AFTERNOON

SESSION C

Please see Special Activity summary ……25

TELESURGERY: THE NEXT FRONTIER IN MEDICINE

1:25 Chairman's Welcome

1:30 Timothy Broderick
Univ Cincinnati Ctr Surgical Innovation [US]
Telesurgery Developments and Demonstrations

2:00 Mehran Anvari
McMaster Univ [CA]
Experiments and Experiences (NEEMO)

2:30 Pablo Garcia
SRI Intl [US]
Robotic Telesurgery Systems

3:00 Break

3:30 Blake Hannaford
Elect Eng, Univ Washington [US]
Engineering Challenges (HAPsMRT and C-Arm)

4:00 Gerald R. Moses (Organizer)
Gardner Carton & Douglas [US]
Future Challenges to Telesurgery

4:30 Discussion

5:15 Adjourn

WEDNESDAY AFTERNOON

SESSION D

Please see Special Activity summary ……25

1:25 – 5:45PM

OPEN SOURCE SOFTWARE FRAMEWORKS FOR MEDICAL SIMULATION

Presentations:

LeRoy Heinrichs
Stanford University [US]
Introduction

Alan Liu
NCA Med Sim Center, Uniformed Services Univ [US]
François Faure
INRIA [FR]
Overview of Medical Simulation and Key Challenges

Individual Framework Presentations with Demonstrations:

Kevin Montgomery and Craig Cornelius
Stanford University [US]
SPRING Framework for Building Networked Surgical Simulators
http://spring.stanford.edu

Frank Tendick
UC San Francisco; UC Berkeley [US]
M. Cenk Cavusoglu
Case Western Reserve Univ [US]
GiPSi: An Open Source/Open Architecture Software Development Framework for Surgical Simulation
http://gipsi.case.edu

Stephane Cotin, Jeremie Allard & Paul Neumann
CIMIT [US]
SOFA: Development of an Open framework for Medical Simulation
http://www.sofa-framework.org

Yoshihiro Kuroda
Med Sci and Bioeng, Osaka Univ [JP]
VRASS Simulation Platform
http://www.kuhp.kyoto-u.ac.jp/~mi/research/vrass/index_en.shtml

François Conti
Stanford Univ; Force Dimension [US]
CHAI 3D: An Open-Source framework for Haptics and Dynamics Simulations
http://www.chai3d.org

WEDNESDAY EVENING

Please see Special Activity summary ……25

6:30-8:00PM

HEALTHGRID.US ALLIANCE

Presenters & Organizers:

Mary Kratz *[US]*
Univ Michigan

Howard Bilofsky *[US]*
Univ Pennsylvania

Jonathan Silverstein *[US]*
Univ Chicago

Parvati Dev *[US]*
Stanford Univ

Jonathan Dugan *[US]*
Matson Systems

Yannick Legré *[FR]*
CNRS; HealthGrid Assoc

Thursday, February 8

THURSDAY MORNING

POSTER SESSION – GROUP 2

7:15-8:15AM

BEHAVIORAL HEALTH & REHABILITATION

HAPTICS

MODELING

ROBOTICS

SURGICAL SIMULATION—SIMULATOR DESIGN TOOLS

TELEMEDICINE, NETWORKS & SENSORS

Alok Shrivastava 66
Vattikuti Urology Inst, Henry Ford Health System [US]
Digital Video Archival and Tele-Retrieval (DIV-ART) for Robotic Surgery

Mingui Sun 69
Neurosurgery, Univ Pittsburgh [US]
Design of the Next-Generation Medical Implants with Communication Channel and Energy Port

Paul M. Vespa 71
Neurosurgery, Univ California Los Angeles [US]
Robotic Telepresence in Intensive Care Improves Physician Response Time

Jochen von Spiczak 72
Radiology, Brigham & Women's Hosp [US]
Device Connectivity for Image-Guided Medical Applications

THURSDAY MORNING

SESSION A

SURGICAL SIMULATION - TECHNOLOGY & LEARNING

Moderator:
Carla M. Pugh

8:25 Moderator's Welcome

8:30 Kanav Kahol 47
Ctr Cognitive Ubiquitous Computing, Arizona State Univ [US]
Cognitive Design of Simulation Training

8:45 W. Bosseau Murray 58
Simulation Development & Cognitive Sci Lab, Pennsylvania State Univ Coll Medicine [US]
Endotracheal Intubation Training Using Virtual Images: Learning with the Mobile Telementoring Intubating Video Laryngoscope

9:00 Mikko J. Rissanen 62
Graduate Sch Informatics, Kyoto Univ [JP]
A Novel Approach for Training of Surgical Procedures Based on Visualization and Annotation of Behavioural Parameters in Simulators

9:15 Elizabeth A. Schmidt 65
Psychology, Old Dominion Univ [US]
Task Sequencing Effects for Open and Closed Loop Laparoscopic Skills

9:30 Rajesh Aggarwal 30
Biosurgery & Surgical Tech, Imperial Coll London [UK]
The Virtual Interventional Suite for Training & Assessment (VISTA): A Pilot Study

9:45 Gyusung Lee.....53
Surgery, Univ Maryland [US]
MIS Surgical Ergonomics: Future Trends

10:00 Break

Moderator:
Randy S. Haluck

10:15 Oliver Burgert 35
Innovation Ctr Comp Assisted Surgery, Univ Leipzig [DE]
Requirement Specification for Surgical Simulation Systems by Use of Surgical Workflows

10:30 Sayra M. Cristancho 36
Mech Eng, Univ British Columbia [CA]
Feasibility of Using Interoperatively Acquired Quantitative Kinematic Measures to Monitor Development of Laparoscopic Skill

10:45 Ronald C. Merrell 56
Surgery, Virginia Commonwealth Univ [US]
Event Capture, Registration and Transmission for Critical Clinical Skill Performance

11:00 Christopher Sewell 66
Comp Sci, Stanford Univ [US]
Evaluating Drilling and Suctioning Technique in a Mastoidectomy Simulator

11:15 Stefan Tuchschmid 70
Comp Vision Lab, ETH Zurich [CH]
Objective Assessment of Surgical Performance in Hysteroscopy Simulation

11:30 Isabelle van Herzeele 71
Biosurgery & Surgical Tech, Imperial Coll London [UK]
Carotid Artery Stent Procedures: Evidence-Based Virtual Reality Simulation for Training and Assessment of Technical skills

11:45 Anthony G. Gallagher 41
Natl Surgical Training Ctr, Royal Coll Surgeons in Ireland [IE]
Simulation Based Objective Assessment of Technical Skills as Part of the Selection of Individuals for Higher Surgical Training in General Surgery at a National Level

12:00 Adjourn

THURSDAY MORNING

SESSION B

MODELING

Moderator:
Michael J. Ackerman

8:25 Moderator's Welcome

8:30 Lenka Jerabkova ……46
VR Group, RWTH Aachen Univ [DE]
Stable Cutting Method for Finite Elements Based Virtual Surgery Simulation

8:45 Denis Laroche ……52
Industrial Materials Inst, Natl Research Council [CA]
In-vivo Validation of a Stent Implantation Numerical Model

9:00 Venkat Devarajan ……39
Elect Eng, Univ Texas at Arlington [US]
Modeling Isotropic Organs Using Beam Models for the Haptic Simulation of Blunt Dissections

9:15 Arielle Drummond ……39
Biomed Eng, Carnegie Mellon Univ [US]
Non-Invasive Anatomical Compatibility Study for a Pediatric Ventricular Assist Device

9:30 Zhuming Ai ……31
Biomed and Health Info Sci, Univ Illinois at Chicago [US]
Cranial Implant Design Using Augmented Reality Immersive System

VISUALIZATION

9:45 Kevin E. Loewke ……55
Mech Eng, Stanford Univ [US]
Real-Time Image Mosaicing for Optical Biopsy

10:00 James W. Ward ……72
Comp Sci, Univ Hull [UK]
Immersive Visualization with Automated Collision Detection for Radiotherapy Treatment Planning

10:15 Discussion

10:30 Break

STEREOSCOPIC PROJECTION

Moderators:
Steven Senger & Michael D'Ambra

10:45 Christoph Aschwanden ……32
Telehealth Research Inst, John A. Burns Sch Medicine [US]
Virtual Reality Environments for Medical Training and Therapy: Surgical Skills Acquisition, Virtual Beach, Virtual Patient and Virtual Nephron

11:00 John T. Moore ……57
Imaging Research Laboratories, Robarts Research Inst [CA]
A Stereoscopic Environment for Surgical Planning and Guidance

11:15 Jonathan C. Silverstein ……67
Surgery, Univ Chicago [US]
Immersive Virtual Anatomy Course Using Cluster of Volume Visualization Machines and Passive Stereo

11:30 Michael D'Ambra ……37
D'Ambra Technologies [US]
The Utility of True 3D Visualization of Cardiac Ultrasound When All Else Fails

11:45 Discussion

12:00 Adjourn

THURSDAY MORNING

SESSION C

Please see Special Activity summary ……26

EVOLVING CHALLENGES IN MEDICAL SIMULATION: IMMERSIVE VIRTUAL ENVIRONMENTS FOR LARGE GROUP TRAINING

8:25 Alan Liu *(Organizer)*
National Capital Area Med Sim Center, USUHS [US]
Welcome and Introduction

8:45 Mark Bowyer
National Capital Area Med Sim Center, USUHS [US]
A Clinical Perspective

9:30 Claudia Johnston
Texas A&M University-Corpus Christi [US]
The Pulse! Virtual Learning Environment

10:15 Break

10:30 Nate Smith
Silver Tree Media, Inc. [US]
Case Study: Rapid Response Sim

11:15 Alan Liu
National Capital Area Med Sim Center, USUHS [US]
The Wide Area Virtual Environment

11:35 Discussion

12:00 Adjourn

THURSDAY MORNING

SESSION D

Please see Special Activity summary ……26

8:25 – 12:00Noon

3D INTERACTIVE REAL-TIME SURGICAL EDUCATION ON THE WEB: EXPLORING THE NEW PARADIGM IN THE AGE OF GOOGLE™

Presenters:

Gerry Higgins (Organizer)
Fed of American Scientists [US]
Crossing the Bleeding Edge: Fully Interactive, 3D Physics-based Surgical Simulation on the Web

Richard Bell
American Board of Surgery [US]
Resident Education: The Next Generation

Larry Brilliant [Invited]
Google.org [US]

Kevin Montgomery
Natl Biocomputation Ctr, Stanford Univ [US]

Vidar Sørhus
SimSurgery [NO]

Jonathan C. Silverstein
Surgery, Univ Chicago [US]

Abe Megahed
Hypercosm LLC [US]

Brian Athey
Univ Michigan [US]

Azhar Rafiq
Surgery, Virginia Commonwealth Univ [US]

THURSDAY AFTERNOON

GENERAL SESSION

Moderator:
Kirby G. Vosburgh

1:25 Moderator's Welcome

1:30 Naoki Suzuki ……70
Inst High Dimensional Med Imaging, Jikei Univ Sch Medicine [JP]
Development of a Surgical Robot System for Endovascular Surgery with Augmented Reality Function

ART CENTER COLLEGE OF DESIGN: NEW COLLABORATIVE PARADIGMS BETWEEN DESIGN EDUCATION, NEW MEDICALTECHNOLOGIES, AND PUBLIC HEALTH

Please see Special Activity summary ……26

Moderator:
Mariana Amatullo

1:50 Mariana Amatullo
International Initiatives/Designmatters, Art Center College of Design [US]
Designmatters: Design Leadership and Global Public Health Advocacy

2:10 Martin Smith
Product Design, Art Center College of Design [US]
Product Design Innovation in the Medical Industries: An Overview of the Funded Educational Program at Art Center College of Design

2:30 Dario Antonioni
Environmental Design, Art Center College of Design [US]
Health Anywhere 2016: A Design Collaboration with General Electric Healthcare to Deliver New Imaging Technologies to Africa

2:50 Discussion

3:10 **Presentation of the 13th ANNUAL SATAVA AWARD**
Presentation:
Richard A. Robb

3:30 Break [Exhibits close following break]

GENERAL SESSION *continued*

INTRA-CELLULAR SURGERY: A NEW FRONTIER?

Moderators:
Richard M. Satava & Jaydev Desai

3:50 Richard M. Satava ……64
Surgery, Univ Washington [US]
Introduction and Need for Intra-Cellular Surgery

4:00 Jaydev P. Desai ……38
Mech Eng, Univ Maryland, College Park [US]
MEMS/Mechanical Effectors for Intra-Cellular Surgery

4:20 Yu Sun ……69
Biomed Eng & Mech Eng, Univ Toronto [CA]
MEMS and Microrobotics for Intra-Cellular Surgery

4:40 [Presenter TBA]

5:00 Discussion

5:20 Adjourn

Friday, February 9

FRIDAY MORNING

SESSION A

SURGICAL SIMULATION - SIMULATOR DESIGN TOOLS

Moderator:
David M. Hananel

7:55 Moderator's Welcome

8:00 Jeremie Allard ……31
Simulation Group, CIMIT [US]
SOFA - An Open Source Framework for Medical Simulation

8:15 Jing Qin ……61
Comp Sci and Eng, Chinese Univ Hong Kong [HK]
An Adaptive Framework Using Cluster-Based Hybrid Architecture for Enhancing Collaboration in Surgical Simulation

8:30 Eric J. Acosta ……30
Natl Capital Area Med Simulation Ctr, Uniformed Services Univ [US]
Burrhole Simulation for an Intracranial Hematoma Simulator

8:45 Stefan Daenzer ……37
Natl Biocomputation Ctr, Stanford Univ [US]
Real-Time Smoke and Bleeding Simulation in Virtual Surgery

9:00 Dhanannjay S. Deo ……38
Mech Aerospace and Nuclear Eng, Rensselaer Polytechnic Inst [US]
Physics-Based Stereoscopic Suturing Simulation with Force Feedback and Continuous Multipoint Interactions for Training on the da Vinci(r) Surgical System

9:15 Yoshihiro Kuroda ……50
Med Sci and Bioeng, Osaka Univ [JP]
Semi-Automatic Development of Optimized Surgical Simulator with Surgical Manuals

9:30 Christopher Sewell ……66
Comp Sci, Stanford Univ [US]
Validating Metrics for a Mastoidectomy Simulator

9:45 Carl A. Nelson ……58
Mech Eng/Surgery, Univ Nebraska [US]
Design Methodology for a Novel Multifunction Laparoscopic Tool: Engineering for Surgeons' Needs

10:00 Break

SURGICAL SIMULATION - SIMULATORS IN PROGRESS

Moderator:
Robert M. Sweet

10:15 Ofek Shilon ……66
R&D, Simbionix Ltd. [IL]
Novel Surgical Simulations of Gastric Bypass and Incisional Hernia Repair Procedures

10:30 Clément Forest ……41
IRCAD/EITS [FR]
Ultrasound and Needle Insertion Simulators Built on Real Patient-Based Data

10:45 Rainer Leuschke ……54
Elect Eng, Univ Washington [US]
Low Cost Eye Surgery Simulator with Skill Assessment Component

11:00 John Hu ……45
Med Robotics and Sys, Energid Technologies [US]
Localized Virtual Patient Model for Regional Anesthesia Simulation Training System

11:15 Scott W. Gunther ……43
Mech Eng, Univ Washington [US]
The Red DRAGON: A Multi-Modality System for Training in Minimally Invasive Surgery

11:30 Bruce D. Anderson ……31
Simulution Inc. [US]
Integrated Lower Extremity Trauma Simulator

11:45 Discussion

12:00 Adjourn

FRIDAY MORNING

SESSION B

TELEMEDICINE, NETWORKS & SENSORS

Moderator:
David C. Balch

7:55 Moderator's Welcome

8:00 Amy C. Lehman ……53
Mech Eng, Univ Nebraska - Lincoln [US]
In vivo Robotics During the NEEMO 9 Mission

8:15 Qiang Liu ……54
Neurological Surgery, Univ Pittsburgh [US]
An Overview of 3D Video Transmission and Display Technologies for Telemedicine Applications

8:30 Bradford R. Wilson ……73
Elect Eng and Comp Sci, Univ California, Berkeley [US]
A Collaborative 3D Tele-Immersive Environment for Remote Medical Consultation

8:45 Donald R. Olson ……60
Neurological Surgery, Oregon Health & Sci Univ [US]
Brain Blast Injury: Treatment with Electrical Stimulation

ROBOTICS

9:00 Pablo E. Garcia
Eng Sys Div, SRI Intl [US]
Development of a Trauma Pod System

9:15 Brett M. Harnett ……44
Surgery/CSI, Univ Cincinnati [US]
Small Unmanned Aerial Vehicle as a Network Access Point for Tele-Robotic Surgical Intervention in the Battlefield

9:30 Amy C. Lehman ……53
Mech Eng, Univ Nebraska - Lincoln [US]
Surgery with Cooperative Robots

9:45 Mehran Anvari ……31
Surgery, McMaster Univ [CA]
NEEMO 9: Evaluating the Impact of 2 Second Time Delay in Telementoring and Telerobotic Surgery

10:00 Ozanan R. Meireles ……56
Surgery, Johns Hopkins Univ [US]
Effects of Visual Feedback Delay on Surgical Task Performance During Telerobotic Surgery

10:15 Break

HAPTICS

Moderator:
Suzanne J. Weghorst

10:30 Sunipa Saha ……64
Biomed Eng, Johns Hopkins Univ [US]
Force Sensing in Robot-Assisted Surgery: Which Degrees of Freedom are Most Important?

10:45 Wm. LeRoy Heinrichs ……44
SUMMIT, Stanford Univ Sch Medicine [US]
A Simple Durometer for Quantifying the 'Haptic Memory' of Surgeons

11:00 Matthew Birtwisle ……34
Sch Computing, Univ Leeds [UK]
A 6-DOF Gravity Compensation Scheme for a Phantom Premium Using a Neural Network

11:15 Marilyn J. Powers ……61
Engineering, MPB Communications, Inc. [CA]
Surgical Scissors Extension Adds the 7th Axis of Force Feedback to the Freedom 6S

11:30 Chih-Hung Aaron King ……49
Ctr Advanced Surgical and Interventional Tech, Univ California Los Angeles [US]
A Pneumatic Haptic Feedback Actuator Array for Robotic Surgery or Simulation

11:45 Jesper Mosegaard ……57
Comp Sci, Univ Aarhus [DK]
Smooth Haptic Interaction from Discontinuous Simulation Data

12:00 Jing Ren ……62
Engineering, Univ Ontario Inst Tech [CA]
Haptics-Constrained Motion for Surgical Interventions

12:15 Adjourn

FRIDAY MORNING

SESSION C

BEHAVIORAL HEALTH & REHABILITATION

Moderators:
Mark D. Wiederhold & Giuseppe Riva

7:55 Moderator's Welcome

8:00 Melba C. Stetz ……68
US Army Aeromedical Research Lab, Ft Rucker, AL [US]
Flight Medics' Virtual Reality Training to Enhance Performance under Combat Stress

8:20 Giuseppe Riva ……63
Applied Tech Neuro-Psychology Lab, Ist Auxologico Italiano [IT]
Cellular Phones for Reducing Battlefield Stress: Rationale and a Preliminary Research

8:40 Michael Verdolin
Interventional Pain Ctr/Anesthesiology, USUHS; Naval Med Ctr, San Diego [US]
The Use of Virtual Reality for Pain Distraction in the Pain Clinic

9:00 Dennis Patrick Wood ……73
Virtual Reality Med Ctr [US]
Combat Related Post Traumatic Stress Disorder: A Case Report Using Virtual Reality Exposure Therapy with Physiological Monitoring

9:20 Steve W. Cole ……36
Research, HopeLab [US]
The Re-Mission Videogame for Cancer: Impact on Psychological Well-Being and Treatment Adherence

9:40 Discussion

10:00 Break

10:20 José Luis Mosso Vázquez ……57
Endoscopy, Clínica A. Pisanty del ISSSTE [MX]
Cybertherapy New Applications for Discomfort Reductions in Surgical Care Unit of Heart, Neonatology Care Unit, Transplant Kidney Care Unit and Delivery Room and Cesarean Surgery

10:40 Hunter G. Hoffman
VR Research Ctr, Univ Washington [US]
Analgesic Effects of Opioids and Immersive Virtual Reality Distraction: Evidence from Subjective Pain Ratings and fMRI Brain Scans

11:00 Albert “Skip” Rizzo ……63
Inst Creative Tech, Univ Southern California [US]
VR Enhanced Upper Extremity Motor Training for Post-Stroke Rehabilitation: Task Design, Clinical Experiment and Visualization on Performance and Progress

11:20 Giuseppe Riva ……63
Applied Tech Neuro-Psychology Lab, Ist Auxologico Italiano [IT]
NeuroVR: An Open-Source Virtual Reality Tool for Research and Therapy

11:40 Discussion

12:00 Adjourn

FRIDAY AFTERNOON

SESSION A

Please see Special Activity summary ……26

1:30 – 3:30PM

GAMES FOR MEDICINE AND HEALTH

Presentations:

Parvati Dev (Organizer)
SUMMIT, Stanford University [US]
The Virtual Hospital—A Framework for What’s Happening

Wm. LeRoy Heinrichs (Organizer)
SUMMIT, Stanford University [US]
Virtual Emergency Department—A Team Training Environment

Laura L. Kusumoto
Forterra Systems, Inc. [US]
Avatars Alive—Physiological Models for Virtual Patients

Patti Hamilton
Texas Woman’s University [US]
SBAR for Nursing—The Patient ‘Hand-off’ at Shift-Change

Claudia Johnston
Texas A&M University-Corpus Christi [US]
Pulse! – Training for First Responders to Mass Casualties

Patricia Youngblood (Organizer)
SUMMIT, Stanford University [US]
Team Performance Assessment—Going Beyond the Individual

Pamela M. Kato
Stanford Hosp; The Game Rx [US]
Re-Mission—Understanding Cancer Treatment

J. Harvey Magee
TATRC / USAMRMC [US]
Closing Analysis

FRIDAY AFTERNOON

SESSION B

Please see Special Activity summary ……27

1:30 – 3:30PM

ROBOTICS TOOLS & TECHNIQUES

Presenters:

Bryan Bergeron (Organizer)
Harvard Med Sch; Archetype Technologies, Inc. [US]

Exhibit Hours

WEDNESDAY, FEBRUARY 7

10:15-10:45AM	Exhibits Open. Break in Exhibit Ballroom [Exhibits closed during lunch break.]
3:00-3:30PM	Break in Exhibit Ballroom
4:30PM	Exhibits close for reception set-up
5:30-6:30PM	**EXHIBITOR RECEPTION**

THURSDAY, FEBRUARY 8

10:00-10:45AM	Exhibits re-open. Break in Exhibit Ballroom [Exhibits closed during lunch break.]
3:30-3:50PM	Break in Exhibit Ballroom
4:00PM	Exhibits close and dismantle

Exhibitors

BOOTH EXHIBITS

3D Image Tek
30100 Town Center Drive #325
Laguna Niguel CA 92677
Info@3DImageTek.com
www.3DImageTek.com
Phone 949 455 1806

Stereoscopic 3D video for medical and surgical applications made easy! Stereoscopic 3D video provides critical information that no single video camera can ... now, as simply and easily as plugging in two cameras you can display, record, transmit, and project stereoscopic 3D video ... in real time! 3-D ImageTek Corp. designs, manufactures, and sells 3D video products, camera systems, and components for real-time recording, displaying, and projecting stereoscopic 3D video from surgical microscopes, surgical robots, 3D endoscopes, tele-medicine cameras, or anywhere dual-camera stereoscopic 3D video would be helpful. Products include 3D Video Encoders, Decoders, 3D video displays, HMDs, and turn-key, low cost, 3D video projection systems.

———

B-Line Medical
12510 Prosperity Drive, Ste. 320
Silver Spring MD 20904
David@BLinemedical.com
www.BLineMedical.com
Phone 301 768 4458

B-Line Medical's SimCenter System™ has been selected by top tier medical institutions as the most advanced, comprehensive and easiest to use solution for managing simulation and training centers. Through its sophisticated web-based architecture, the SimCenter System™ addresses the unique set of challenges associated with running simulation scenarios, including simultaneous monitoring of numerous locations, capturing data from multiple simulators of varying types, immediate debrief of simulation participants, and real-time video annotation. These elements are bound together in a simple, secure interface, providing aggregate reporting and streamlined facility administration.

B-Line Medical solutions maximize resources, allowing faculty and staff to focus on student and curriculum development. For more information visit www.blinemedical.com.

———

CFD Research Corporation
215 Wynn Drive, 5th Floor
Huntsville AL 35805
AJP@CFDRC.com
www.CFDRC.com
Phone 256 726 4815

CFD Research Corporation (CFDRC) is developing Leonardo – an anatomy/physiology based multiscale model of a virtual human. Leonardo integrates compartmental and 3D distributed models of cardiopulmonary circulation, lung respiration, oxygen/glucose metabolism, neural regulation, and other systemic physiological components. Leonardo is built from a spatially distributed arterial-venous vascular system perfusing several organs. The organs, in the multiscale modeling framework, can be represented as multi compartment reactors, 1D vascular trees embedded in the tissue compartment, or geometrically fully resolved 3D vasculature/tissue models. The multiscale modeling capability spans from systemic, organ, tissue, cellular, to subcellular pathway models. Our goal is to simulate Leonardo's virtual life with "faster than life" speed using novel multiscale modeling and parallel computing. The "Life Editor", Leonardo's GUI, will allow programming of his daily life including circadian clock, nutrition, exercise, trauma injury, surgical procedures, and pharmacologic treatment. At present, Leonardo is being tested on his responses to traumatic injuries resulting from explosion blasts and on novel resuscitation, reperfusion, and pharmacological treatment ideas. We are working on the integration of top-down system level physiology models with the bottom-up systems biology. Leonardo is available for academic scientific research.

———

Claron Technology, Inc.
Mars Centre - South Tower
101 College Street, Suite 225
Toronto, ON M5G 1L7, Canada
Info@ClaronTech.com
www.ClaronTech.com,
Phone 416 673 8175

Claron Technology Inc. designs and markets innovative products to measure and track objects in space using computer vision technology. Our main product line is the MicronTracker, the first truly passive real-time sub-millimeter optical pose sensor specialized for medical applications.

———

D'Ambra Technologies
PO Box 7308
Portland ME 04112
Davegdi@DAmbraTec.com
www.DAmbraTec.com,
Phone 207 766 3300

D'Ambra Technologies (DTLLC) is dedicated to providing the benefits of elite three-dimensional technologies to the medical community. We have fostered a unique collaboration of software design and optical engineering with state-of-the-art hardware. We exercise total control of illumination, image acquisition, recording, storage, manipulation of content, and 3D display. This process affords precise control of every pixel in time and space. The result is a convincing 3D image rendered in real-time that passes the rigors imposed by clinical medicine.

_____

Force Dimension
PSE-C
Lausanne, CH-1015, Switzerland
Info@ForceDimension.com
www.ForceDimension.com
Phone 41 21 693 1911

Force Dimension is a recognized leader in development and manufacturing of high precision force-feedback interfaces, including the OMEGA and DELTA family of haptic devices. Force Dimension's technology has been successfully deployed in many research fields, as well as industrial and medical products. Force Dimension also provides engineering and service support for institutions that wish to integrate haptics technology in their applications.

_____

Handshake VR, Inc.
9-564 Weber Street North, Unit 9
Waterloo, ON N2L 5C6, Canada
Phone 519 747 3969
Tim@HandshakeVR.com
www.HandshakeVR.com
Phone 519 747 3969

Handshake VR Inc. specializes in the creation and deployment of local and networked based touch-enabled applications for medical simulation, training and healthcare delivery. Handshake's flagship product, the Handshake proSENSE®Virtual Touch Toolbox is a rapid prototyping, development tool for creating dynamic sense-of-touch and touch-over-network applications. The Handshake proSENSE graphical programming environment is built on top of The MathWorks MATLAB® and Simulink® development platform. The easy-to-use, drag-and-drop environment enables novice users to quickly develop and test designs while being sufficiently sophisticated to provide the expert user with an environment for application development and deployment of new haptic techniques and methodologies. Handshake proSENSE provides a complete hapto-visual development environment which provides developers with the tools to quickly create, intuitively manage, easily modify and readily deploy networked hapto-visual applications. Handshake proSENSE is fully integrated with the MATLAB® help browser and provides direct access to a comprehensive library of context sensitive help, including reference pages, manuals, search capabilities and demonstrations.

_____

Hypercosm Medical LLOC
1212 Fourier Drive
Madison WI 53717
FrakerN@Hypercosm.com
www.Hypercosm.com
Phone 804 389 9853

Hypercosm Medical's interactive 3D simulation and modeling solutions provide a new method for creation of large scale Internet-based medical visualization from simple concepts to anatomical viewers, surgical simulation and medical skills training. Hypercosm builds off of the "scene interactivity" currently found in medical viewers to provide true "object interactivity" through such benefits as manipulation of human anatomy, working tools and instruments, linked text and user viewing control - all deliverable via the Internet to the desktops of medical students, interns, residents, physicians, researchers and allied health personnel.

For medical applications, Hypercosm's advantages include file compression designed specifically for 3D graphics, creating small file sizes while maintaining high fidelity images, unlimited scripting of interactivity during content creation, offering users not just pre-rendered animations or video, but the ability to perform in real-time, and extreme security encryption with no access to anatomical models or software.

From the molecular to gross levels of spatial human morphology, the applications are almost limitless. Interactive 3D visualization and the dynamics of molecular interactions for drug design, medical procedural training and web-based anatomical atlas capabilities are all within the range of this exceptional technology.

_____

Pacific Telehealth & Technology Hui
459 Patterson Road, 4th Flr, East Wing
Honolulu HI 96819-1522
Nancy.Downes@PacificHui.org
www.PacificHui.org
Phone 808 433 7347

The Pacific Telehealth & Technology Hui ('Hui') is a joint venture of the Department of Defense and Department of Veterans Affairs formed in 1999 with the support and encouragement of U.S. Senator Daniel K. Inouye. A subsidiary of the Telemedicine and Advanced Technology Research Center (TATRC) under the U.S. Army Medical Research and Materiel Command, the Hui facilitates interdisciplinary research partnerships with government, academia and industry to advance the development of emerging technologies and improve health care for beneficiaries in the Pacific region. At this year's MMVR, the Hui exhibit booth will feature three of its collaborative projects with the University of Hawaii Telemedicine Research Institute and the University of New Mexico Medical School. These virtual reality (VR) initiatives developed for use in medical education include simulations of a new triage application, as well as a haptics/VR surgical

and fine-motor skills training application. The Hui booth will also showcase two immersive panoramic video (IPV) video applications developed for use in behavioral health therapy (anger management and smoking cessation intervention).

PhoeniX Technologies, Inc.
4302 Norfolk Street
Burnaby, BC V5G 4J9, Canada
Info@PTIPhoeniX.com
www.PTIPhoeniX.com
Phone 604 321 3238

PTI manufactures the world's fastest wide-angle high accuracy active optical motion capture systems. Visualeyez has been developed to provide professional motion capture solutions to science sectors for Virtual Reality, biomechanics, sports analysis and industrial measurement purposes, and to entertainment industries for game development, VFX production and animation applications.

SensAble Technologies
15 Constitution Way
Woburn MA 01801
MTatkow@SensAble.com
www.SensAble.com
Phone 781 937 8315

SensAble Technologies provides software and devices that add the sense of touch to the digital world, including 3D touch-enabled modeling systems and the PHANTOM® line of haptic devices and OpenHaptics® toolkit. SensAble modeling systems are used for product design, medical and dental modeling, digital content creation, and fine arts. The PHANTOM force-feedback devices, which enable users to touch and manipulate virtual objects, and the developer toolkit, are used for simulation and training, robotics, and third-party development. In addition to off-the-shelf solutions, SensAble offers contract development to OEMs for new and customized software applications and haptic devices. Selected haptic application development customers include Boeing, CSIRO, General Electric, KAIST, MIT, NTT Research Lab, RIKEN, Sandia National Labs, Stanford University, Tokyo University, University of Glasgow, University of Hong Kong, University of North Carolina, and University of Siena. SensAble maintains headquarters in the United States and a sales office in Japan. SensAble products are available through direct and reseller channels.

SenseGraphics AB
Isafjordsgatan 22
Kista 15440, Sweden
Info@SenseGraphics.com
www.SenseGraphics.com
Phone 4687508070

Do you want to develop cost effective and realistic medical simulators using the latest in Virtual Reality? Maybe you are looking for alternative stroke rehabilitation solutions? SenseGraphics will show examples of how SenseGraphics development platform is used in the medical and stroke rehabilitation industry during MMVR15 in Los Angeles.

Products featured: Temporal bone surgery simulator from MedicVision, Stroke rehabilitation activity station, needle injection simulator, SenseGraphics development platform including H3D API, VHTK and haptic and 3D visualization Immersive workbench solutions.

TATRC
MCMR-ZB-T Bldg. 1054 Patchel Street
Ft. Detrick, MD 21702-5012
debernardis@tatrc.org
www.TATRC.org
Phone 301 619 7927

For the 2007 Annual MMVR Conference, the US Army Medical Research & Materiel Command (USAMRMC) and The Telemedicine & Advanced Technology Research Center (TATRC) have decided to take a novel approach. TATRC will extend the definition of telemedicine and advanced medical technologies, to include an array of technological innovations which impact the provision of healthcare to the military. This exhibit will focus on and highlight the Congressional Partners and their projects who have teamed with TATRC in an effort to improve joint medical readiness, provide greater battlespace medical awareness, and more effectively employ our medical forces in the 21st century. Funded as areas of Special Congressional interest for Army research, over 60 projects totaling more than 300 million dollars have been executed and managed by TATRC, and carried out in universities and private laboratories all over the country. Please stop by TATRC's advanced technology showcase for a thought-provoking and exciting experience demonstrating how technology will enhance life on the battlefield, in military medicine and beyond. For more information about TATRC, please visit us at at MMVR, or visit us at: www.tatrc.org, or call Ms. Lori DeBernardis, Director of Marketing and Public Affairs at 301.619.7927.

TrueVision Systems
114 E. Haley Street, Ste. G
Santa Barbara CA 93101
Latifa@TrueVisionSys.com
www.TrueVisionSys.com
Phone 805 963 9700

TrueVision Systems developed TrueVision™ , a revolutionary 3D vision system for microscopes that frees users from looking through eyepieces. TrueVision converts the optical 3D image viewed through the microscope to a digital, high-definition, 3D image displayed to a projection screen or monitor in real time. It is an ideal tool for surgery, teaching and collaboration.

Wolters Kluwer Health - Lippincott Williams & Wilkins
530 Walnut Street
Philadelphia PA 19107
Info@LWW.com
www.LWW.com
Phone 215 521 8806

Lippincott Williams & Wilkins is a leading publisher of medical journals, books, and electronic media for physicians, nurses, students and allied health professionals. Stop by our booth to pick up a sample copy of Simulation in Healthcare: Journal of the Society for Simulation in Healthcare, and to see our other products.

TABLE TOP EXHIBITS

Society for Simulation in Healthcare
223 North Guadalupe PMB 300
Santa Fe NM 87501
www.SSIH.org
admin@SSiH.org
Phone 505 983 4923

The Society is a non-profit organization whose membership represents the many disciplines involved in simulation in healthcare. Membership in the Society is open to all individuals and benefits include a subscription and on-line access to our peer-reviewed journal, Simulation in Healthcare, members-only listserv and discounts for the annual scientific meeting held annually in January.

Fundamentals of Laparoscopic Surgery (FLS) Program
A SAGES/ACS Division of Education Program
11300 W. Olympic Blvd. Suite 600
Los Angeles, CA 90064
Lisa@SAGES.org
www.FLSProgram.org
Phone 310 437 0544 x115

The Fundamentals of Laparoscopic Surgery (FLS) is an interactive, hands-on, educational program that gives surgical residents and practicing surgeons the opportunity to learn the fundamentals of laparoscopic surgery in a consistent, scientifically accepted format, while providing a tool that measures your cognitive, clinical and technical skills. Soon to be web-based, two multimedia CD-ROMs present materials on preoperative and intraoperative considerations, basic laparoscopic procedures, postoperative care and complications, and manual skills instruction. The FLS Trainer Box and Accessory Kits allow you to practice your technical skills, improve dexterity and psychomotor skills.

The assessment component is a two-part, proctored exam consisting of a 75-question multiple-choice test and hands-on skills test utilizing the FLS Trainer Box. The exams cover the course materials and the application of this knowledge with emphasis on clinical judgment and intraoperative decision-making. FLS Tests are administered at several Test Centers across the U.S. and Canada in addition to the SAGES Annual Meeting and ACS Clinical Congress. For more information on becoming an FLS Test Center, to sign up for the FLS Test, to request a brochure or purchase the FLS program, please contact the FLS Office.

Endotracheal Intubation Training using Virtual Images: Learning with the Mobile Telementoring Intubating Video Laryngoscope
University of Nebraska
984455 Nebraska Medical Center
Omaha, NE 68198
boedeker1@aol.com
www.medccat.org
Phone 402 871 4901

The indirect laryngoscope used in our study was the Storz Medi Pack Mobile Imaging System™ This Medi Pack System consists of a light source and video camera head which is inserted into a modified Macintosh blade (3 or 4). A fiberoptic bundle interfaces with the camera head and runs to the distal end of the Macintosh blade. The image seen at the distal blade tip is transmitted via this fiberoptic bundle to the camera head and projected onto a video monitor. This system allows the laryngoscopist to view an indirect image of a patient's glottic opening on the video monitor and introduce a styletted endotracheal tube which has been shaped into a curve resembling the shape of the Macintosh blade. This curved shape in the endotracheal tube permits the laryngoscopist to maneuvered it beyond his direct field of vision into the indirect field projected by the distal fiberoptic bundle; in effect "seeing around the corner" with the video laryngoscope.) When using the indirect view, the image projected from the distal tip of the laryngoscope blade permits observation of the glottic structures without the need to align the basic airway axis to permit a direct line of sight. The indirect glottic view was expected by the authors of this paper to be better than the direct view offered by conventional laryngoscopy, especially in a confined intubation setting as experienced in the simulated helicopter intubation.

CIMIT
165 Cambridge St.
Boston, MA 02114
KVosburgh@Partners.org
www.CIMIT.org
Phone 617 643 3800

CIMIT fosters and nurtures interdisciplinary collaboration among world-class experts in medicine, science and engineering, in concert with industry and government, to rapidly improve patient care. A non-profit consortium of Boston area teaching hospitals and engineering schools, CIMIT provides innovators with resources to explore, develop and implement novel technological solutions for today's most urgent healthcare problems. In nine years, CIMIT has demonstrated the power of connecting creative minds from diverse areas of expertise, demonstrating that actively catalyzing the collaborative process accelerates progress in applying new technologies to healthcare needs. CIMIT-enabled teams have produced novel, cost effective healthcare solutions.

Art Center College of Design
1700 Lida Street
Pasadena, CA 91103
mariana.amatullo@artcenter.edu
www.ArtCenter.edu
Phone 626 396 2200

Please see the Art Center College of Design's listing in the Special Activity Summaries. (page 26)

WEDNESDAY MORNING—GENERAL SESSION

AMERICAN COLLEGE OF SURGEONS (ACS) ACCREDITED EDUCATION INSTITUTES: WHERE ARE WE NOW? WHERE ARE WE GOING?

David Hananel, Organizer

This panel is an update on the American College of Surgeons Accredited Education Institutes. In past years, we heard from the Director of the Education Division of the ACS, Dr. Ajit Sachdeva, about the concept of having a series of training centers across the nation that would meet specific criteria in support of surgical education. This concept has now become reality – the first seven centers are operational.

The ACS states: "The vision of the ACS Accredited Education Institutes is to create a network of ACS-approved regional Education Institutes that offer practicing surgeons, surgical residents, medical students, and members of the surgical team a spectrum of educational opportunities including those that address acquisition and maintenance of skills; and focus on new procedures and emerging technologies."

Representatives of the College and several Education Institutes will discuss the approval process and the reasons why these Institutes chose to become part of this innovative program.

WEDNESDAY AFTERNOON—SESSION C

TELESURGERY: THE NEXT FRONTIER IN MEDICINE

Gerald Moses, Organizer

Experts in the development and practice of telesurgery will present advances in technology that support telesurgery, will review research efforts to construct and refine telerobotic surgery systems, and will report current and proposed collaborative projects to validate telesurgery systems and the progression toward animal trials.

WEDNESDAY AFTERNOON—SESSION D

OPEN SOURCE FRAMEWORKS FOR MEDICAL SIMULATION

Stephane Cotin, Organizer

This workshop discusses several design strategies for the development of an open source framework for the Medical Simulation community. These frameworks should be generic, platform-independent, public domain, open source, and extendible. They also attempt to provide a common established set of programming interfaces between components which take into account known algorithms, their future directions, dependences and required exchange information between different components. Discussion will focus more on simulation components to enable tissue deformation, collision detection with response, numerical integration methods, multiprocessing, and haptics. It is critical that such frameworks do not degrade a simulator's interactive run-time performance. As an end result, these frameworks should foster collaboration among research groups, simplify the developmental time for simulators, reduce production costs, and provide a means to share components through a common interface.

The workshop will begin with a introduction to the main challenges of designing a computer-based simulation system, and will be followed by presentations of five different software frameworks currently being developed by the research community. Each presentation will discuss the main objectives of the framework, its structural organization, the main advantages of the approach, and will be illustrated with various videos or live demonstrations of applications in the area of Medical Simulation. The workshop will finish with a panel session with all of the framework developers. If there is time remaining, hands-on demonstrations of some of the systems will be available.

WEDNESDAY EVENING

HEALTHGRID.US ALLIANCE

Mary Kratz, Howard Bilofsky, Jonathan Silverstein, Parvati Dev, Jonathan Dugan, and Yannick Legré, Organizers

The HealthGrid is an emerging international community of individuals from the public and private domain who are actively exploring the beneficial impact of grid technologies on healthcare provision and research. The HealthGrid.US Alliance provides a forum for US organizations who:

- Deploy advanced computational environments for biomedical informatics research such as in-silico docking methods
- Implement security and access services to enable sharing of datasets across virtual organizations
- Utilize collaborative tools to provide medical education
- Configure and curate knowledge environments to enhance healthcare via translational research methods

Grid technologies emerged from specific needs in the particle physics research community for high-end computing intensive applications, and from the availability of high performance networks. The term "grid" rapidly evolved toward a concept of ubiquitous and transparent computing to support a wide variety of applications, and it builds on the well-known metaphor of the pervasive "electricity grid". Biomedical scientists today need access to these new information technology capabilities and sophisticated tools in order to realize the benefits of new models for scientific discovery at the frontier of knowledge.

This session will provide an introduction to this emerging cyberinfrastructure to enable computation, data, collaboration and knowledge environments. Implementation of virtual organizations across the biomedical community will be presented. Please join the session and discover the benefits of the HealthGrid.US Alliance.

WEDNESDAY & THURSDAY, FEBRUARY 7 & 8

THE CYBERARIUM

Dave Warner, Organizer

The Cyberarium returns to MMVR this year as an emergent space that seeks to influence the design of the future and exploit the past. It will be a pan-disciplinary place to share ideas and demo both new and old technologies. Most of all, it will be a place where the diverse social networks represented at MMVR can mix, match, and mash up with creative impunity.

The Cyberarium will start as a free form space with bandwidth, power and very little adult supervision. Join us as we continue to develop new methods of thinking, learning, exploring, and growing. Bring your insight and an open mind.

The Cyberarium will serve as the basis of designing an intelligent migration into the next future of medicine and healthcare.

THURSDAY MORNING—SESSION C

EVOLVING CHALLENGES IN MEDICAL SIMULATION: IMMERSIVE VIRTUAL ENVIRONMENTS FOR LARGE GROUP TRAINING

Alan Liu, Organizer

Simulation has become an accepted part of medical training. Students practice and acquire skills in a structured, uniform, and risk-free learning environment. Formal studies have demonstrated that simulation training aids the development of clinical skills. Recent technical advances have significantly improved the realism and capabilities of modern simulators. The upsurge of interest has led to the commercial development of simulators that support a wide range of different procedures.

Current trainers focus on single-person instruction, but complex medical treatment almost invariably requires team effort. Medical simulation has yet to adequately address the unique challenges of team training and mass-casualty management. In this workshop, we examine the issues involved in training healthcare providers where complex, dynamic interactions between team members and groups of patients are the norm. The need for team-oriented simulation is motivated from a clinical perspective. A survey of current state-of-the-art is presented. The workshop will showcase three initiatives to develop the next-generation of immersive virtual environments for medical training. Open research questions and future directions are discussed. The workshop will conclude with an open forum for discussion.

THURSDAY MORNING—SESSION D

3D INTERACTIVE REAL-TIME SURGICAL EDUCATION ON THE WEB: EXPLORING THE NEW PARADIGM IN THE AGE OF GOOGLE™

Gerry Higgins, Organizer

There have been significant technology advancements that have made possible real-time interaction with complex, three-dimensional (3D) models of anatomy, physiology and pathology on the internet. These include both laparoscopic and open surgical interventions such as cutting, suturing, tissue deformation and organ behaviors with accurate physical properties. The goal of this workshop is to bring together experts from the surgical curriculum developers and experts in the new interactive 3D web-based modeling and simulation domains to establish a new paradigm for collaboration and delivery to almost any environment.

THURSDAY AFTERNOON—GENERAL SESSION

ART CENTER COLLEGE OF DESIGN: NEW COLLABORATIVE PARADIGMS BETWEEN DESIGN EDUCATION, NEW MEDICAL TECHNOLOGIES, AND HEALTH

Mariana Amatullo, Organizer

This plenary session provides an overview of the synergies between design innovation and new medical technologies as well as public health communication. The growing consciousness that design should be harnessed to meet a wide range of societal needs is epitomized within Designmatters at Art Center College of Design, an institutional initiative that weaves rigorous aesthetic values and business acumen with a broad social and humanitarian agenda for positive change. Through Designmatters and Art Center's long-established Funded Educational Program-which brokers educational collaborations with leading industries-students and faculty develop design-based explorations that have a profound impact in the community at large. The outcomes yield a varied portfolio where issues of ethics, empathy and humanism stand front and center. Along with key examples of the GE Healthcare collaboration, the presentation underlines the unique opportunity for design to become a vital partner with the medical industry in pursuit of innovation.

FRIDAY AFTERNOON—SESSION A

GAMES FOR MEDICINE AND HEALTH

Parvati Dev, Patricia Youngblood, and LeRoy Heinrichs, Organizers

An emerging trend in healthcare training is using videogame and related technologies to create web-based, 3D Virtual World environments that allow users to play the role of healthcare professionals or patients. The mode of engage-

ment is with a computer station and a head-set; healthcare professionals interact in real-time with virtual patients and their colleagues, or patients interact with their diseases, all represented by avatars. We use the Virtual Hospital as a framework to link the many activities of Simulation and Game-based Learning.

FRIDAY AFTERNOON—SESSION B

ROBOTICS TOOLS AND TECHNIQUES

Bryan Bergeron, Organizer

This session provides an overview of the technologies, tools, and best practices of robotics development. Topics discussed include:

• Sensors – An introduction to the range of sensors available for robotics sensing applications, from omnidirectional vision to pressure; How to select sensor for specific applications; Understanding specifications; Simple and advanced sensor fusion.
• Actuators – Mechanical effectors available for robotics, from servos to linear actuators.
• Microcontrollers & Microprocessors – Capabilities and limitations of common microcontrollers; When to use microprocessors; Selecting microcontrollers and microprocessors.
• Software Development – Options for microcontroller and microprocessor software development; Operating systems for microprocessor development; Architectures for robotics systems.
• Communications – Intra-and inter-robot communications, from controller area networks (CANs) to multi-node MESH networks.
• Materials – Overview of the materials available for robot construction, from graphite to aluminum; review of strength, magnetic properties, EMI shielding capabilities.
• User Interface – User interface options, from haptics to voice recognition.
• Resources – Where to find components, tools, and more information.

After attending the session, attendees will be able to:

• Understand the components common to all robotics development projects
• Understand the issues related to component selection and application
• Know where to turn for additional information

Presentation Summaries

MMVR 15

Medicine Meets Virtual Reality 15

in vivo, in vitro, in silico:

DESIGNING THE NEXT MEDICINE

Ables, David C.

Quantifying the Sense of Touch with Conformable Capacitive Tactile Sensors

Session: Thursday Posters

While the value of the sense of touch has long been understood in the medical field, the lack of associated science and objectivity, combined with the frequent lack of physical access to tissue, has limited its usefulness to initial, qualitative assessments. Multiple different tactile sensor designs have been developed over the past 10 years, but difficulties in wiring, adapting to complex shapes, and achieving sufficient sensor performance have limited their viability. Capacitive tactile sensors have recently been developed that allow a great deal of design flexibility while providing the data quality required in medical applications. Several medical device companies have commercialized this technology, demonstrating that the sense of touch can now be quantified as a reliable measurement method in the medical field.

Ables, David C.

Development of a Device for Documenting the Clinical Breast Exam Using a Capacitive Tactile Array Sensor

Session: Thursday Posters

Clinicians use their senses of touch to assess and detect breast abnormalities as part of the Clinical Breast Exam (CBE), but the inherent subjectivity of the sense of touch raises concerns about repeatability and interpretation. An innovative technology called electronic palpation (EP) has been developed using tactile array sensors to measure variances in tissue hardness. An EP device was developed and tested on a number of simulated lesions in breast phantoms with very positive results. Ongoing clinical studies look to assess an EP device's viability as a diagnostic and screening tool. The ability to quantify the sense of touch in the form of repeatable digital images may open the possibility of improved breast cancer care.

Acosta, Eric J.

Burrhole Simulation for an Intracranial Hematoma Simulator

Session: Friday AM, Session A

An intracranial hematoma can elevate intracranial pressure, leading to complications and death. A craniotomy is performed when conservative measures are ineffective. We are developing a Virtual Reality-based intracranial hematoma simulator to practice this skill. A critical step in craniotomies involves cutting burrholes in the skull. This presentation describes volumetric-based visual and haptic algorithms developed to simulate burrhole creation. The algorithms described make it possible to simulate several tools (e.g. perforator and bone drills) that are typically used in clinical practice. We are using a haptic workbench to generate a virtual environment with 3D stereoscopic visual and haptic feedback. Realistic 3D models are created from real surgical tools. The actions of these models are controlled using a phantom haptic device.

Aggarwal, Rajesh

The Development of a Proficiency-Based Training Curriculum on the Lapmentor Virtual Reality Laparoscopic Simulator

Session: Thursday Posters

The implementation of a competency-based laparoscopic surgical skills curriculum necessitates the development of tools to enable structured training, with in-built objective measures of assessment. Simulation in the form of virtual reality has been proposed for technical skills training at the early part of the learning curve. The aim of this study was to determine the construct validity and training potential of a commercially available laparoscopic VR simulator with force (haptic) feedback (Lapmentor, Simbionix, USA). A subsequent aim was to derive a competency-based laparoscopic training curriculum based upon this evidence. The study recruited 20 general surgeons of varying levels of experience who performed nine basic tasks on the simulator. All tasks have been proven to be construct valid, and learning curve analysis proves that novice surgeons improve their performance with repeated practice on the simulator. The results of this study enable the definition of a competency-based training curriculum for laparoscopic surgery.

Aggarwal, Rajesh

The Virtual Interventional Suite for Training & Assessment (VISTA): A Pilot Study

Session: Thursday AM, Session A

The ultimate goal of simulation has been to deliver procedural, multi-disciplinary sessions in an authentic setting for both formative and summative assessment. It is with this aim that we developed and piloted a virtual-reality based simulated surgical scenario, from patient admission through to discharge. Each simulated scenario (laparoscopic cholecystectomy) was divided into pre-, intra- and post-operative phases, and all phases delivered in high-fidelity simulated environments: consultation room, operating theatre and ward respectively. The operative procedure was performed on a virtual reality simulator (Lapmentor, Simbionix, USA) in the presence of a full operative team, and simulated patients

employed for pre- and post-operative phases. Ten surgeons of varying experience levels completed the simulated scenarios. Technical difficulty was adjusted to ensure appropriate levels of challenge for each operator's level of experience. It is proposed that this concept could underpin a structured, proficiency-based approach to curriculum design and assessment within the healthcare professions.

Ai, Zhuming

Cranial Implant Design Using Augmented Reality Immersive System

Session: Thursday AM, Session B

We have created software tools that utilize haptics for sculpting precise fitting cranial implants. In this paper, these tools are used in an augmented reality immersive system to create a virtual working environment for the modelers. The virtual environment is designed to mimic the traditional working environment as closely as possible, providing more functionality for the users. It uses a haptic rendering algorithm directly on patient CT data to provide a sense of touch, which is as crucial in virtual sculpting as in traditional physical sculpting. The system replaces the expensive and time consuming traditional sculpting steps such as physical sculpting, mold making, and defect stereolithography. This augmented reality system is part of a comprehensive tele-immersive system, and has been used to design patient-specific cranial implants with precise fit.

Allard, Jeremie

SOFA - An Open Source Framework for Medical Simulation

Session: Friday AM, Session A

SOFA is a flexible Open Source framework which will allow independently developed algorithms to interact together within a common simulation while minimizing the development time required for integration. The main objective of SOFA's research and development is to foster collaboration among research groups. SOFA will simplify the development time for simulators, reduce production costs, and provide a means to share components in a standardized manner. In this paper we present the main concepts of SOFA, describe the current implementation of the framework, and illustrate its potential through a series of examples.

Anderson, Bruce D.

Integrated Lower Extremity Trauma Simulator

Session: Friday AM, Session A

Simulution Inc., in collaboration with Melerit Medical AB, is creating an integrated lower extremity trauma simulator. TraumaVision, a part-task, virtual reality simulator, was originally designed to train surgeons in internal fixation techniques of fractured femurs and hips. We are modifying TraumaVision to include training in trauma triage, external fixation and the treatment of compartment syndrome. A physical model of a leg has been added to the simulator. The user palpates and manipulates the physical model to reduce the fracture and identify points for incisions and needle insertions. The MiniBird position locating system allows manipulations of the physical model to be reflected in the outer views and fluoroscopic images in the VR simulation. The VR simulation is used to make incisions that bleed, apply an external fixator, insert needles for monitoring intercompartment pressure, and perform fasciotomies. A scoring system is being developed and a validation assessment will be performed.

Anvari, Mehran

NEEMO 9: Evaluating the Impact of 2 Second Time Delay in Telementoring and Telerobotic Surgery

Session: Friday AM, Session B

A recent NASA Extreme Environment Mission Operation (NEEMO) explored the feasibility of performing telementoring and telerobotic surgical assistance with a 2-second communication delay (simulating transmission between the earth and moon). The mentor surgeons where in Hamilton, Ontario, Canada, and the astronauts were inside Aquarius, an underwater habitat 5 miles off the Florida coast. Studies included simulated radiologic and orthopedic procedures performed by the astronauts while telementored by specialists from Hamilton, as well as telerobotic suturing and manipulation by a surgeon in Hamilton using a portable M7 robot assembled on board Aquarius, during artificially produced time delays of up to 2.5 seconds. Our results demonstrated that while telementoring remains an effective option even at 2.5-second time delay, certain surgical tasks take too long to accomplish telerobotically, and would not be an effective clinical option. In these situations, a semiautonomous robot capable of performing some pre-programmed tasks could be a viable option.

Aschwanden, Christoph

Centralized Data Recording for a Distributed Surgical Skills Trainer to Facilitate Automated Proficiency Evaluation

Session: Thursday Posters

Virtual reality simulators have the special ability to allow for automated score taking when compared to inanimate box trainers. In our presentation, we will discuss the implementation of a remote score recording system for a surgical skills trainer. Our system allows for data recording over a TCP/IP network, respectively the Internet. Results are stored in a database and made accessible through a web site. The skills trainer is built using SPRING a framework for surgical simulation. Data recording is enabled through an Apache web server and a MySQL database and can be extended to other virtual reality trainers. Recordable data is customizable through a web interface.

Aschwanden, Christoph

Virtual Reality Environments for Medical Training and Therapy: Surgical Skills Acquisition, Virtual Beach, Virtual Patient and Virtual Nephron

Session: Thursday AM, Session B

A ten minute stereoscopic video demonstration will present our projects created: a virtual reality skills trainer; a Hematoma simulation for medical students; a virtual beach for therapy and a virtual nephron visualization. We will comment on both technical implementations as well as experiences gained. Our simulations use motion tracking, joystick and Haptics input devices. Head mount displays, projection systems and monitors are utilized for rendering. The systems have been applied in educational and research settings.

Aschwanden, Christoph

A Feasibility Study for the Validation of the Virtual Reality Motor-Skills Trainer

Session: Wednesday Posters

The Virtual Reality Motor Skills Trainer (VRMS) is a new, low cost virtual reality (VR) distributed computer training system to teach baseline fine-motor skills that are needed in performing laparoscopic surgery. VRMS is currently being developed at the Telehealth Research Institute, University of Hawaii. VRMS can function in either a standalone or a distributed sever/client based model. No other VR fine-motor skills trainer is based on this model. The results demonstrated that all three measures, i.e., speed, accuracy and economy of motion, were sensitive indicators of performance. Also, the scoring system provides an objective way to measure performance. The pilot study demonstrated that it is feasible that the VRMS system can be used to measure and train fine motor-skills needed for laparoscopic, endoscopic, and microscopic surgery. The system is flexible in that multiple different scenarios can be implemented, with dynamic user feedback, and performance can be objectively measured.

Banerjee, P. Pat

Virtual Reality and Haptics Interface for Cellular Mechanotransduction Simulation

Session: Thursday Posters

Cellular mechanotransduction, is the mechanism by which biological cells convert mechanical signals into biochemical responses. In their normal setting, cells exist in a complex micro-environment in which they must adapt and react to cues present in their surroundings. These cues may be both soluble (growth factors and cytokines) and insoluble (adhesion and mechanical forces). Very little is currently known about how cells mechanically sense and transduce signals from insoluble cues (collectively referred to as "mechanotransduction") . Early work indicates the notion that mechanically controlling cell shape (geometry) could control cell function. In this work this issue is further investigated. A 3-D visual information is provided to the operator through a 3-D reconstruction method using vision-based tracking deformations of the cell. The proposed human-machine user's interface allows real-time realistic visual and haptic control strategies for constrained motion in image coordinates. Using these fundamentals, a cellular mechanotransduction simulator is being developed and tested.

Barriga, Simon

Automatic Training System for Laser Eye Surgery

Session: Thursday Posters

To become highly proficient at a given surgical procedure and to reduce risk to patients, physicians must gain experience through a number means. This paper presents an automated system that will be used for training ophthalmologists in the performance of two processes involving the application of laser to the retina: photodynamic therapy (PDT) and panretinal photocoagulation (PRP). The presented work will lead to a system that will allow realistic training to take place through computer simulation. The simulation is composed of four building blocks: Pre-operation planning, multi-modality image registration, tracking the patient's eye movement, and positioning the laser according to the pre-planned aim points. A prototype simulation was developed in Umbra to demonstrate a realistic depiction of the PRP and PDT procedures. The vision of this project is to integrate the software in an already existing ophthalmic device to increase the accuracy of the laser application procedure.

Beardi, Joerg

Stress Influence on Specialist Performance During Operation on a Laparoscopic VR-Simulator - Impact on Training and Education

Session: Wednesday Posters

In simulation medicine score systems and expert levels are developed and used for evaluation of surgical skills. We performed this study to examine the influence of stress on the outcome of experienced surgeons. At the congress of the German society of surgery we enclosed 10 experienced laparoscopic surgeons with a minimum of 10 years practice in laparoscopic surgery. Subjects performed testing tasks on a laparoscopic virtual reality simulator. All tested subjects had no experience with simulation in any way. Stress was induced through a noisy environment and a minimum of ten adjacent observers. Three different tasks were chosen and subject were randomised to one task. Each task was performed with 10 iterations. The performance was evaluated through defined expert levels. Stress induction leads to reduced performance levels. None of the subjects reached the expert levels. Stress therefore has a great impact to the performance of all subjects.

_____

Becker, Daniel M.

Painful Conversations, A Game-Based Simulation: How to Learn to Say What No One Wants to Hear

Session: Wednesday PM, Session A

It is one thing to teach students the concrete skills and knowledge they need to recognize and treat common diseases. It is another thing altogether to teach students to manage the unpredictable and emotionally charged discussions that take place when biotechnology has failed and cure is not an option. Painful Conversations is a computer simulation game that attempts to mediate this instructional deficit by providing a venue in which health care providers can develop affective skills for delivering difficult or bad news to patients through exploration and incidental learning. It is designed to encourage users to experience in a risk-free environment how difficult it is to say the right things to patients near the end of life and at the same time, to develop an approach for these types of patient contacts. Currently in the prototype phase, Painful Conversations features a complicated patient scenario involving a case of incurable breast cancer.

_____

Bello, Fernando

Development and Evaluation of a Virtual Intensive Therapy Unit - VITU

Session: Wednesday Posters

The Intensive Care Unit (ITU) is a specialised environment where severely ill patients receive 24 hour individual care. Healthcare professionals from medicine, nursing and a range of allied professions work together in a co-ordinated way, combining their expertise for the benefit of each patient. In this high-technology setting, continuous monitoring provides data about cardiac, respiratory, renal and other body systems. Life support systems are frequently necessary. Invasive procedures are also common, with many patients requiring central venous cannulation, arterial lines, tracheostomy or intercostal drains. The ITU is daunting to newcomers and contains considerable potential for harm by inexpert treatment. Current training is largely workplace based and depends upon observation and supervised practice with real patients. We present a distributed collaborative virtual environment - the Virtual Intensive Therapy Unit or VITU - that recreates key elements of critical care, providing a safe yet realistic adjunct to the clinical workplace with great potential benefit.

_____

Bello, Fernando

Training and Assessment of Procedural Skills in Context Using an Integrated Procedural Performance Instrument (IPPI)

Session: Wednesday Posters

Clinical procedures are a core component of healthcare practice. Current assessment focuses on technical skill, often using simulation ranging from inanimate models (e.g. venepuncture, intravenous infusion, urinary catheterisation) to advanced VR simulators (e.g. MIST, VIST, AccuTouch). Likewise, training based on the traditional apprenticeship model and, more recently, utilising simulation, tends to disregard non-technical skills such as communication and other professional skills. In this paper we describe an Integrated Procedural Performance Instrument (IPPI) which combines physical or high level computer generated virtual models with simulated patients (SPs) to create a closer approximation to actual clinical situations. This innovative approach uses a panel of realistic scenarios, each addressing a combination of clinical challenges (technical and non-technical) relating to core procedures, together with a powerful computer-based remote assessment methodology that makes possible the provision of timely, personalised and focused feeback.

_____

Birtwisle, Matthew

A 6-DOF Gravity Compensation Scheme for a Phantom Premium Using a Neural Network

Session: Friday AM, Session B

We have developed a six degrees of freedom gravity compensation scheme, specifically for the Sensable Phantom Premium, but that should be portable to other Sensable haptic devices. Motivation for this came from a complaint that haptic devices were too heavy to be used as surgical educational tools. Due to the number of number of parameters needed for traditional approaches to robotics problems we view the system as a black-box and use a neural network to generate a force for any given coordinates. Trained on 300 coordinate-force pairs, a [2, 32, 2] standard back-propagation network is able to learn to a point where it can generalise for 80% of the workspace to send sufficient force to render the Phantom weightless in the hand of the user, irrespective of position and orientation. Early investigation shows a positive attitude towards the performance of the scheme and its inclusion in simulators.

_____

Blum, Melissa B.

Real-Time Incident Preparedness Simulation (RIPS)

Session: Wednesday Posters

The National Bioterrorism Civilian Medical Response Center (CIMERC) presents its latest product, an interactive web-based program used by emergency responders as a planning tool for mass casualty incidents called Real-time Incident Preparedness Simulation (RIPS). RIPS is the audio and visually enhanced version of a collection of written sample disaster scenarios). tThis advanced technology was developed to effectively educate, train and coordinate efforts between disaster responders. Users choose between different mass casualty disaster scenarios and roles, and then simultaneously work through the scenario in accordance with the roles they are representing. Users must make crucial decisions rapidly, which in turn affect the progression of the situation and ultimately the outcome of the simulated response. The unique features of RIPSAll these unique and noteworthy features offered by RIPS combine to create a more powerful, interactive and reality based training tool to assisthelp disaster response professionalsders of all types make the best possiblebetter decisions using a more coordinated approach during complex medical emergencies.

_____

Blyth, Phil

Development and Face Validity of a Virtual Reality Markup Language (VRML) Simulator for Hip Fracture Fixation

Session: Wednesday Posters

A virtual reality simulator for hip fracture fixation has been developed. The simulator runs on computers within the hospital environment. The simulator can be accessed at all hours via a web browser with the Octaga (Octaga AS, Norway) plugin. Bone models were made with the FEM software CMISS (Auckland University) using the Visible Human Dataset. This software allows host mesh customization to patient specific geometry from CT or MRI. The femur is then fractured and exported into the simulator. Trainees perform all relevant tasks to the procedure, from fracture reduction, skin incision, guidewire, lag and cortical screw placement. Surgically relevant objective feedback such as quality of reduction, length of incision and position of the screw is given. Face validity was assessed by trainees and medical students. The median score for realism was 8.2/10. The majority indicated the simulator should be available 24 hours a day (median score 9.4/10).

_____

Brodlie, Ken W.

Evaluating Enhanced Volume Rendering Visualization of Cerebral Aneurysms

Session: Wednesday Posters

The paper describes the evaluation of a novel approach to the visualization of cerebral aneurysms. The novelty lies in the special volume rendering effects which allow a focus on the aneurysm region without losing the context of the surrounding vasculature. The focus is achieved in three different ways: by spatial distortion (where the aneurysm is enlarged and the surroundings compressed); by highlighting of the aneurysm; and by attenuation of surrounding material such as the outer skull to reveal inner structures. Implementation is by programming the graphics processor on conventional PC hardware, allowing interactive exploration of a patient's vasculature network in a clinical situation. We explain how an evaluation by a neurosurgical team was carried out, distinguishing requirements from surgeons and radiologists. The evaluation also confirmed the ease of use of the interface and suggested wider applicability of the work to tumour investigation and educational use.

_____

Buckley, Oliver

Efficient Modelling of Soft Tissue Using Particle Systems

Session: Thursday Posters

The motivation for our work is to provide an improved alternative to fixed models in training interventional radiology procedures through the use of high fidelity virtual environments. An important aspect is to accurately simulate soft tissues using a haptic feedback interface, which can be integrated with existing anatomy models to provide a dynamic, varied and customisable option. We present full details of our approach, which has explored a novel use of particle systems for efficient soft tissue modelling. We demonstrate the creation and deformation of anatomical shapes, in real time on a standard desktop PC.

Burgert, Oliver

Requirement Specification for Surgical Simulation Systems by Use of Surgical Workflows

Session: Thursday AM, Session A

The aim of this paper is to describe a novel goal-oriented method for the design of surgical simulation systems: we propose using "Surgical Workflows" (S-WF) as basis for the definition of the surgical scene and the surgical skills which shall be trained in a surgical simulator. Surgical Workflows are an abstraction of many individual interventions and describe individual and average intervention courses. These workflows are including different surgical strategies and all can be mapped to the requirements specification of a surgical simulator. The aims of the simulator can be more easily determined and for each step of the intervention it is possible to define sub-goals which can be modeled and trained separately.

Carnahan, Heather

Surface Exploration Using a Surgical Instrument: The Perception of Friction

Session: Thursday Posters

Understanding how instruments influence the discrimination surface friction has implications for the development of high fidelity simulation. The purpose of this study was to investigate the ability to discriminate friction during surface exploration using a finger and surgical instrument under normal vision and when vision is absent. Naïve participants explored glass slides with various coatings either with the finger or with a tip of surgical snaps. Participants then rated the slipperiness of the surfaces. Results showed that the explorations with the instrument were estimated to be more slippery and less sensitive than those for the finger. There were no effects for visual condition. This study showed that novices who use instruments to make estimations of tissue slipperiness require practice and training in order to adequately perceive friction. Novices' reduced ability to perceive friction with instruments should be integrated into simulator design.

Carnahan, Heather

A User-Friendly Interface for Surgeons to Create Haptic Effects in Medical Simulation

Session: Thursday Posters

Haptics, namely the sense of touch, has been playing an important role in medical simulation. However, most medical practitioners, who are best suited to create the training environments, do not have the engineering expertise necessary for programming a haptic environment. We propose a user-friendly interface that allows surgeons to arbitrarily select regions on a 3D model of an organ, similar to "painting-by-numbers", and tune the haptic properties of each region in an intuitive way. The selected region and tuned haptic properties will be recorded in a lookup table in real-time. The proposed user interface is validated and assessed by comparing the haptic effects of a tumor on a virtual liver created by a number of surgeons.

Cho, Jang Ho

Non-Clinical Evaluation of the KAIST-Ewha Colonoscopy Simulator II

Session: Wednesday Posters

Colonoscopy requires minimally over 100 procedures for competency. The computer-based simulators can accelerate the learning curve, and reduce the risk to the patients. The KAIST-EWHA colonoscopy simulator II is developed to provide various training scenarios. In this paper, it is to be determined whether the developed simulator can improve the identified skills of the practical colonoscopy. 31 engineering students participated in the study, and they do not have medical background. They were given brief instruction on the operations of the colonoscope and basic colonoscopy skills by the colonoscopy expert. The participants were divided into two groups. Both groups underwent a baseline evaluation. The simulation-trained group was required to practice the colonoscopy repeatedly until their performance met all criteria established by experts. Both groups performed final evaluation after the training was complete. This study shows that the subjects who have been trained using the developed simulator, have improved the skills.

Cole, Steve W.

The Re-Mission Videogame for Cancer: Impact on Psychological Well-Being and Treatment Adherence

Session: Friday AM, Session C

Re-Mission videogame was developed as a rationally targeted behavioral intervention to support psychological well-being and enhance self-care behavior and adherence to medical treatment regimens. In a randomized multi-site intervention trial involving 375 cancer patients of aged 13 to 29 recruited from 34 medical centers in the United States, Canada, and Australia, participants randomly assigned to the Re-Mission treatment group showed significantly greater increases in quality of life ($p = 0.039$), self-efficacy ($p = 0.021$), and cancer-related knowledge ($p = 0.044$) than did participants in the control group. Among those prescribed oral 6-mercaptopurine or antibiotics, blood monitoring of chemotherapy metabolites and MEMS cap monitoring of antibiotic use showed significant advantages for participants in the Re-Mission group ($p = 0.012$ and $p = 0.035$ respectively). These data show that a rationally targeted videogame intervention can effectively support psychological and behavioral outcomes in adolescents and young adults with cancer.

Combs, C. Donald

Analyzing the MMVR and the MMSD(c) Research Spaces: Understanding Rapid Growth

Session: Wednesday Posters

For MMVR 11 in 2003, the author conducted a meta-analysis of almost three hundred research articles resulting from MMVR conferences 8, 9 and 10. The MMVR conference is a key forum where leading researchers regularly convene to discuss medical modeling and simulation. As such, a meta-analysis of the MMVR conference presentations represents a reasonable overview of both the state-of-the-art in virtual reality applications in medicine and the basic and applied research trends in the field. For MMVR 15, this meta-analysis is extended to cover the research presented during MMVR conferences 11, 12, 13 and 14. This seven-year meta-analysis of MMVR research is then compared to a similar analysis of the 200,000 medical modeling and simulation articles, written from 1965 to the present, included in the Medical Modeling and Simulation Database(c) (MMSD(c)). Together, these analyses provide a comprehensive overview of the status and trends of medical simulation research.

Crane, Gary R.

Developing Regional Grid Technology Support for TATRC Programs

Session: Wednesday Posters

This presentation will summarize a quantitative methodology developed for analyzing and scoring research applications for their grid technology potential. The application of this methodology to 200+ TATRC funded projects resulted in classification of TATRC projects into four broad categories: 1) Pre-hospital data analysis, 2) bioinformatics, 3) medical records data mining and 4) bio-medical simulations. Illustrative grid technology application scenarios were developed for which demonstration projects were implemented. The methods and technologies that were used to create these grid enabled research application demonstrations will be discussed. Grid enabled research application demonstrations will be incorporated into the presentation and, if facilities permit, live grid application demonstrations will be part of the presentation, effectively providing the audience with a brief tutorial on the benefits of a regional grid infrastructure for TATRC.

Cregan, Patrick C.

Simulation and the Quality and Safety Agenda - Realistic Expectations

Session: Wednesday AM General Session

The problems of safety and quality in the health care system are often cited as drivers for the development of simulation.. Care, however, is needed in defining the realistic expectations of simulation, especially in regard to surgical skills training, simulators and their likely impact on quality and safety. To illustrate this, a typical article on surgical simulation has been randomly selected and the first paragraph of the preamble and its references examined. Large numbers of errors and substantial associated cost were cited and referenced. Unfortunately these references when examined closely do not support simulation and skills training as a large component of the quality and safety agenda. This is in line with the general literature on quality and safety. The educational and individual skills assessment value of simulation remains however a vital goal to pursue.

Cristancho, Sayra M.

Feasibility of Using Interoperatively Acquired Quantitative Kinematic Measures to Monitor Development of Laparoscopic Skill

Session: Thursday AM, Session A

The purpose of this presentation is to demonstrate the feasibility of using a new hierarchical motor-cognitive modelling technique for quantitatively analyzing live surgical procedures. We begin by explaining the importance of using objective techniques to assess surgical skill and go on to explain the framework we've developed for capturing intraoperative movement data 'in context' - that is, with some representation of what stage in the surgical process the data is associated with. A key need for surgical trainers

is monitoring skill development, so we show through experimental results from a physical simulator (dissecting a mandarin orange) that the quantitative data obtained by tracking real surgical tools can be used to distinguish between surgical trainees with different levels of experience. Since this data has many dimensions, we show that a dimensionality reduction technique allows us to present the differences between surgeons on a two-dimensional plot that is easily interpreted by trainers. We conclude by describing our plans for applying this technique to live surgical procedures.

Crouch, Jessica R.

Parametric Eye Models

Session: Thursday Posters

The geometry of one structure in a multi-part anatomical model cannot be specified independently from its neighbors because complex connections and shape dependencies exist between structures. A shape parameter network can represent these dependency relationships and support anatomical model creation. This will be demonstrated in the context of patient-specific volumetric eye model generation. Multi-part eye models are created based on a set of clinically measurable eye parameters. These geometry models are space-filling with non-overlapping interior structures, include fiber orientation vectors for some parts of the eye, and support the generation of 3D finite element meshes as well as surface meshes. The parameter network approach allows a large library of different eye models to be generated by simply adjusting input parameter values. This approach can be employed with any type of solid shape model that defines an object based coordinate system.

D'Ambra, Michael N.

The Utility of True 3D Visualization of Cardiac Ultrasound When All Else Fails

Session: Thursday AM, Session B

There is overwhelming evidence that survival of patients is dramatically improved if abnormal mitral valves can be repaired as opposed to replaced. Centers of expertise can achieve rates of mitral repair of over 90%, but the overall US ratio of repair to replacement is 36%.

Two cases will be presented which demonstrate the fact that 2D trans-esophageal ultrasound and direct surgical valve visualization provide insufficient information to completely assess dynamic Left Ventricular Outflow Tract Obstruction or "SAM" [systolic anterior motion of the anterior mitral leaflet].

SAM is caused by the anterior leaflet of the mitral valve being pulled into the flowstream during left ventricular ejection, and is a major reason for surgeons to abandon repair attempts and resort to mitral valve replacement. Surgical and 2D ultrasound video sequences will be presented which will give the audience the same information available to surgeon and anesthesiologist at the time of these operations.
True 3D ultrasound will be projected so that the audience can appreciate the power of this new imaging modality. Valve anatomy and subtle pathology, previously unappreciated is revealed by this new technique. The surgical repair which eliminates SAM based on the unique information available in true 3D ultrasound will also be projected in stereo video.

True 3D visualization allows surgeons and anesthesiologists to predict SAM in mitral valve repair operations, and to design patient-specific preemptive surgical techniques. The ability to know when to utilize these techniques should improve patient outcomes and increase an institution's repair / replacement ratio.

Daenzer, Stefan

Real-Time Smoke and Bleeding Simulation in Virtual Surgery

Session: Friday AM, Session A

The presentation will give an overview of implementations of the uncoupled particle system, the Newton solver, and the billboarding-enabled 2D texture mapping method used for the smoke simulation. In addition, the presentation will describe the model-based bleeding simulation technique and the different visualizations as polygonal stripes, textured polygonal stripes, and 3D elliptical stipes. A video presentation of the smoke and bleeding simulation in the open source surgical simulator, SPRING, will also be shown.

Dalmiya, Vishal

Determination of Key and Driving Points of a Beam Model for the Simulation of Tissues

Session: Thursday Posters

The simulation of catheter, guidewire and rigid tissues using mass spring and FEM are computationally expensive or inaccurate. Our new beam model uses well established dynamics of Civil Engineering making it accurate and potentially real time. We first take several cross-sections of the organ and find the edges. Then, we fit curves to the cross-section. If the cross-section of the organ does not change over a certain length, no information needs to be stored for that length of the organ. Thus, a set of equations represent a section of the organ. With the determination of an axis of

symmetry, we determine the deflection of driving points lying on this axis. The key points always are at a constant position vector with respect to these driving points. Hence with the knowledge of the new position of driving points, deflection of the key points can be evaluated using a simple transformation matrix.

De, Smita

CIELab Color Values of in vivo Normal and Grasped Porcine Liver

Session: Thursday Posters

Accurate color rendering of organs can improve the realism of surgical simulators. We have developed a methodology to measure the color of tissue surfaces in vivo using three approaches to provide validated color information in the standardized CIELAB space. Specifically, we were interested in the difference between normal and grasped, damaged tissues, as this is not typically addressed in simulators. One measurement method estimates CIELAB values based on digital photograph RGB values of in vivo tissues calibrated using a tissue-specific color chart and interpolated with a regularized local linear regression. The second method directly measures tissue reflectance using a spectrophotometer. A third measurement method is subjective visual validation based on the high-resolution tissue-specific color charts learned from the first two methods. Preliminary results indicated that this approach was able to determine device-independent color values for normal and damaged porcine liver and that these different color values can be visually validated.

Deo, Dhanannjay S.

Remote Virtual Surgery: Intermediate Representations for Internet-Aware, Real Time, Scalable Interactions with Physics-Based Deformable Models

Session: Thursday Posters

To facilitate training of surgical residents on realistic surgical scenarios involving complex organ geometries and millions of degrees of freedom, a distributed computational environment is necessary where surgical residents may train on desktop PCs or laptops connected to massively parallel computers over the internet. The limited computational power at the client side necessitates novel computational algorithms to sustain such a distributed training environment. In this paper we lay the foundations of such an environment by developing a scalable, internet aware "intermediate representation" algorithm. In our technique, a local representation of the simulation scenario in the vicinity of the surgical tool-tip is simulated in real time on the client computer. The server, simulates the complete scene at higher resolution and updates the local model based on the tool tip motion updates received from the client. This intermediate representation can be tuned to the computational capacity of the client computer and allows for the multi-resolution surgical scene including arbitrary local refinements. It is also scalable to the quality of the available network resources (bandwidth, delay, delay jitter) for the connection between client and server.

Deo, Dhanannjay S.

Physics-Based Stereoscopic Suturing Simulation with Force Feedback and Continuous Multipoint Interactions for Training on the da Vinci(r) Surgical System

Session: Friday AM, Session A

In current paper we present a 3d stereoscopic, bimanual surgical suturing system with realistic thread model and physics-based thread-tissue interaction algorithm to help train surgeons on the da Vinci surgical system. The tissue deformations may be computed at multiple points due to both the frictional pull resulting from the passage of the thread through the tissue and the additional forces applied by both hands of the user on the thread or tissues, enabling, for the first time, continuous sutures and knot tying with force feedback. Two Phantom Premium 1.0 are used for force rendering and Planar system's dual monitor based stereo vision system is used for simultaneous rendering of left and right eye views facilitating 3D rendering. Examples with realistic organ geometries from the Visible Human project will be presented.

Desai, Jaydev P.

MEMS/Mechanical Effectors for Intra-Cellular Surgery

Session: Thursday PM General Session

This talk will focus on the need for haptic (sense of touch) feedback in cell manipulation which can eventually lead to effective cellular and sub-cellular surgery for transgenesis. This talk will present the development of a single degree of freedom force sensor that has been developed along with the haptic feedback interface to provide force feedback to the operator during a typical cell injection task. We have also shown through human factors studies that the success rate of a typical cell injection task can be as high as 81% when both vision and force feedback are provided to a operator compared to only 37% success rate with vision feedback alone. Furthermore, we have recently microfabricated a novel Polypyrrole-gold (PPy-Au) bi-layer actuator for cell grasping in aqueous media at room temperature. In a typical micromanipulation task, the pipette suction force required to hold the cell cannot be well controlled by hydrodynamic pressure. Excessive suction force may rupture the cell membrane. Thus it is important to hold the cell without applying excessive forces during a cell manipulation/injection task. To address this problem, we have developed a PPy-Au bi-layer actuator

to hold the cell in place. Through a haptic feedback interface, the eventual goal is to automate the cell manipulation process and increase the percentage of successful outcomes.

Devarajan, Venkat

Modeling Isotropic Organs Using Beam Models for the Haptic Simulation of Blunt Dissections

Session: Thursday AM, Session B

Haptic modeling of organs using existing approaches is still not realistic and/or real time. We propose and develop the mathematical foundation of a new approach to modeling organs using beams. Beams are well known entities in Civil and Structural engineering. We develop their mathematical properties in the context of organ characteristics. The real time advantage arises from the fact that a single beam implementation eliminates hundreds, if not thousands of mass springs from the traditional mass spring models and, thousands of polygons from the finite element method. Even more importantly our derivation is valid for large deformation. Most previous work has developed equations only for small deflections. This is important because we set out to simulate blunt cutting which requires models for large deflections. Our new model, when simulated and compared with an FEM model provides comparable accuracy.

Drummond, Arielle

Non-Invasive Anatomical Compatibility Study for a Pediatric Ventricular Assist Device

Session: Thursday AM, Session B

An innovative pediatric ventricular assist device (PVAD) is being developed to treat young patients (2.5kg-15kg) with severe heart failure who otherwise have very few options due to their small size. To optimize the design of the PVAD for the target patient population, three-dimensional anatomical compatibility studies must be conducted. The aim of this project was to develop a library of 3D models of pediatric patients in the target patient population. Serial CT scans of the thorax and upper abdomen were acquired to complete this study. The results were visualized as surface renderings of the rib cage, heart, lungs, diaphragm and liver. This data was then amended with solid models of the implantable hardware, including the PVAD and cannulae. Manipulation of the relative orientation of the components revealed surgical challenges that may motivate design modifications to improve the anatomic compatibility as well as design specific cannulae sets for the device.

Dubrowski, Adam

Low Fidelity Simulation of Temporal Bone Drilling Leads to Improved but Sub-Optimal Outcomes

Session: Wednesday Posters

Novices' learning of temporal bone drilling on a simple model was compared to learning of the skill on a complex model. Medical students practiced precision drilling on either high (3D) or low (2D) fidelity models, and at the end of practice both groups performed one additional practice trial on the 3D model. All participants were pre- and post-tested on the 3D task. A group of ENT Fellows was assessed on the 3D model. Expert assessment of final products and amount of mass removed were measured. Results showed that trainees practicing on 2D model required an additional 3D practice to remove the same amount of bone mass as those practicing on a 3D model and the ENT Fellows. This implies that during learning fundamental psychomotor adaptations take place, regardless of the exact skill practiced. However to achieve optimal products the depth of drilling must be practiced separately on high fidelity models.

Eggers, Georg

Automated Registration of Intraoperative Computer Tomography Image Data

Session: Wednesday PM, Session B

A system for fully automated patient-to-image registration for intraoperatively acquired CT image data is presented. The system consists of an infrared-camera based navigation system with registration software (BrainLab VectorVision Sky) and an intraoperative CT-scanner (Siemens Somatom Emotion). The CT scanner has a moving gantry while the patient on the OR-table is immobile during scanning. The gantry is equipped with a dynamic reference frame (DRF) so that its position can be tracked by the navigation system during image data acquisition. With the tracking information from gantry and patient, and the known transformation between the DRF of the gantry and the image plane, the patient-to-image registration is calculated fully automatically. After experiments with test-objects, the system is in use successfully in patient care.

Englmeier, Karl-Hans

Multimodal Virtual Bronchoscopy Using PET/CT-Images

Session: Wednesday Posters

The combination of PET with CT offers several advantages in comparison to PET and CT alone. In scientific literature, the fusion of molecular/metabolic and anatomic/morphologic

information has been shown to improve the diagnostic accuracy in identifying and characterizing of malignancies, assessment of tumor stage, therapeutical response and tumor recurrence. The purpose of this study was to demonstrate the possibilities, advantages and limitations of a virtual endoscopic examination using data sets from PET/CT. Therefore, a transparent color-coded surface-rendered virtual hybrid bronchoscopy system was developed to quantitatively evaluate tumor lesions and lymph node metastases.

Entin, Eileen B.

Web-Based Teamwork Skills Training for Emergency Medical Teams

Session: Wednesday PM, Session A

Team Training and Remote Assessment in a Networked Environment (T-TRANE) is a web-enabled, distributed scenario-based teamwork skills training program for emergency medical teams. By providing training that focuses on teamwork skills in emergency medical settings, the program is designed to rapidly increase team proficiency. The program is comprised of information about and examples of teamwork skills; and scenario-based training exercises that provide practice in strategies to promote teamwork such as conducting pre-planning and debriefing sessions. T-TRANE is comprised of four modules, two live (synchronous) interactive modules and two self-paced (asynchronous) modules that students can complete at their convenience within scheduled intervals. The program includes an Instructor's Guide that provides the necessary support to conduct the training. T-TRANE was positively evaluated by several groups of medical professionals. The pedagogical approach and delivery technology it uses can be adapted to any domain in which distributed teams will benefit from teamwork skills training.

Felländer-Tsai, Li

Implementing Virtual Worlds for Systematic Training of Prehospital CPR in Medical School

Session: Wednesday Posters

In this project, a previously developed Virtual World prehospital CPR traning program was evaluated in 12 Swedish medical students (Forterra Systems, Inc.'s On-Line, Interactive, Virtual Environment, OLIVE) game development platform). In Massively, Multi-player, Online Simulation (MMOS), "virtual worlds", medical students played the role of a character ("avatar") in a scenario practicing first steps in prehospital CPR. Formative evaluations of the online training system indicated high mean scores for "Immersion" 3.5/5.0 and "Ease of Use" 4.0/5.0. When asked if this type of simulated training has a part in the education of tomorrow, the medical students' mean score was 4.7. The medical students also indicated an increase in Flow experience during the training process (from 55 to 66) and increased Self Efficacy (from 5.8 to 8.4). Mental strain was low and stable over the test period. This study demonstrates the added value of MMOS for situated training of CPR medical students.

Feng, Chuan

Data Fusion in a Laparoscopic Surgery Training Assistive System

Session: Thursday Posters

Due to the nature of laparoscopic surgery, inexperienced surgeons often lack the correct perception of instruments' position and haptic feedback. This presentation will discuss the design of a computerized laparoscopy training assistant that uses a variety of sensors. The system fuses data from sensors and provides information to surgeons such as the range of motion, potential danger zone warnings, and haptic feedback from the instruments. A data fusion method is employed to achieve effective utilization of multi-sensors and to ensure information correctness and precision. The presentation will show the data fusion techniques, the underlying system design, the experimental set up and simulation results.

Fiedler, Matthew J.

Virtual Reality for Robotic Laparoscopic Surgical Training

Session: Wednesday Posters

Virtual reality (VR) simulation has been used to improve training for manual laparoscopy and to give surgeons superior performance in the operating room. However, VR has not been used to train surgeons in robotic laparoscopy. This study presents our preliminary efforts to develop a VR environment for robotic laparoscopy. We also compared our VR environment to the actual environment (the da Vinci Robotic Surgical System; Intuitive Surgical Inc.) using simple tasks (needle passing and bimanual carrying) to determine the validity of the simulation.

Fischer, Gregory Scott

Validation System of MR Image Overlay and Other Needle Insertion Techniques

Session: Wednesday PM, Session B

Development of CT/MRI guided assistance techniques for needle placement procedures necessitates a comparative validation environment. Clinical equipment is prohibitively expensive and often inadequate for precise validation. We

developed a laboratory validation system for measuring operator performance. The system can be applied to methods of assistance ranging from augmented reality to tracked navigation systems and robots. We describe the validation system and its use for comparative analysis of virtual image overlay, bi-plane laser guidance, and unassisted techniques. Trials are performed in a spine phantom with stereotactic fiducials for automatic registration between anatomical images, phantom and electromagnetically tracked needle. Needle trajectory is recorded during insertion, and performance of the operator is analyzed. Initial assessments of the image overlay, laser guide, and freehand needle insertions were performed. Experiments with experienced radiologists are currently underway to provide large scale accuracy assessment of needle insertion procedures using commercial surgical navigation systems, image overlay, laser guide, and traditional techniques.

_____

Forest, Clément

Ultrasound and Needle Insertion Simulators Built on Real Patient-Based Data

Session: Friday AM, Session A

We presents here the state of our work on medical simulators. We have developed several patient-based training simulators for ultrasound examination and ultrasound guided needle insertion. Those simulators are built upon a method already described in MMVR in 2005 that allows the creation of new cases automatically from a 3D medical image (CT or MRI) They use indifferently one or two force feedback devices Omni from Sensable. An automatic evaluation allows to inform the user of the correctness of its gesture. Simulated procedures include hepatic biopsy, radiofrequency thermal ablation, prenatal examination and amniocentesis. An early prototype has been made to simulate the epidural procedure. Breath movement have also been simulated in some version of the simulators.

_____

Furberg, Robert

Simulation-Enhanced Triage Training for Iraqi Medical Personnel

Session: Wednesday PM, Session A

Triage establishes priority of care when the number of casualties exceeds resources. Current triage training relies upon lectures and tabletop exercises prior to live actor exercises. As part of a USAID project to enhance medical training in Iraq, we developed a "Train-the-Trainer" curriculum in trauma triage, including an introduction to pre-hospital trauma care. By incorporating patient simulation, we hoped to facilitate understanding of triage processes, provide cased-based experience, enhance competency, and help participants gain confidence in the START algorithm. The course blended lectures and labs in triage, trauma assessment, recognizing life-threatening conditions, using the Sim-Patient simulator, practicing triage and patient assessment, and triage course presentation. Thirty-one physicians, identified by the Iraqi Ministry of Health, received training in two 2-day courses during July 2006. Participants evaluated the curriculum using a questionnaire (Likert-scale), and offered comments and suggestions. Comments were 95% positive (n=75) and 5% negative (n=4). Complete results will be presented.

_____

Gallagher, Anthony G.

The Effects of Excessive Alcohol Consumption on Laparoscopic Performance the Following Day

Session: Wednesday Posters

There is robust objective evidence which shows that alcohol consumption degrades performance on a variety of tasks. Two studies were completed to assess the effect of excessive alcohol the day after it had been consumed. In the first study 16 laparoscopic novices were trained on all six MIST VR tasks on medium setting and then randomized to consume alcohol freely or not. In the second study very experienced laparoscopic surgeons were trained on the MIST VR manipulate diathermy task (difficult setting). The following day all subjects were assessed on the tasks they had trained on. The results showed that performance of the control group who did not consume alcohol did not differ from baseline assessment. However, the laparoscopic novices and the experienced laparoscopic surgeons performed significantly worse the following day even at 4pm. Conclusion: Excessive consumption of alcohol even the evening before operating should be discouraged.

_____

Gallagher, Anthony G.

Simulation Based Objective Assessment of Technical Skills as Part of the Selection of Individuals for Higher Surgical Training in General Surgery at a National Level

Session: Thursday AM, Session A

The purpose of this study was to objectively assess the technical skills of surgeons who had applied for a national higher surgical training program in general surgery at the Royal College of Surgeons in Ireland (RCSI). Thirty two individuals (20 male) applied for higher surgical training in Ireland in 2006. Fifteen applicants (nine males) were short-listed for interview and further assessment. All 15 candidates completed ten surgical skills stations, four using virtual reality and six open surgery tasks. Each skills station was assessed by a consultant surgeon. The nine individuals who were selected for higher surgical training in general surgery consistently scored higher than those

candidates who were not, in technical skills (156 Vs 125, p< 0.002). Conclusion: The objective assessment of technical skills introduced by RCSI for selection of candidates for the national program in higher surgical training in general surgery reliably and consistently distinguished between candidates.

Garza, Daniel C.

Use of a Virtual Human Performance Laboratory to Improve Integration of Mathematics and Biology in Sports Science Curricula in Sweden and the United States

Session: Wednesday Posters

We are designing a course to be taught simultaneously at Göteborg University and Stanford University. We will present two approaches to creating a virtual environment in sport science experiments that are central to the course. The first virtual environment allows students at any location to utilize Marratech web-hosting software to conduct real-time experiments in venues as sophisticated as Lundberg Laboratories in Göteborg and the Stanford Human Performance Laboratory. We have conducted two trials to validate the feasibility of this design, which accommodates simple technologies such as a laptop and consumer devices at the participant site. The second virtual environment is a computer-generated biomechanics laboratory that will allow students to conduct experiments of their own design. Both Göteborg and Stanford will collect motion capture and force plate data on Olympic-caliber and professional athletes. Students will manipulate this data to conduct novel biomechanical investigations under the direction of a set of learning models under development.

Gercek, Erol

Development of a Training Program Including Periodical Laparoscopic Training on a Virtual Reality Simulator

Session: Wednesday Posters

We developed a training programm on a virtual reality laparoscopic Simulator (Immersion Corporation, San Jose, California, USA) to determine if surgical novices can be brought up rapidly to a level of a third year intern by periodical simulator training. A group of 30 medical students after finishing their rotation in surgery was trained with our schedule. A second group of 12 interns in the second to third year of surgery was build and their performance of the same tasks was recorded. A periodically performed training programm including standard resident and staff directed instructions can bring up surgical novices to a level of third year interns with a minimum duration of 4 months.

Gerdt, David W.

The Structure of the Radial Pulse - Comparison of a Novel Noninvasive Ambulatory Systolic Blood Pressure Device to Standard Blood Pressure Monitoring in Dialysis Patients

Session: Thursday Posters

We will briefly review the significant and growing need for monitoring BP in patients with advanced kidney disease. We will then motivate the approach of de-convolving the radial arterial pulse into its constituent pulses by presenting a comprehensive physical model of arterial reflections in the context of results that have been obtained us and by other researchers. This will be followed by presentations of component delay time data from patients with different vascular health under different blood pressure conditions. The different temporal and amplitudinal responses of the component pulses will be explained in detail, as will be their general relationships with blood pressure and central arterial distensibilities. Results of statistical analyses as well as implications for the range of applications for the device will conclude the talk.

Goodman, Nathan

GDxBase and Gaggle: Software Frameworks to Enable Analysis and Exploration of Diverse Systems Biology Datasets by Laboratory Biologists

Session: Thursday Posters

Systems biology operates through analysis of global datasets produced by large scale laboratory methods augmented by large scale computational predictions. In current practice, biologists explore these datasets through manual integration of software tools and databases, cutting and pasting queries, creating temporary files, running web searches, and taking notes. This strategy is inefficient and scales poorly as more data types are included. GDxBase and Gaggle are open source software frameworks that help scientists work with these datasets. GDxBase is a generic disease oriented website framework that can be readily customized for specific diseases. Gaggle is Java framework to support interactive data exploration; it provides a simple architecture for integration of existing Java tools and connection of these tools to biological datasets. GDxBase and Gaggle facilitate different modes of use. GDxBase gives the user an overview of data of potential interest. Gaggle enables intensive exploration of datasets known to be of interest.

Goude, Daniel

Game Design in Virtual Reality Systems for Stroke Rehabilitation

Session: Thursday Posters

We employ a haptic and stereo vision immersive workbench to be placed in stroke patients' homes for daily adjusted rehabilitation of the arm and hand. We believe that the ability to clearly communicate ideas between medical professionals and game designers is a vital component in the process of virtual reality rehabilitation game design. To create games that are simultaneously entertaining for the patient and beneficial for rehabilitation, we exploit concepts from the field of game design, and relate these to a taxonomy of ADL, neurology and rehabilitation needs. To test the feasibility of our approach, several stroke rehabilitation games are designed and implemented. In these games we integrate assessment methods, tuning of game parameters with respect to degree of difficulty and patient abilities, and biofeedback mechanisms. It is our hope that the design methods produced will serve as valuable and extensible tools in the future.

_____

Gould, Derek Alan

Interventional Radiology Simulation for Training: Development of an Implementation Strategy by a Joint International Simulation Task Force

Session: Wednesday PM, Session A

Technical proficiency in interventional radiology (IR) is increasingly difficult to train and learn owing to pressures on the traditional apprenticeship. The use of computer-based simulation to train IR is a very promising development, in particular for learning catheterisation skills. There is however little evidence to support validity for learning catheter manipulation skills. The successful use of such technology therefore requires careful consideration before assimilation into curricula. This requires significant input from the credentialing organisations concerned, who have set up a Joint International Simulation Task force. This has published recommendations, including simulator design and validation. At MMVR 2006 we suggested a need for standards in medical simulation, as are already in place for aviation. This presentation describes the work of the Joint Task Force in developing a working strategy for the use of simulation within statutory training curricula in the US and EU.

_____

Gunther, Scott W.

The Red DRAGON: A Multi-Modality System for Training in Minimally Invasive Surgery

Session: Friday AM, Session A

The Red DRAGON (Digital Recording Apparatus for Grasping Orientation) is a novel system for measuring the positions, forces, and torques of two endoscopic tools to be used for teaching and training common minimally invasive skills and procedures. It builds upon the concepts of the Blue DRAGON (the University of Washington's previous surgical simulator), but instead of being mechanically designed on the foundation of a pantograph, it is significantly smaller and less cumbersome due to its serial spherical mechanism design. The mechanical device was integrated with a software package for data acquisition, kinematic calculation, real-time graphing, and force, torque, and position plotting. The results of this research provide the foundation for a new commercialized surgical simulator as well as the next generation system for University of Washington's ongoing analysis of the kinematics and the dynamics of minimally invasive surgical tools.

_____

Gutierrez, Fátima

The Impact of the Degree of Immersion Upon Learning Performance in Virtual Reality Simulations for Medical Education

Session: Wednesday PM, Session A

We and others have demonstrated the use of VR training modules in medical education. Virtual reality (VR) simulations provide a means of making experiential learning reproducible and reusable. Applying a knowledge structure approach, this study examined and compared knowledge acquisition of first-year medical students using a fully immersed, head mounted display (HMD) VR environment or a partially immersed, computer screen VR environment. Both groups demonstrated improvements in knowledge structure after VR simulation experience as measured by the significant increases in similarity to the expert knowledge network. However, the immersed group showed a significantly higher gain than the partially immersed group. This study demonstrates a positive effect of VR simulation on learning as reflected by improvements in knowledge structure but an enhanced effect of full-immersion using a HMD vs. a screen-based VR system. This may have important implications when determining the most appropriate systems to use for medical education and training.

_____

Hager, Gregory D.

Stereoscopic Video Overlay with Deformable Registration

Session: Wednesday PM, Session B

Minimally invasive cardiac surgery promises significant reductions in the pain, trauma, and disfigurement associated with traditional techniques. However, it is challenging to perform due to the restrictions on the field of view imposed by the instruments, and the inability to locate subsurface structures through palpation. As part of the Context-Aware Surgical Assistance (CASA) project, we are developing a system for integrated, three-dimensional display of deformably registered volumetric data. By doing so, subsurface operative targets will become clearly apparent, thus reducing the need for tactile feedback and wide-area visualization The CASA visualization system involves three major components: a stereo engine for tracking deformable surfaces in endoscopic video, a registration engine performing deformable surface-to-volume registration, and a visualization engine for overlaying information tied to the 3D data into the video stream. In this presentation, we will describe our real-time stereo engine and present results of integrated stereo processing and deformable surface registration.

_____

Halín, Nina

Experiences of Using the EndoAssist-Robot in Surgery

Session: Thursday Posters

EndoAssist is a robotic camera-holding device controlled by the operator's head movements. This study assesses its introduction into clinical practice. During our study two surgeons practised using EndoAssist. After three months we started to collect test data. We collected the operation times from fifty laparoscopic operations and surgeon filled in the questionnaire after operation. About half of the operations were laparoscopy cholecystectomies, less than half were fundoplications, some hernia repairs and a few other operations. The aim of our project was to find out how using an EndoAssist-robot influences the operating times and how the surgeons feel about using it. A tentative result showed that most tasks were completed more quickly with the EndoAssist than with human assistance. The mean operating time was shorter using the robotic assistant than with human assistance. In this presentation we will describe the results of our project.

_____

Hamza-Lup, Felix George

Comprehensive 3D Visual Simulation for Radiation Therapy/Surgery Planning

Session: Wednesday Posters

Radiation therapy/surgery is a life saving procedure that involves sophisticated machinery able to deliver radiation doses to the internal tumor, hindering its' reproduction mechanism. The problem occurs when the hardware system components collide with the patient and/or external objects in the treatment room. We present and 3D simulation system build in X3D, Web deployable, that aids radiation therapists and surgeons in the radiation therapy/surgery planning procedure to avoid potential collisions among hardware components. The current prototype makes use of Java Server Pages (JSP) and Java Servlet technology for data collection and distribution. We made an online version of the simulation system available to the medical radiation therapy personnel at MD Anderson Cancer Center Orlando and integrated their feedback in the simulation. We are in the process of designing the assessment component to validate the 3D simulator for acceptance in clinical trials.

_____

Harnett, Brett M.

Small Unmanned Aerial Vehicle as a Network Access Point for Tele-Robotic Surgical Intervention in the Battlefield

Session: Friday AM, Session B

The modern battlefield is a high tech arena. Reconnaissance, weaponry and communications are supported by mobile Internet Protocol (IP) networks that facilitate robust and highly scalable network links. A new generation of robotic extraction vehicles and specialty equipment will begin to segue into mainstream battlefield configurations. With the IP networks already in place, additional services can be implemented such as far-forward battlefield surgical intervention through the use of surgical telerobotics. The primary objective of this project was to develop and validate a Mobile Robotic Telesurgery (MRT) system that will allow a remote surgeon to effectively operate on an injured soldier regardless of the soldier's location or environment. These experiments successfully used a novel MRT system comprised of an Unmanned Airborne Vehicle (UAV)-based communication system and a prototype next generation surgical robot in the desert of Simi Valley, California.

_____

Heinrichs, Wm. LeRoy

A Simple Durometer for Quantifying the 'Haptic Memory' of Surgeons

Session: Friday AM, Session B

Quantitative data about resistances produced by haptic perception during probing and retracting of physical materials are needed for programming VR surgical simulators, and matching these to the densities and visco-elastic properties of human tissues, as perceived by the 'haptic memory' of surgeons. Further development of this simple system for measuring resistance will permit more detailed measurements of 'haptic

memory'. The method could be used to inform the design and development of laparoscopic trochars that could provide minimal impedance of the touch sense. A simple method has been assembled that allows users to accurately discriminate between different thicknesses of latex-rubber membranes. This instrument will be used to link the perceptions of touching physical objects and virtual objects, and linking both to the 'haptic memory' derived from surgical experience.

Hentschel, Bernd

Virtual Reality Based Comparison of Nasal Airflows

Session: Wednesday PM, Session B

In an interdisciplinary research project, the flow field inside the human nose is analyzed, in order to understand the nose's functionality and its dependcy on geometric changes. In the course of this project, airflow simulation has been carried out for a number of different configurations. The resulting data sets needed to be compared to each other. In this presentation we describe a tool for the interactive comparison of flow fields in virtual environments. This tool features a variety of different visualization techniques, including global error metrics, and vector field topology, which are used to quickly highlight key differences between two data sets. Moreover, we use direct interaction for probing the data sets in order to investigate local differences in more detail. While the methods itself are generally applicable to data sets resembling other phenomena, our prototype application has been built specifically for the use case of nasal airflow exploration.

Hernell, Frida

A Blending Technique for Enhanced Depth Perception in Medical X-Ray Vision Applications

Session: Wednesday Posters

We present a novel x-ray vision blending technique designed to enhance depth perception in a pre-surgical planning application. One depth cue that can override all others is interposition, since near objects cannot be occluded by far objects. The focus of the proposed technique is therefore to emphasize important structures close to the observer while homogenous surfaces become transparent. This gives the observer hints of the object hierarchy which strengthen the interposition depth cue. Front to back ray casting is used to traverse the volume with the blending algorithm based on properties such as gradient magnitude, angle between the volume gradient and the viewing direction, depth of the sample position etc. The blending method is quite general and can be applied in other AR applications where information of hidden objects are available.

Hofer, Mathias

Surgery on the Lateral Skull Base with the Navigated Controlled Mill Employed for a Mastoidectomy (Pre-Clinical Evaluation)

Session: Wednesday PM, Session B

Patients who are treated with a mastoidectomy usually suffer from an inflammation of the petrosal bone. The intervention is a time consuming landmark based surgery and usually performed with a powered mill. Delicate risk structures must be respected. Navigated Control (NC) describes the control for a power driven instrument which is controlled by a surgeon and additionally controlled according to the position of the instrument relatively to a deliberated position known from a preoperatively segmented work space which excludes risk structures. The force of a mill can be regulated by the principle of NC. Following results were received: 1. Risk structure segmentation is feasible 2. The drill and phantom can be registered. 3. With NC the resection is faster, more accurate and with no risk structures damage. 4. The phantom is suitable.

Hu, John

Localized Virtual Patient Model for Regional Anesthesia Simulation Training System

Session: Friday AM, Session A

In this presentation, we will introduce our design and implementation of a localized virtual patient model for regional anesthesia simulator. We show the simulation results of needle insertion for femoral nerve block procedure, the novel design of a neuro-muscular-skeletal model for local patient modeling, muscle contraction and tweaking phenomena, and the sensory functions in a femoral block procedure. The haptic, visual, and auditory perceptions are simulated through the localized patient model we developed in regional anesthesia simulation. We also present accurate anatomic structures including accurate nerves, vessels, muscular-skeleton, and tissue using a 3D virtual patient model (from Zygote); the visualization of the complications of nerve blocks, like bleeding, tissue irregularities, swelling, shock, and so on. Results of haptic rendering and visualization of tissue deformation during needle insertion will be shown using a meshless tissue deformation model technique called MFS (Method of Finite Sphere).

Hurmusiadis, Vassilios

Interactive Medical Simulation of the Human Heart

Session: Wednesday Posters

The aim of this project is to investigate the technical feasibility of computer-based interactive simulation for medical education. The human heart is chosen for the main focus of the simulation. To this end an "in-silico" model of the heart is developed, by integrating a-priori knowledge of the motion through the simulation of the electro-mechanical contraction. The presented research extends previous work by the authors by incorporating a functional heart model into a real-time interactive e-learning environment. The developed 3D interactive application serves as a "test-bed" for the reconstruction of cardiac electro-mechanical processes. This interactive simulation framework provides a vehicle for the technical feasibility investigation and forms the basis for future product development work. The wider aim is to provide a comprehensive interactive cardiology e-learning environment. Aspects of normal and pathological function of the heart are viewed in 3D and over time and explored through direct user interaction.

Jarrell, Bruce E.

An Interactive, Cognitive Simulation of Gastroesophageal Reflux Disease

Session: Wednesday PM, Session A

A demonstration of the Maryland Virtual Patient (MVP) system will be presented that will focus on the generation, diagnosis and treatment of gastroesophageal reflux disease (GERD). The MVP system is an interactive, cognitive model of humans experiencing various states of disease and health, whose goal is to promote the training of clinical medicine. The demonstration will include: the computational model of GERD; creating a wide spectrum of GERD patients through patient authoring; generating GERD in achalasia patients who have undergone a successful Heller myotomy or pneumatic dilation; and diagnosing and treating GERD patients using the MVP interface. Discussion will focus around the potential educational benefits of the MVP environment.

Jerabkova, Lenka

Stable Cutting Method for Finite Elements Based Virtual Surgery Simulation

Session: Thursday AM, Session B

We present a novel approach for stable interactive cutting of deformable tissue in virtual surgery simulator. Our method is based on the extended finite elements method (XFEM), allowing for an efficient modeling of discontinuities without remeshing. As no new elements are created, the impact on performance of the simulation is minimized. We also propose an appropriate mass lumping technique to guarantee for the stability of the simulation independently on the position of the cut. We show that the XFEM is suitable for both, the partial cut and the total dissection. The proposed technique has been integrated into a virtual surgery training framework, where it is used for interactive progressive cutting with force feedback.

Jin, Bei

Visualization of Large-Scale Confocal Data Using Computer Cluster

Session: Wednesday Posters

Confocal microscopy is a tool for obtaining high-resolution images of specimens at various depths. Volume rendering can interactively generate 3D reconstructions of the tumor microcirculation from multiple confocal thin sections. The reconstructed volume has to be restrained in the size much smaller than the available confocal data due to the limitation of the graphic card texture memory. Investigators have to trade off between the covered area and the resolution. In this study, volume rendering on a computer cluster is the solution for this problem. A networked volume rendering system is developed to divide the large-scale confocal data into smaller blocks and let each node in a cluster to handle them. The system consists of a local interface PC and remote cluster renderers, so the cluster nodes can share the workload and render the divided volume data in parallel to increase the efficiency and the processing power on large-scale data.

John, Nigel W.

Interactive Physically-Based X-Ray Simulation: CPU or GPU?

Session: Wednesday Posters

Interventional Radiology (IR) procedures are minimally invasive, targeted treatments performed using imaging for guidance. Needle puncture using ultrasound, x-ray, or computed tomography (CT) images is a core task in the radiology curriculum, and we are currently developing a training simulator for this. One requirement is to include support for physically-based simulation of x-ray images from CT data sets. In this paper, we demonstrate how to exploit the capability of today's graphics cards to efficiently achieve this and compare performance with an efficient CPU-based implementation.

Jonckheere, Edmond A.

Magnetically Levitated Nano-Robots: An Application to Visualization of Nerve Cells Injuries

Session: Thursday Posters

This presentation proposes a swarm of magnetically levitated nano-robots with high sensitivity nano-sensors as a mean to detect chemical sources, especially the chemical signals released by injured nervous cells. They have the following attributes: first, they are coated with magnetic material and are moved by external magnetic field; secondly, they incorporate nano-sensors that can detect chemical signals such as NO and Ca2+ released from injured nervous cells; thirdly, the sensor signals are converted to some format that can be visualized by Soft X-ray Microscopy; fourthly, the highly charged nano-robots in the swarm repel each other to form a colloid stabilization mechanism, and the area covered by this colloid should be decreased as the swarm get close to the target; finally, the large scale integration of X-Ray Microscopy, magnetic poles, and controller with control and detection algorithms will be presented.

Judkins, Timothy N.

Validation of Robotic Surgical Skill Assessment Using Subjective Expert Evaluation

Session: Wednesday Posters

Robotic surgical systems have revolutionized minimally invasive surgery; however, standard techniques for training and assessment have not been established. In this study, we sought to determine if previously identified objective measurements are related with a subjective expert evaluation of robotic surgical skill. Novices and experts performed three training tasks using the da Vinci Surgical System. Objective measures were calculated for each trial via computer measurements. Each trial was also video taped a scored subjectively by an expert using the OSATS survey. A Spearman's correlation found that all objective measurements were correlated with at least one subjective scores, and all subjective scores were correlated with at least one objective measurement ($p<0.05$). This study showed that objective measurements of robotic surgical skill are well correlated with subjective evaluation by an expert. These measurements can nicely complement expert subjective evaluation and lessen the time required to evaluate robotic surgical skill.

Kahol, Kanav

The Effect of Real-Time Visualization of Skill Level on Surgical Training

Session: Wednesday Posters

Current research in surgical training focuses both on objectively quantifying and assessing surgical skill levels as well as determining more efficient and effective methods of teaching those skills. This paper describes a novel method of measuring endoscopic surgical skills by using gesture analysis of hand movements via Hidden Markov Models and comparing them to trained expert models for assessments. These assessments along with other data are then provided to the surgical resident in immediate real time visual feedback on their operative monitor screen. This allows for both objective as well as proximal feedback for the resident, both of which have been shown to provide a more optimal learning experience. Preliminary data demonstrates that this learning technique improves the rate of learning of these surgical skills, and shows promise as an effective teaching aid in the training of surgical residents.

Kahol, Kanav

Cognitive Design of Simulation Training

Session: Thursday AM, Session A

Current research in surgical training focuses both on objectively quantifying and assessing surgical skill levels as well as determining more efficient and effective methods of teaching those skills. This paper describes a novel method of measuring endoscopic surgical skills by using gesture analysis of hand movements via Hidden Markov Models and comparing them to trained expert models for assessments. These assessments along with other data are then provided to the surgical resident in immediate real time visual feedback on their operative monitor screen. This allows for both objective as well as proximal feedback for the resident, both of which have been shown to provide a more optimal learning experience. Preliminary data demonstrates that this learning technique improves the rate of learning of these surgical skills, and shows promise as an effective teaching aid in the training of surgical residents.

Kerckhoffs, Roy

Ventricular Interaction Maintains RV Function During Right Coronary Artery Occlusion: A Numerical Study with a Multi-Scale Canine Cardiovascular Model

Session: Wednesday Posters

Ventricular interaction (VI) is of clinical importance in cardiomyopathy. Also, VI is important for normal functioning of

the right ventricle (RV): it has been shown experimentally, that an almost complete ischemic RV free wall (RVFW) in dogs, hardly affected RV function. In this study, a dynamic multiscale canine cardiovascular model was used to investigate the importance of direct and series interaction in left ventricular (LV) assistance to RV function. An overview will be given of the model, composed of a 3D finite element model of cardiac mechanics (active and passive) fully coupled to a lumped systems model of the systemic and pulmonary circulation. In the model, the RVFW was inactivated after 2 normal beats. Results of global hemodynamics show that RV function is still relatively close to normal with an inactivated RVFW, owing to both direct and series interaction, but at elevated systemic venous pressures.

Kesavadas, Thenkurussi

Data Acquisition and Development of a Trocar Insertion Simulator Using Synthetic Tissue Models

Session: Thursday Posters

Complications arising out of trocar insertions have been most commonly named in laparoscopic malpractice suits. While there are many simulators catering to laparoscopic surgery, there is no dedicated simulator for the trocar insertion procedure. In our earlier work, we developed a baseline simulator for the same. In this paper we present further improvements made to it, chiefly the use of data from synthetic tissue models to achieve a further degree of realism in the simulation, especially in terms of the variety of cases that can now be simulated. The synthetic tissue model is made out of readily available and inexpensive surrogate material. A matrix of tissue properties corresponding to varying tissue thickness has been created and verified against animal tissue. The tissue model also incorporates frictional forces and the simulation is being in the process of validated for realism through a series of human trials with surgeons.

Kesavadas, Thenkurussi

Evaluating Tool-Artery Interaction Force during Endovascular Neurosurgery for Developing Haptic Engine

Session: Thursday Posters

Minimally invasive neurosurgery is gaining acceptance as the best method of treatment of cerebral aneurysms. However, the process is associated with difficulties in stent placement and stent snagging due to arterial complexities and demands highly skilled and trained surgeons. Currently there is no haptic device for training or surgical planning that provides force information from the process of stent placement. With the recent approval of Virtual Reality (VR) simulation process for carotid stenting by FDA, the use of such force feedback simulators may facilitate advanced training and in the near future preoperative planning of such procedures in the surgical room itself. Our goal is to create a fast synthetic endovascular force simulator, which will provide the surgeon with information of tool-artery interaction, in terms of force, based on the various combinations of tool-artery diameters and vessel complexity developed here

---

Kim, Yoon Hyuk

Computer Aided Planning and Robotic Assisted Execution in Long Bone Fracture Surgery under External Fixaton

Session: Thursday Posters

External fixation method has been primarily used to stabilize long bone segments following fracture. The objective of this study was to develop a computer aided planning and robotic assisted execution of external fixation system necessary for optimal bone fracture reduction. A mathematical model of the external fixation system was used to determine the joint values of the system as a pre-operative planning program. The computer graphic model of a femur and the fixation system was developed and the robotic assisted execution system was constructed to perform the fracture reduction process. The fracture reduction processes by the computer graphic simulation and the robotic assisted execution based on the computer aided pre-operative planning were presented. The final residual bone deformities were within clinical tolerance. Hence, the developed computer aided planning program and robotic assisted execution system can be a powerful tool for executing knowledge-based fracture treatment.

Kim, Yoon Hyuk

Virtual Biomechanical Evaluation of New Spinal Fixation Device for Dynamic Stabilization

Session: Wednesday Posters

Dynamic stabilization is originated to reduce excessive intervertebral motions and stresses of adjacent segments. In this study, the virtual biomechanical evaluation of spinal fixation device for dynamic stabilization was presented to quantitatively measure the efficacy of the dynamic stabilization. A three-dimensional finite element model of the lumbar spine was developed based on CT images. In addition, two finite element models of posterior two-level spinal fixation in L4-L5-S1 with shape memory alloy (SMA) rod and titanium (Ti) rod were constructed. The intersegmental rotation angle and the von Mises stress on the intervertebral disc were predicted under 10° flexion and 10° extension. Through the virtual biomechanical evaluation, it was shown that the spinal fixation using the SMA rod was more appropriate for the dynamic stabilization

because the spinal motion can be recovered and the stress can be decreased. The virtual evaluation technology can provide a useful tool for biomedical research.

King, Chih-Hung Aaron

A Pneumatic Haptic Feedback Actuator Array for Robotic Surgery or Simulation

Session: Friday AM, Session B

Robot-assisted minimally invasive surgery (MIS) offers many improvements over conventional laparoscopic MIS, such as stereoscopic vision, more degrees-of-freedom, and telemedicine capabilities. However, it is characterized by a total loss of haptic feedback, leading to increases in inadvertent tissue damage and surgical errors. To address this limitation, we have developed a pneumatic balloon-based actuator array which has several advantages in comparison to existing haptic feedback technologies. Based on the sensory receptor physiology of the human fingertip, the balloon-based actuator array targets the cutaneous slow-adapting mechanoreceptors. The manufacturing process of the balloon-based actuator array and the design of the actuator's controlling unit will be covered. We have conducted human perceptual testing to determine the optimal size of the actuator; the methodology and data analysis of this testing will be presented. In conclusion, future directions of the project will be discussed, including adaptations for rendering haptic feedback in virtual-reality based surgical simulators.

Koepfle, Andreas

Real-Time Marker-Based Tracking of a Non-Rigid Object

Session: Thursday Posters

A real-time tracking of non-rigid objects for use in interfaces of VR-simulators is presented. Colored markers are attached to the objects and observed by several cameras with attached image-processing hardware which extracts relevant marker data (centroid, area & color) on the fly. The main simulator PC matches the marker data from the different camera images to reconstruct their 3D-positions. We present two aproaches to this correspondence problem as standard image feature based algorithms are not feasible. A model of the deformation is fitted into the reconstructed 3D-point-cloud and the simulation model is updated accordingly. Results show that our setup yields robust low-latency real-time tracking data describing the deformation of the object. We implemented a first prototype as a deformable eye interface for the ophthalmosurgical simulator EYESI. The approach is extensible to other types of simulators where deformable tissue has to be tracked, e.g. the abdominal wall in a laparoscopy simulator.

Kozmenko, Valeriy V.

Advanced Case Scenarios Based on the Clinical Model Provide More Effective Training

Session: Wednesday Posters

Physicians at the Louisiana Health Sciences Center in New Orleans have developed and implemented a Clinical Model that brings METI's Human Patient Simulator to the new level. The new clinical model represents a higher level of integration of physiological processes in simulated medical conditions. The model incorporates standard treatment protocols into its logical structure and it is capable of analyzing the patient's condition and appropriateness of its management by trainees. Acting as a virtual agent with artificial intelligence, the new software represents a complex system that runs multiple asynchronous processes, analyzes the user's interventions, realistically reacts to them, and helps the user to correct mistakes. This complex mechanism is hidden underneath an ergonomic user friendly Graphic User Interface (GUI) that allows the users to quickly attain proficiency in using the Human Patient Simulator.

Kratz, Mary E.

Grid-Enabled High Throughput Virtual Screening Against Neglected and Emerging Diseases

Session: Wednesday Posters

In silico drug discovery is one of the most promising strategies to speed-up the drug development process at a much lower cost than in vitro. Large scale grids open opportunities of particular interest to neglected and emerging diseases. In 2005, for the first time, we have been able to deploy large scale virtual docking within the framework of the WISDOM initiative against plasmepsin, the aspartic protease of malaria: more than 46 million ligands were docked in less than 6 weeks using about 80 years of CPU on the EGEE infrastructure. Guanidino analogues are very promising to become a novel class of plasmepsin inhibitors. This success led to a second computing challenge targeting Avian Flu neuraminidase N1 that required more than 100 CPU years on the EGEE, Auvergrid and TWGrid infrastructures in spring 2006. These achievements demonstrated the relevance of large scale grids for the drug discovery process.

Kumagai, Toru

A New Force-Based Objective Assessment of Technical Skills in Endoscopic Sinus Surgery

Session: Wednesday Posters

We propose new objective measures of technical skills in endoscopic sinus surgery (ESS): maximum and average

forces (Fm, Fa) generated during instrument-to-patient contact. Fm and Fa applied during gauze packing to the right ethmoidal sinus were experimentally measured using a precise nasal model equipped with a force sensor. Among 4 subject groups (3 Experts with ESS experiences > 100 cases; 6 Intermediates with ESS experiences 10-50 cases; 4 Beginners with ESS experiences 0-2 cases; 3 Students), Fa of "Intermediates" and Fm of "Students" and "Intermediates" were significantly larger than those of "Experts" (at 5% level, Mann-Whitney U test). It suggests that inexperienced physicians tended to be unaware of intranasal damage being caused by instrument-mucosal contact en route to the lesion. Subjective assessment by experts combined with feedback of Fm and Fa has the potential to increase patient safety.

Kume, Naoto

A Proposal of Speculative Operation on Distributed System for FEM-Based Ablation Simulator

Session: Thursday Posters

This study aims to provide ablation training simulator. Up to now, this study proposed an ablation model based on FEM. Simulation model of ablation requires determination of rupture threshold. The model calculates stress distribution during deformation. After determination of element destruction, the model requires stiffness matrix reconstruction. The model requires huge computational complexity that makes difficult to achieve real-time simulation on PC based simulator. This paper proposes application level speculative operation on PC cluster for concealing of computational delay caused by stiffness matrix reconstruction. The proposed method manages every processing unit as a simulator. Prediction of user manipulation by stress distribution generates speculative order of matrix construction. The prediction can be classified with depth and pattern. This paper prepares performance measurement of server response time to client in order to estimate possibility of real-time interaction on massive simulation.

Kundu, Kishalay

Tissue Resection Using Delayed Updates in a Tetrahedral Mesh

Session: Thursday Posters

In open surgery simulations, cuts like incisions and resections introduce irreversible changes to underlying geometry. In such circumstances, updating tetrahedral meshes for sophisticated physical modeling methods like finite elements becomes computationally intensive. We present an algorithm that does not need to update every time there is an incision. It allows multiple incisions and only performs subdivision after resection. We will show that compared to some existing subdivision methods, our method leads to fewer subdivisions and increases the interactivity of the simulation. Furthermore, our method is a logical fit for extended finite element methods (XFEM's.) Our subdivision strategy also results in potentially fewer degenerate tetrahedra. These improvements make our system more robust and scalable.

Kuroda, Yoshihiro

Organ Exclusion Simulation with Multi-Finger Haptic Interaction for Open Surgery Simulator

Session: Thursday Posters

In conventional medical education, residents train their skills via clinical experiences (OJT). However, training opportunity is decreasing due to the increasing respect of patient's rights. Virtual reality (VR) based training simulator comes under the spotlight as a powerful tool to solve the problem. Exclusion is a surgical manipulation of pushing aside organs in order to make a hidden target visible or enlarge work space. Improper manipulation causes fatal damage. Thus, this study aims to develop VR based exclusion training simulator. Multiple-finger interaction method with an elastic object is developed and glove-type multi-finger haptic device is integrated to the system. The prototype equips interactive visualization of stress distribution under exclusion. The system enables real-time calculation of deformation, reaction force and stress. The result of training trial suggested that the display of stress distribution enable effective training. Subjective evaluation by medical doctors proved the effectiveness of the system for exclusion simulator.

Kuroda, Yoshihiro

Semi-Automatic Development of Optimized Surgical Simulator with Surgical Manuals

Session: Friday AM, Session A

So far, a lot of studies have been done for human modeling, analyzing of surgeon's skills and validating of surgical simulators. Recently, several research groups provide simulation libraries or open-source software for supporting development of surgical simulators. However, for simulating a surgical procedure, medical doctors and engineers have to spend much time to describe surgical environment, scenarios and successful criteria of manipulation. On the other hand, surgical manuals can be used as knowledge source of surgical simulators. In this study, semi-automatic development of optimized surgical simulator by support vector machine based language processing of surgical manuals and by level-of-detail control based optimization of the simulation was proposed. Results showed 60% correctness of automatic development by using 400 training data. By using optimization methods, visualization and pre-computed simulation was displayed on a low spec PC and interactive soft tissue deformation with force feedback was displayed with high-end spec PC.

Kusumoto, Laura L.

Avatars Alive! The Integration of Physiology Models and Computer Generated Avatars in a Multiplayer Online Simulation

Session: Wednesday Posters

To date, multiplayer game technologies have given limited physiological fidelity to their characters, thus limiting the realism and complexity of the scenarios that can be practiced by medical professionals. This paper describes the status of a current program to merge medical and gaming technologies so that computer generated, but human-controlled, avatars used in a simulated, mass casualty training environment will exhibit realistic life signs. This advance introduces a new level of medical fidelity to simulated mass casualty scenarios that can represent thousands of injuries. The program is identifying the critical instructional challenges and related system engineering issues associated with the incorporation of multiple state-of-the-art physiological models into the computer generated synthetic representation of patients. The work is a collaboration between Forterra Systems and the SUMMIT group of Stanford University Medical School, and is sponsored by the US Army Medical Command's Telemedicine and Advanced Technologies Research Center (TATRC).

_____

Lai, Fuji

A Simulation-Based Program for Medic Cognitive Skills Training and Evaluation

Session: Wednesday Posters

Simulation-based training is a promising instructional approach for training military and civilian medical first responders, especially for training cognitively-based skills such as situation assessment and decision making. The First Responder Simulation Training (FIRST) program trains cognitive skills using complex and degraded situations. The program is comprised of five detailed scenarios, evaluation instruments and debriefing guidelines for each scenario, a multimedia tutorial that explains how to use the evaluation and debriefing instruments, and a detailed scenario guide for administering the scenarios. We conducted an evaluation of the FIRST program to assess its usefulness and usability. The program was well-received by both the instructors and the participants. Instructors noted the importance of training cognitive skills and found the instructor materials valuable for teaching them how to administer a simulation-based training program. Participants found the scenarios realistic and challenging, and noted that such simulation-based training would be a valuable supplement to medic curricula.

_____

Lai, Fuji

Human Factors Engineering for Designing the Next in Medicine

Session: Wednesday Posters

Good design of emerging medical technology in an increasingly complex clinical and technological environment requires an understanding of the context of use, workload, and environment as well as appreciation for ease of use, fit into clinical workflow, and the need for user feedback in the design process. This is where human factors engineering can come into play for good design. Human factors involves the application of principles about human behaviors, abilities, and limitations to the design of tools, systems, environments, and training in order to optimize human performance and safety. The human factors engineering process should be an integral part of the technology development process and needs to be incorporated upfront. This can help ensure that the new technology is safe, functional, natural to use, seamlessly integrated into existing clinical workflow, and embraced by users to be incorporated into practice for maximum benefit to patient safety and healthcare quality.

_____

Lapeer, Rudy J.

Intra-Operative Registration for Image Enhanced Endoscopic Sinus Surgery Using Photo-Consistency

Session: Wednesday PM, Session B

In this paper, we present an intensity based registration method for aligning CT/MRI data with the endoscopic image of a patient. Our technique is based on the minimisation of photo-consistency of a set of images. Unlike methods reported in previous research, our algorithm operates directly on the voxel level without the need of an explicit surface model. Current registration errors are within the range of 1-2mm.

_____

Lapeer, Rudy J.

In vitro Skin-Tissue Experiment for Increased Realism in Open Surgery Simulations

Session: Thursday Posters

Our work aims to compare various models to determine an optimum solution for skin tissue simulation. As part of this ongoing work we have conducted stress tests on samples of human skin to assess its hyperelastic, orthotropic properties when stretched quickly. Resulting data has been applied to a hyperelastic (Mooney-Rivlin) Explicit Dynamic Finite Element model which has been qualitively tested by a number of plastic surgeons.

_____

Laroche, Denis

In-vivo Validation of a Stent Implantation Numerical Model

Session: Thursday AM, Session B

A finite element model for rapidly predicting patient specific stent implantation is presented and validated using in-vivo data. The proposed model computes large deformations and interactions of the balloon/stent device and the stenosed artery during the stent deployment and the elastic recoil after the balloon deflation. An elasto-plastic constitutive model is used for the stent, and a nonlinear anisotropic constitutive model is used for the artery. An in-vivo validation of the proposed model is presented, using imaging data from a patient who underwent a stent implantation on a coronary artery. The predicted final artery shape is compared to post-intervention images. The effect of the device properties on the predicted artery reopening is also discussed.

Lee, Chang Ha

Towards an Immersive Virtual Environment for Medical Team Training

Session: Wednesday PM, Session A

Most computer-based medical simulators focus on individual training. However, medical treatment is performed in a team setting. In many circumstances such as mass-casualty events and battlefield conditions, the condition under which care is provided is a crucial factor in training. This presentation describes our work toward the development of an immersive virtual environment that meets these needs. We have expanded Flatland, an immersive 3D virtual environment, to support a distributed rendering for CAVE-like immersive virtual environment. Our system consists of three walls upon which stereoscopic images are displayed. An observer standing in the enclosed space perceives the illusion of being immersed in a 3D environment. For realistic environment effects such as smoke, fire, and explosions, we have implemented a sprite-based particle system with animated textures. Our modeling framework with a direct channel from 3D modeling tools to Flatland helps to create diverse and realistic training scenarios.

Lee, Christopher D.

Haptic Rendering of Device and Patient Impedances in Catheter-Based Simulation

Session: Thursday Posters

Endovascular interventions are making use of increasingly complex devices to address an expanding list of conditions. Whereas early haptic simulations of such procedures needed only to reproduce resistive haptic effects and free feel, current simulators require active movement of catheters to emulate certain types of implantable devices. In addition, some interventions now insert wires and catheters through multiple entry points and the total number of tools can become large. The Simsuite haptic interface incorporates both active and passive endovascular tool control via two insertion points. The actively controlled tools use force based impedance control to drive the perceived impedance to the desired impedance of the patient anatomy and implantable devices. The desired impedances of the devices are created from physics-based models. Force sensors track the behavior of the trainee throughout the procedure. The control system is implemented on a dedicated Pentium III processor.

Lee, Bryan C.

Progressive Update Approach to Real-Time Cutting of Finite Element Models in Surgical Simulation

Session: Thursday Posters

We present an extension of our work on topology modification and deformation for Finite Element Models, in which the inverse stiffness matrix is updated rather than recomputed entirely. Previously we integrated condensation to allow for realistic interaction with larger models. We improve on this by redistributing computational load to increase the system's real-time response times. Removing a tetrahedron only requires data associated with the nodes of that tetrahedron, and the surface nodes, to be updated. The equations used to update the inverse stiffness matrix are split up such that calculations are only performed for the affected nodes. Data regions corresponding to the surface nodes necessary for deformation calculations are computed immediately, whilst remaining regions can be computed as required, resulting in up to a ten-fold improvement in system response times within the framework of our surgical simulator.

Lee, Doo Yong

Clinical Evaluation of the KAIST-Ewha Colonoscopy Simulator II

Session: Wednesday Posters

Rigorous clinical evaluation involving physicians is integral to the success of the medical simulators. This paper presents a clinical evaluation of the KAIST-Ewha colonoscopy simulator II, extended from the prior version jointly developed by KAIST and Ewha Womans University, for its realism and training efficacy. The realism-validation study included five subjects consisting of three colonoscopy experts and two fellows. The subjects completed colonoscopy simulation after an introduction to the developed simulator. The subjects were then asked to fill out a questionnaire regarding the experience. The training-efficacy study was carried out including twelve subjects consisting of six fellows and six residents. The fellows and residents were divided into two groups, simulator-trained group and patient-trained group. The both groups were evaluated during their colonoscopies to actual patients, which were performed under close supervision of colonoscopy experts.

Lee, Gyusung

MIS Surgical Ergonomics: Future Trends

Session: Thursday AM, Session A

Laparoscopic or Minimally Invasive Surgery (MIS) is proving to be a less traumatic alternative to open surgery for patients. For surgeons, learning MIS means specialized training in manipulating long-shaft instruments, maneuvering in limited access, and working in a reduced field of depth. A challenge occurs, however, when instructors, who must depend on visual analysis, past experience, and training protocols and guidelines not likely to be defined quantitatively, try to precisely monitor trainees' body movements. Our initial studies using motion analysis and force plate systems have examined posture and joint movement of MIS surgeons as they performed simulated surgical tasks. The goal at our surgical ergonomics laboratory as we move towards developing standard matrices is to identify characteristic, task-specific movement patterns, particularly as evidenced in sub-tasks, in addition to cataloging and analyzing the movement strategies of expert MIS surgeons.

Lee, Gyusung

Registration of 3D Volumes and Echocardiography Images for Training Purposes

Session: Wednesday Posters

In this paper, we present a visualization and registration method to incorporate 3D volumetric data with 2D Transesophageal Echocardiography (TEE) images. This system has been developed to create an educational training program to assist TEE operators and physicians in determining the relative position of their TEE views in relation to a model of the patient's actual heart. We believe that the fusion and insertion of 2D echocardiographic images within 3D volumetric data will increase the overall understanding and orientation for a TEE operator during cardiac surgical cases, as well as provide valuable spatial information for preoperative planning in complex reoperations.

Lee, Ming-Yih

Realization of a Sound-Guided Navigation System for Tibial Intramedullary Interlocking Nail Fixations in Orthopedics

Session: Wednesday Posters

A sound-guided 3D navigation system was developed for the fixation of distal locking screws in the tibia intramedullary nailing. This system consists of a 3D digitizer arm, 3D coordinate registration / transformation and sound-guided navigation modules. The proposed sound-guided navigation module was designed with an audio guiding mechanism through which a sound with different tones and intermittence frequencies would be produced, as the probe of the digitizer navigates toward the location of distal screw holes. No preoperative computed tomography or intra-operative fluoroscopy was required during navigation. In vitro assessment was performed with a donor bone successfully, and a clinical case of a young male with tibia fracture was also carried out at the operation theater. The surgery was conducted under sterile manner without complication, and the clinical course was smooth with prompt bone healing.

Lehman, Amy C.

Surgery with Cooperative Robots

Session: Friday AM, Session B

The paper describes the use of miniature in vivo robots in cooperation with the da Vinci surgical system. The concept is demonstrated in the context of a porcine cholecystectomy. Here, the in vivo robots provide complementary visual feedback to assist the surgeon using the da Vinci system. One or more of these in vivo robots can be placed entirely within the abdominal cavity where they can be repositioned to provide auxiliary views to the surgeon without the need for additional incisions or the repositioning of da Vinci. These multiple viewpoints improved the understanding of the surgical environment. In this paper two robots were used including an in vivo mobile camera robot and an in vivo pan-and-tilt camera robot. This paper demonstrates how a family of in vivo robots can cooperate with da Vinci to improve surgical care.

Lehman, Amy C.

In vivo Robotics During the NEEMO 9 Mission

Session: Friday AM, Session B

The NASA Extreme Environment Mission Operations (NEEMO) uses the Aquarius underwater habitat several times each year to provide analogous training for Astronauts. Aquarius is a submersible that houses crews for up to several weeks 20 m underwater off the coast of Key Largo, FL. During the NEEMO 9 mission, April 2006, in vivo robots from the University of Nebraska were tested and evaluated by the crew. Results showed that the Aquanauts performed the tasks both faster and with improved accuracy using the in vivo robots video feedback as compared to the results using the laparoscope. This suggests that the ability to position the in vivo robot at arbitrary viewing angles can provide improved

visualization and understanding of depth. While these results are for a small population, the results help show that in vivo robotics could be used in the future in extreme and forward environments.

Lepage, Olivier M.

From Stimulation to Virtual Reality Environments: An Example of Integration into a Traditional Equine Surgery Education Program

Session: Wednesday PM, Session A

Integration of stimulation and simulation learning into a traditional equine surgery program is described. The advanced technologies used in this project are: an educational platform, Centra One for virtual classrooms, Perception for simulation modules and an interactive Equine Clinic including specific materials placed in locations such as the surgery room, adjacent teaching gallery, distanced theatres and office. It is still too early to appreciate the effect on professional attitude of the new trained veterinarians but the success obtained in 5 years concerning attendance, and discussions keep us confident to go forward to an additional step in the surgery learning process, with the unique goal of having a more effective professional education in equine surgery. This new step should include the creation of a simulation centre and the development of 3D computerised databases in real time to expose residents to virtual reality and give supervisors tools to assess surgical skills.

Leuschke, Rainer

Low Cost Eye Surgery Simulator with Skill Assessment Component

Session: Friday AM, Session A

The human eye is an extremely delicate structure. Ophthalmic surgeons need years of training and continuous practice to successfully manipulate the tissues. Development of the fine motor skills is an important component of resident training. A novel device was developed to measure, record and evaluate surgical tool/tissue interaction data for eye surgery training. A cup supporting an ex-vivo human or porcine eyeball is placed on top of a 6-axis force/torque sensor. A Styrofoam head prop representing patient anatomy is mounted to the platform. The collection of force and torque data provides the means to develop a better understanding of the interaction of tissue and surgical tools. The data will also be used to develop statistical models for assessing resident skill objectively. Primarily aimed at improving the training experience of surgical residents, this approach lends itself to broad adaptation due to its relatively low complexity and cost.

Lio, Cindy

Measuring Subjective Stress Profiles During MIS Skills Training

Session: Wednesday Posters

Although minimally invasive surgery is viewed by surgeons as more psychologically stressful than open surgery, there have been few attempts to measure the stress profiles experienced by surgeons or trainees. The Short Stress State Questionnaire (SSSQ) is a promising tool that decomposes stress along three dimensions -- distress, engagement, and worry. The SSSQ was administered to eleven volunteers who used a training box and graspers to perform repeated trials of two bead transfer tasks. The stress related to task difficulty was characterized by increased distress and decreased engagement. Practice, however, reduced stress by selectively affecting distress and worry. Thus, different training manipulations seem to influence stress in different ways. If different stress profiles in actual training are predictive of different outcomes in more advanced surgical tasks, then stress measures such as the SSSQ may be useful additions to the assessment of training success and the diagnosis of training needs.

Liu, Qiang

An Overview of 3D Video Transmission and Display Technologies for Telemedicine Applications

Session: Friday AM, Session B

To promote the utilization of 3D visualization technologies in telemedicine applications, we present an overview of the state-of-the-art 3D display devices and discuss the related video transmission methods to support remote 3D display. We present the mechanisms of two major categories of 3D display technologies: 1) stereoscopic displays, including stereo glasses and glasses free displays; and 2) volumetric displays, including solid-state volume, swept volume and holograph. We also discuss 3D video transmission methods including spherical mapping, stereo video coding and free viewpoint coding. The availability of the technologies allows developments of remote 3-D visualization systems to support a variety of applications in telemedicine.

Liu, Qiang

Eye-Gaze Based Video Compression for Telesurgery

Session: Thursday Posters

We present a content-based codec specifically designed for telesurgery applications. An eye-gaze detection technique is utilized to identify the critical region in surgical video frame

and the highest priority is assigned to the transport packets representing the critical region. We relax the coding quality of the non-gazing region in an adaptive fashion according to the network condition while best preserving the information in the critical region. Since the gazing region usually covers a smaller portion of the entire video frame, a significant reduction in bit rate can be obtained. In addition, the packets carrying the critical contents are processed with less buffering latencies at both the encoding and the decoding ends. When networking resources are limited, this identification and organization of contents leads to the optimal transmission of critical data.

Loewke, Kevin E.

Real-Time Image Mosaicing for Optical Biopsy

Session: Thursday AM, Session B

Recently, the development of micro-endoscopes has allowed for tissue structures to be observed in vivo. These optical biopsies are moving toward unifying diagnosis and treatment within the same procedure, but are inherently limited by their tunnel vision field-of-view. In this presentation we describe the hardware and software development of a real-time, robotically-assisted image mosaicing system to widen the field of view while retaining micro-architectural detail. The user engages the robotic device manually via the end effector and scans a region of interest while watching the corresponding image mosaic develop. We present a novel method for achieving real-time performance that incorporates robotic position sensing into the mosaicing software to determine optimal image overlap and provide the algorithms with an initial estimate of the relative geometric motion between successive image frames. We present experimental results of our system for a mock clinical procedure and discuss future applications.

Lum, Mitchell J.H.

Telesurgery Via Unmanned Aerial Vehicle (UAV) With a Field Deployable Surgical Robot

Session: Thursday Posters

Just as minimally invasive techniques revolutionized the way many surgical interventions are performed, robotically assisted surgery stands to further revolutionize the medical field. A new challenge is deploying a surgical robot system in a mobile setting and/or extreme environment and to control it through wireless communication through an Unmanned Arial Vehicle (UAV). This has implications for battlefield trauma and rural or remote telesurgery. We present the design solutions for creating a field deployable surgical robot platform for telesurgery in an extreme environment as well as results from an experiment in which the system was deployed in Simi Valley, CA. This was the first experiment in the emerging area of Mobile Robotic Telesurgery (MRT). The creation and initial testing of a deployable surgical robot system will facilitate growth in this area and eventually lead to future systems saving human life on the battlefield or in other remote environments.

Manak, Joseph J.

Novel Tomographic X-Ray System for Use in Trauma Assessment and Surgical Intervention

Session: Wednesday Posters

A novel tomographic x-ray system developed to provide imaging capabilities for the DARPA trauma pod program is described. The system consists of multiple large area flat-panel detectors embedded in a portable intensive care system (LSTAT) and a high performance x-ray tube and open overhead gantry. The system is capable of obtaining high quality 3D diagnostic images to aid in the diagnosis of trauma and 2D fluoroscopic images to aid in interventional procedures. The 3D diagnostic images are similar to coronal reformations of CT data sets with excellent (<0.4mm) resolution in the plane parallel to the detector and reduced (~0.5mm) resolution in direction perpendicular to the detector plane. Performance of the system will be illustrated using both simulations and lab acquisitions.

Markert, Mathias

Manual Registration of Ultrasound with CT/Planning Data for Hepatic Surgery

Session: Wednesday PM, Session B

In this article a simple and yet effective method of real-time visualization of registered ultrasound images within a preoperative 3D planning model is described. This technique is used within a novel assistance system for soft tissue surgery (i.e. hepato-biliary surgery) which was developed in ambition to offer a better spatial orientation for liver surgeons.

McDonald, Jennifer A.

Ultrasound-Guided, Robotic Cannulation of Central Veins: Mating Medical Imaging, Machine Vision and Haptic Robotics

Session: Wednesday PM, Session B

We have combined 2D ultrasound imaging, machine vision software, and haptic robotics to create a system that will identify and target a central vein (internal jugular or

femoral) and allow an operator to insert a needle, guide wire, and cannula. Trauma resuscitation requires venous access, and central veins may be easier to access robotically because they are larger and more anatomically consistent. A human operator moves the haptic robotic arm (HRA) into position over a central vein. The real-time video feedback from the ultrasound probe is fused with the machine vision targeting information. The vision system identifies and "locks on" the target central vein. The HRA system then freezes in position, freeing the operator to proceed with cannulation of the vein using a sterile cannulation cassette attached to the ultrasound probe. This system provides the infrastructure which will support the development of fully-autonomous robotic cannulation.

_____

Meireles, Ozanan R.

Effects of Visual Feedback Delay on Surgical Task Performance During Telerobotic Surgery

Session: Friday AM, Session B

In stereoscopic telesurgery, it is critical to understand effects of both monocular and binocular delay on surgeon performance. In our laboratory, the daVinci surgical robot binocular camera video streams were intercepted, buffered, and fed back into it's console, generating controllable asynchronous visual delay, making possible the assessment of surgeons' performance under different conditions of monoscopic and stereoscopic visual delay. As visual feedback delay increases, performance degrades, and task completion time increases. Both binocular and monocular delay degraded subject's task speed and accuracy. Monoscopic delay on a stereoscopic system seems to play a major role, increasing the amount of time necessary to perform similar tasks. It is necessary to identify and compensate for delays in stereoscopic systems for reliable and safe telesurgical performance.

_____

Merrell, Ronald C.

International Live Intraoperative Consultation

Session: Thursday Posters

This presentation will highlight a software system for multimedia data capture, integration, storage and retrieval of electronic surgical record designed to allow for interactive consultation with an expert at a distant site. In this study open surgical procedures were captured as multimedia events, stored as an accessible data set, transmitted for subsequent review and for synchronous consultation. The hardware for event capture included multiple cameras including robotic cameras, microphones and text entry to record both video, still images and voice recognition. The software design allowed rapid review based upon a master clock for all data capture. The data sets were sent to a web site for rapid review by a consultant who also joined the operation in real time to interact with the surgeon. The use of medical informatics to manage data from complex events in the operating suite is feasible.

_____

Merrell, Ronald C.

Event Capture, Registration and Transmission for Critical Clinical Skill Performance

Session: Thursday AM, Session A

This disucssuion examines the concerns of objectively trainig individuals for critcal care life support skills such as airway amangement. Additionally, the discussion covers the significance having a documentation systemin orocess such that the skills performed are recorded inclusive of video, objective skill performance metrics, and audio notes.

_____

Miyahira, Sarah D.

Immersive Panoramic Video vs Flat-Screen Display: Reactivity to Cue Exposure

Session: Thursday Posters

Computer graphics (CG) virtual reality environments are costly, labor intensive, and may take more than a year to create. Immersive panoramic video (IPV) may be a viable alternative to CG environments, but research is needed to evaluate its utility. Two studies were initiated to: 1) assess the immersiveness and psychophysiologic effects of the IPV environment, and 2) compare panoramic video displayed through a head-mounted display (HMD) with a flat-screen display. The first study investigates anger reactivity to video cues for anger that are displayed as standard video images on a flat-screen or as panoramic images viewed through a HMD. Using a counterbalanced design, the second study evaluates the use and utility of panoramic and flat-screen video stimulus cues to induce nicotine craving in a sample of heavy smokers. Outcome measures include self-report and physiologic data obtained pre-, during, and post-video exposure for both groups.

_____

Moore, John T.

2D Ultrasound Augmented by Virtual Tools for Guidance of Interventional Procedures

Session: Wednesday PM, Session B

Ultrasound is enjoying increasing use as a real-time guidance modality during minimally-invasive interventions.

While 2D US is capable of yielding high resolution real-time images of soft tissue, the concurrent visualization of interventional instruments and devices by the same imaging system is problematic, (a US image of a tool typically consists of a bright specular reflection corresponding to the surface of the tool closest to the transducer). Because such an image is difficult to interpret in terms of assessing the orientation and position of the tool, US has limited value in guiding an instrument to a target, even if the target is well appreciated in the US image. We have addressed this limitation through the development of an environment whereby the 3D ultrasound image is combined with a virtual representation of the tool. Initial targeting tests indicate significant improvements in accuracy when using US+VR over the use of US alone.

Moore, John T.

A Stereoscopic Environment for Surgical Planning and Guidance

Session: Thursday AM, Session B

Multi-modality image guidance for minimally invasive procedures demands new methods of visualizing and interpreting image data in three dimensions. The AtamaiViewer (http://www.atamai.com) is a software platform designed to integrate all components necessary for image guided surgery applications. The software platform integrates the registration and visualization of preoperative MR, CT and other modalities with intraoperative US, endoscope data, tracked surgical tools, haptic devices and virtual models. Stereoscopic visualization is possible using either head-mount displays or other projection media. This presentation will demonstrate the various applications to which this environment is being applied, taking advantage of stereoscopic techniques. Stereoscopic overlays of cardiac MRI, CT, 3D ultrasound modalities will be integrated with virtual shape and electrophysiological models as well as tracked surgical tools.

Mora, Vincent

Development and Evaluation of Algorithms for Accurate Force Rendering in Neurosurgery Simulation

Session: Thursday Posters

We present an interactive simulator for neurosurgery training. It is targeted towards the accurate rendering of low forces that occur during handling of delicate brain tissues. We briefly present the general layout of the simulator. The focus of the presentation is twofold. First the performance of realistic material models (Ogden and Mooney-Rivlin) is compared to the performance of classical models in haptic simulation (linear elastic finite element and mass-spring). Secondly, a method for objective evaluation of the quality of haptic response is proposed. This method uses an accurate offline simulation as a reference solution that should be reached by the real-time haptic simulation.

Mosegaard, Jesper

Smooth Haptic Interaction from Discontinuous Simulation Data

Session: Friday AM, Session B

In this presentation we deal with a specific problem arising within the field of haptic-rendering. The problem occurs in the GPU (graphics processing unit) based simulation since it supports the execution of several simulation-steps for each visualization-step. During a visualization step the simulation is suspended but the user can still move the interaction-device. When simulation is resumed, the position of the virtual instrument, as seen from the simulation, will appear to have moved in a discontinuous way. This results in noisy and uneven haptic-feedback. We propose a method to realign interaction-time with simulation-time.

Mosso Vázquez, José Luis

Cybertherapy New Applications for Discomfort Reductions in Surgical Care Unit of Heart, Neonatology Care Unit, Transplant Kidney Care Unit and Delivery Room and Cesarean Surgery: 10 Case Reports

Session: Friday AM, Session C

Virtual Medical scenarios are used in 12 Mexican patients hospitalized in Surgical Recovery Unit Cares and labor rooms. We present the results around homodynamic, metabolic and cardiovascular responses in patients with different ages and medical conditions. Newborns, pregnancy women and cardiac patients. New cybertherapy applications was possible thanks the collaboration of the The virtual Medical Center of San Diego who supported with VR Scenarios and the Southerm University of los Angeles with a HMD, patients from 4 Mexican hospitals participated in this program to demonstrate, if cybertherapy is useful in critital patients, cybertherapy is usefull in the majority of medical services. Pain 1 program was employed.

Mosso Vázquez, José Luis

Applications of Computer Assisted Surgery and Medical Robotics at the ISSSTE, México: Preliminary Results

Session: Thursday Posters

We describe preliminary results of the project (SALUD-

2002-C01-8181) supported by the Mexican Fondo Sectorial of CONACyT (Consejo Nacional de Ciencia y Tecnología) to develop the following systems: Neuronavigation system, prostate for TURP surgery simulation, Gastrointestinal endoscopic simulator and a robot for laparoscopic surgery. Since 2004, three Mexican Universities (Universidad Autonóma Metropolitana campus Iztapalapa, Universidad Nacional Autónoma de México y el Instituto Tecnológico y de Estudios Superiores de Monterrey Campus Cuernavaca) and a Hospital (National Medical Center 20 de Noviembre) are participating to develop medical systems to be integrated and support surgeons and physicians, in the preoperative and intraoperative planning, to make surgeries with high accuracy and to train surgeons. The devices will be integrated in many services of a Medical Center from the ISSSTE (Instituto de Seguridad y Servicios Sociales para los Trabajadores del Estado) such as: Neurosurgery, neurology, pediatry, Radiology, General surgery, urology, and Gastrointestinal endoscopy services. Our preliminary results reflect 2 years of research. The projects will be concluded in 2007.

Murray, W. Bosseau

Endotracheal Intubation Training Using Virtual Images: Learning with the Mobile Telementoring Intubating Video Laryngoscope

Session: Thursday AM, Session A

During resuscitation of an unconscious patient, placing a breathing tube through the vocal cords (intubation) is an essential skill for many health care workers. Unfortunately, there is a steep learning curve, and incorrect placement of the breathing tube (in the esophagus) may lead to brain damage or death. We studied the use of a virtual image using a video-laryngoscope as a teaching tool to assess the ability of the instructor to help the trainee through the early phases of learning the intubation technique. We also studied the success rate of intubation of novice medical students in a normal and difficult airway intubation model using a standard intubation technique (MacIntosh blade) compared to the video-laryngoscope. The video-laryngoscope provided a statistically significantly better view of the vocal cords, as well as a significantly improved success rate for intubation.

Murray, W. Bosseau

Developing Parameters for Haptic Epidural Needle Insertion Simulation: Clinicians' Perceptions of Texture Rendering by Haptics and Sandpaper

Session: Thursday Posters

The advent of Virtual Reality devices has enabled the teaching of medical procedures (such as spinal and epidural anesthesia) to be moved to the Simulation Laboratory, prior to encountering patients. To create more realistic epidural parameters for a haptic teaching device, we asked 29 clinicians (who regularly perform spinal and epidural anesthesia) to use a PhanTom Omni haptic device and a specially created software program to determine settings (alpha - static to dynamic friction ratio) that most closely represents the grittiness sensation produced by the interspinous ligament in patients. We also suggest and study the use of sandpaper as an international standard for immediate human calibration of the grittiness sensation re-created by haptic devices.

Musuvathy, Srideep S.

A Visual Evaluation and Training Tool for Chiropractic Education

Session: Wednesday Posters

This project develops a software based visual training and evaluation tool to aid chiropractic education. The purpose of this tool is to help train students acquire 'set-up' skills wherein the student has to set himself or herself up in a certain body posture before delivering a light force for the chiropractic adjustment. This project involves mathematical modeling of the problem in two parts. The first part is an evaluation tool. The second part is a training tool. The problem is solved by representing it as an inverse kinematics problem. A graphical display is used to provide visual feedback to the student both for evaluation and training. Mathematical models are used to compare similarity of the performance of the student and an expert. This tool will help revolutionize the way education and training of chiropractors is achieved and free valuable resources, time and cost of making better chiropractors.

Navarro Newball, Andrés A.

Development of an Interactive Module to Enhance and Understand 3D Cavity Navigation

Session: Thursday Posters

In previous work a Web Environment for Surgical Skills Training in Otolaryngology (WESST-OT) was presented; then, it was stated that WESST-OT needed some enhancements and one of them was the support and evaluation of cavity navigation. The Interactive Module for Cavity Navigation (IMCA) was created in order to provide a solution for this. Surprisingly, it has been found that IMCA does not only contributes to the development of WESST - OT but also that it can be used as an independent module which allows the study and the practice of path navigation in any medical cavity. Moreover, potential use of IMCA with

patients has been demonstrated. IMCA has a great potential since cavity navigation and in general path navigation remains a major problem in many surgical tasks.

Nelson, Carl A.

Design Methodology for a Novel Multifunction Laparoscopic Tool: Engineering for Surgeons' Needs

Session: Friday AM, Session A

In minimally invasive surgery (MIS), the small number of incisions necessitates the insertion and removal of many different instruments to complete a given procedure. Using the technique of functional decomposition, it was found that some functions are repeated for different instruments, such as positioning and actuation of the tool's tip. Axiomatic design principles motivated a redesign of current technology to consolidate these repeated functions into a single multifunction tool. The investigators surveyed a laparoscopic surgeon to obtain functional requirements and their relative importance in MIS. These requirements were used in a Quality Function Deployment analysis to design a laparoscopic tool which combined the functionalities of multiple tools into one handheld device, and allowed the integration of the surgeon's needs into the design. This novel tool eliminates the need to remove and reinsert multiple tools during a surgical procedure and decreases the OR time, monetary cost and trauma to the patient.

Ni, Tianyun

A Haptic-Enabled Toolkit for Illustration of Procedures in Surgery

Session: Wednesday PM, Session A

Surgical training currently depends greatly on experiences that have been difficult to model in software. There is no existing technology that provides the ability to practice rarely performed or hazardous procedures, or to detect and recover from failure. The kit aims to overcome these limitations to reduce surgical errors. For the author, the kit provides the ability to efficiently represent key aspects of visual and haptic feedback to convey surgical expertise by the specialist. For the learner, the benefits arise largely from the ability to address the problems and situations repetitively, and to practice on models of unusual anatomic variations in a safe environment. We will explain the use and the quality of our toolkit for the illustration of surgical procedures by a life demonstration and modification of a teaching unit for removal of the adrenal gland.

Nistor, Vasile

Haptic Guidance for Laparoscopic Surgery Immersive Training and Mentoring

Session: Thursday Posters

This system combines the functionality of real time, intraoperative videoconferencing with haptic guidance that together allow a novice operator to perform an endoscopic procedure with the assistance of a remote expert. Using a console, the mentor defines the appropriate pathways for the novice surgeon to manipulate his instruments. Via this haptic guidance system, a distant mentor can effectively guide the hands of the trainee as the novice surgeon executes fairly complex procedures. In addition to the telementoring application, an immersive training simulation is being generated by recording an expert surgeon perform a real operation while using this system. Intraoperative data is stored and later accessed at one or multiple training stations that are designed to reproduce an operating surgeon's ergonomic experience. Our system is based on tracking the spatial position and orientation of the instruments on the console for both the expert surgeon and the trainee.

Niu, Qiang

Modeling and Rendering for Development of a Virtual Bone Surgery System

Session: Thursday Posters

A virtual bone surgery system is being developed to guide a novice surgeon practicing bone surgery operations, as well as to allow an experienced orthopedic surgeon planning and rehearsing bone surgery procedures. The development of this system implements medical image processing, geometric modeling, graphics rendering, haptic rendering, and auditory rendering with a personal computer and a PHANToMTM device capable of providing the position and orientation information of the virtual tool and generating force feedback. This paper presents the methods we have used for the development of this surgery simulation system. By the use of a virtual reality environment, this system can provide a realistic, safe, controllable environment allowing medical students and doctors to make mistakes during bone surgery practice and planning without causing serious consequences. To make the simulation system more intuitive and interactive, the overall architecture of the developed system runs in several threads with multiple rates in parallel.

Nosek, Thomas M.

Next Generation Computer Assisted Instruction: A Serious Gaming/Immersion Environment For Medical Education

Session: Wednesday PM, Session A

Students today see more power-performance learning in their popular culture than in their schools. When they go to college they expect an active, engaged learning environment. To meet this educational challenge, we are creating an interactive, simulated "Tower of Learning" for the learning of Clinical Cancer Genetics by medical students (casemed.case.edu/cancergenetics). The environment uses gaming theory to help students achieve specific learning objectives as a prerequisite for advancement. The first floors include virtual laboratories where students achieve the basic underpinnings of Cancer Genetics. Upper levels apply these principles to clinical practice. A virtual attending physician and four virtual patients enrich each floor. The pinnacle clinical simulation challenges the learner to integrate all information and demonstrate mastery to "win" the game. We hope this immersion environment will be so captivating that it will motivate students to actively engage the milieu and enjoy the challenge and satisfaction of mastering difficult material.

Olsen, Dale E.

Virtual Standardized Patients for Training Health Professionals on Biological Agent Exposures

Session: Wednesday PM, Session A

Biological and chemical warfare agents including smallpox, anthrax, and sarin are candidates for use in terrorist attacks because of their potential to create widespread panic with serious medical and economic consequences. Since these agents are unlikely to be encountered in events other than terrorist attacks, most health care professionals have had negligible preparation for the diagnosis and treatment of the resulting medical conditions. However, prompt and appropriate care will be critical if such a need ever arises. SIMmersion LLC has employed their unique simulation technology to develop an interactive, computer-based training program that enables trainees to evaluate patients with potential biological and chemical exposures and respond accordingly. The training system utilizes a Virtual Standardized Patient to prepare clinicians to recognize and manage victims of bioterrorism. The simulation replicates the function of live standardized patients; however, it facilitates repeated use, requires limited resources, can be easily distributed, and provides immediate feedback.

Olson, Donald R.

Brain Blast Injury: Treatment with Electrical Stimulation

Session: Friday AM, Session B

Brain blast injury has become the signature affliction of the Iraq and Afghanistan wars. Over 3,000 brain injuries have been reported among American service personnel in Iraq, and estimates suggest a $14 billion cost to the U.S. government for treating war-related brain injuries over the next 20 years. A traumatic brain injury changes autoregulation causing malignant edema and, if left untreated, death. Military neurosurgical technique includes emergency hemicraniectomy with modulation of small vessel deep brain vasospasm, and complex monitoring and medical management to realign auto regulation and reduce edema to avoid permanent brain damage. The implantation of a wireless, programmable electrical neurostimulator is proposed, during emergency neurosurgery, which may increase cerebrovascular oxygenation and blood flow. Patient condition and therapy effectiveness can be measured with standard blood flow and intracranial pressure monitors using statistical pattern analysis; and stimulation parameters adjusted accordingly. The system may simplify treatment and enhance patient outcomes.

Pavy, Dominique

A Collaborative Virtual Desktop as Decision Support System for Surgical Planning

Session: Wednesday Posters

Today, diagnosis of cancer and therapeutic choice imply strongly structured meeting between specialized practitioners such as general practitioner, radiologist, oncologist or surgeon. These meetings are generally located at a same place and need a heavy preparation-time in order to take the best decision as promptly as possible with the available part of the medical history. Through interviews of practitioners and a previous experiment named Argonaute 3D we have identified the need of a Collaborative Decision Support Systems (CDSS) in order to reduce decision time and improve reliability of the chosen treatment through networks. We have designed a prototype of 3D collaborative Virtual Desktop as CDSS for surgical planning. And in order to introduce progressively the system in such an activity it is bound to initialize an iterative participatory design method involving end users.

Pham, Thuy M.

Virtual Nursing Simulator with Haptic Force-feedback for Oral Hygiene

Session: Thursday Posters

Oral care to older frail adults is often neglected by nurses in part due to inadequate knowledge about it's relationship to overall health. The goal of this research is to improve the oral hygiene knowledge and skills of nursing by providing them with a virtual training tool to practice oral care. This tool, the Oral Hygiene Simulator, provides the nurses with a virtual toothbrush controlled by a Phantom Omni Stylus. As the student "brushes" the 3D model of the mouth, they receive realistic haptic feedback. The simulator then evaluates the performance and provides feedback and guidance to improve in their oral care skills.

Powers, Marilyn J.

Surgical Scissors Extension Adds the 7th Axis of Force Feedback to the Freedom 6S

Session: Friday AM, Session B

A virtual reality surgical simulator ideally allows seamless transition between the real and virtual world. In that respect, all of a surgeon's motions and tools must be simulated. Until now researchers have been limited to using a pen-like tool in six degrees-of-freedom. This paper presents the addition of haptically enabled scissors to the end effector of a 6-DOF haptic device, the Freedom 6S. The scissors are capable of pinching a maximum torque of 425 mN·m with low-inertia and back-drive friction. The device is a balanced design so that the user feels like they are holding no more than actual scissors. The system is interchangeable between the 6-DOF and 7-DOF configurations to allow switching tools quickly.

Qin, Jing

An Adaptive Framework Using Cluster-Based Hybrid Architecture for Enhancing Collaboration in Surgical Simulation

Session: Friday AM, Session A

Research on collaborative virtual surgery opens the opportunity for simulating the cooperative work among surgeons during the surgical operations. It is however a challenging task to design and implement a high performance collaborative surgical simulation system because of the difficulty in maintaining a high level of state consistency under limited network transmission capacity. In this paper, we present an adaptive framework using cluster-based hybrid architecture to support the real-time collaboration in surgical simulation. This architecture can tackle the disadvantage of client-server architecture by reducing the additional latency caused by round-trip to the server as well as avoiding the transmission bottleneck at the server. Meanwhile, system consistency can be well-maintained through the administrative server and reliable transmission protocols. In addition to the TCP communication protocol, the framework is also equipped with UDP for multicasting, allowing for a flexible strategy to reduce network latency. Reliable message exchange on top of unreliable multicast protocols has been implemented using a set of techniques.

Rafiq, Azhar

Real Time Performance Feedback in Virtual Reality-Based Surgical Task Execution

Session: Wednesday Posters

This discussion is reviewing the concerns of better training modules for clinicians using minimal invasive surgery simulators. The discussion covers the spectrum of object assessments of skill set but also providing real time feedback of performance metrics to the user.

Ramachandran, Sowmya

From Simulations to Automated Tutoring

Session: Wednesday PM, Session A

With computer-based simulations, it is possible to deliver cost-effective training with the added benefit that anywhere, anytime learning. In order to support such self-paced learning, simulations must be accompanied by performance assessment and feedback. As the healthcare community starts to invest significantly in simulation-based training, it is running against the limitation of requiring hands-on instructor-led facilitation to make it effective. This is prohibitively expensive. Automated coaching and feedback reduces the need for instructor facilitation. We are currently developing technologies for applying the concept of Intelligent Tutoring Systems (ITS) to healthcare simulations. ITSs are software tutors that are designed to provide human-like one-on-one tutoring. Automated performance assessment and coaching is the first step in this direction. This presentation will describe a plug-in tool for adding these features to simulations, provide an overview of Intelligent Tutoring Systems, and describe directions for future growth.

Rambani, Rohit

3D Visualization and Open Planning Platform in Virtual Fluoroscopy

Session: Wednesday Posters

Virtual fluoroscopy (VF) is a surgical navigator that displays tracked instruments as a projected shadow on a number of 2D x ray images, enabling interactive guidance. Thus, surgeons must infer 3D position and structure from these 2D projections. the scope of this study is to provide 3D reconstructions of anatomy, implants or virtual operative plan, without additional x-ray exposure using an ordinary C-arm. The detail of the reconstructions was of sufficient quality to perform most tasks in operation and be easier to comprehend than the equivalent 2D projections. Furthermore the system was able to provide a 3D planning platform using tools available in VF that can be used to perform operations without the need further software development.

Ren, Jing

Haptics-Constrained Motion for Surgical Interventions

Session: Friday AM, Session B

A new procedure in cardiac surgery for the treatment of atrial fibrillation, septal defect repair and valve replacement is to introduce an ablation tool through the appendage of the left atrium, a procedure that provides increased control over the ablating instrument. It is envisaged that this procedure will ultimately be performed under robotic control and image-guidance provided by intra-cardiac ultrasound. However, the intra-cardiac guidance suffers from several drawbacks such as limited field of view, loss of signal from time to time and, in some cases, difficulty in interpreting the signal. We believe that the introduction of haptic feedback into this environment would enhance the procedure by providing tactile cues to assist in the location of the surgical targets. In this work, we present a method to augment the intra-cardiac navigation system with haptic feedback. The proposed method can generate soft constraints from surfaces of arbitrary shape, and thereby help the user to perform delicate procedures reliably and safely and without curtailing their freedom of motion.

Rieger, Klaus

Development of a Guiding Endoscopy Simulator

Session: Thursday Posters

Endoscopy simulators get more and more common for training of physicians. It is important to make simulation as realistic as possible by providing optical, acoustical and haptical feedback. The haptic display of our simulator EndoSim allows applying active forces to all degrees of freedom and moving to a defined position. The second possibility is used for our automatic guiding system. If the user asks for help, an algorithm calculates how to get over the next barrier, factoring forces and distances. It is able to decide if it is wise to choose a longer way in order to reduce the force. The result is shown to the user by signs or the simulator can guide the user directly by moving the endoscope. This guiding system is a new possibility for learning physicians to increase their examination capabilities.

Riener, Robert

Obstacle Crossing in a Virtual Environment with the Rehabilitation Gait Robot Lokomat

Session: Thursday Posters

For automated treadmill training the actuated gait orthesis LOKOMAT was developed. In order to enhance gait training, a virtual scenario has been implemented enabling the subject to cross obstacles. Feedback modalities include haptics, graphics and sound. The treadmill speed can be chosen arbitrarily by the subject. Four healthy subjects were testing the setup. With a questionnaire the quality of the feedback modalities was assessed and compared. Sound and visual feedback were judged well, haptic rendering slightly worse. With that scenario implemented, new therapy forms are possible to be created.

Rissanen, Mikko J.

A Novel Approach for Training of Surgical Procedures Based on Visualization and Annotation of Behavioural Parameters in Simulators

Session: Thursday AM, Session A

Recording of performance during training sessions on simulators is becoming the new standard for assessment of surgical skills and thus a significant part of training. Typical simulators give feedback about the performance as numbers. Our approach for training of surgical skill is based on Annotated Simulation Records (ASRs) and visualization of behavioural parameters of interaction in surgery. ASRs are authored into teaching scenarios and segmented into individual movements which important behavioural characteristics are annotated and visualized during training. In this paper, we demonstrate our approach in a simulator based training of force exertion. In an initial experiment, force exertion tasks were assessed with the following criteria in order of importance: power, direction and location. These characteristics of example manipulation were visualized during training sessions. The visualization was proven to provide better results for the most important characteristic than plain playback in which the user observed the example manipulation directly.

Riva, Giuseppe

Managing Exam Stress Using UMTS Phones: The Advantage of Portable Audio/Video Support

Session: Thursday Posters

We developed a specific protocol based on mobile narratives - multimedia narratives experienced on UMTS/3G phones (Nokia 6680) - to help students in managing exam stress that was tested in 4 different media: UMTS phones, DVD, MP3 player, CD.The trial showed a better efficacy of mobile narratives experienced on UMTS phones in reducing the level of exam stress and in helping the student to relax. These results suggest that for the specific sample considered - university students - the media used for providing an anti-stress protocol has a clear impact on its efficacy. Further, the data confirm that 3G mobile handsets may be used as relaxation tools when backed by a specific therapeutic protocol and meaningful narratives.

Riva, Giuseppe

NeuroVR: An Open-Source Virtual Reality Tool for Research and Therapy

Session: Friday AM, Session C

We introduce NeuroVR, a virtual reality software platform that allows non-expert users to adapt the content of a pre-designed virtual environment to the needs of the clinical or experimental setting. Using the NeuroVR Editor, the user can choose the appropriate psychological stimuli/stressors from a rich database of 2D and 3D objects, and easily place them into the virtual environment. In addition to static objects, the NeuroVR Editor provides the ability to overlay on the 3D scene video composited with a transparent alpha channel. The edited scene can then be visualized in the NeuroVR Player. NeuroVR is based on Blender, an integrated suite of 3D creation tools released under the GNU License. Thanks to the incorporation of Blender, the NeuroVR Editor allows the creation of 3D interactive content, including modeling, uv-mapping, texturing, and rendering.

Riva, Giuseppe

Cellular Phones for Reducing Battlefield Stress: Rationale and a Preliminary Research

Session: Friday AM, Session C

Battlefield stress is the consequence of man being exposed to the hostile environment of combat. One of the best strategies for dealing with stress is learning how to relax. However, relaxing is difficult to achieve in typical real world situations. In this study we developed a specific protocol based on mobile narratives, to be experienced on UMTS/3G phones. Mobile narratives are audio-visual experiences, implemented on mobile devices, in which the narrative component is a critical aspect to induce a feeling of presence and engagement. A preliminary trial including 33 subjects showed the efficacy of mobile narratives in reducing the level of stress experienced during a commute trip. These results suggest that 3G mobile handsets, even with their small screens and limited multimedia capabilities, may be used as relaxation tool if backed by a specific therapeutic protocol and an engaging experience. Future research is needed to define and test a specific protocol targeted to battlefield stress.

Rizzo, Albert

Optimal Choice of Virtual Reality Displays for Stroke Rehabilitation

Session: Thursday Posters

Implementation of VR technologies for post-stroke rehabilitation has been shown to be effective in several empirical studies, but there has been little or no research directly comparing the usability of VR displays in this context. We examined the usability of three different types of display in a VR-enhanced stroke rehabilitation system: (1) head-mounted display (eMagin Z800 visor with two high-contrast SVGA 3D OLED Microdisplays); (2) 15-inch CRT monitor with active liquid crystal shutter eyewear and emitter; and (3) 15-inch TFT LCD Sharp autostereoscopic monitor. Three individuals post-stroke participated in the evaluation. The results indicated that participants most preferred the CRT monitor with goggles, followed by the autostereoscopic monitor. Preferences were affected by comfort issues particular to this patient population and the nature of their therapeutic regimen.

Rizzo, Albert

VR Enhanced Upper Extremity Motor Training for Post-Stroke Rehabilitation: Task Design, Clinical Experiment and Visualization on Performance and Progress

Session: Friday AM, Session C

A VR-based motor training task, the Reaching Task, one of a series developed for post-stroke upper extremity rehabilitation was tested with five patients over 12 two-hour sessions. Within the Reaching Task VR environment, patients were to reach with synchronized forearm and hand movements on their paretic side, for multiple virtual targets located in 3D space. The targets were arrayed across various combinations of individually tailored pitch, yaw and arm extension ratio settings. Three kinematics performance indexes, movement efficiency, moving speed and performance time were derived from continuous capture of the patients' 3D hand positions. Results from the experiment indicated significant UE motor performance progress and a methodology was devised for

visualizing performance change within and across defined peripersonal space zones over multiple practice sessions. Similar improvements were found for moveing speed and performance time measures and the data from these patients will be presented at MMVR along with the details of our visualization approach.

Rosen, Jacob

Objective Medical Skill Evaluation: A Comparison of Popular Methods of Pattern Identification

Session: Wednesday Posters

Previous work used discrete Markov models (MM) to analyze simulator data. What benefits are there to analyzing simulator data with hidden Markov models (HMM)? This presentation will briefly explain the fundamentals of both kinds of models, with a focus on the pros and cons of using HMM. Graphical illustrations and analogies help relate the models to medical procedures. The results of analyzing data taken with the E-Pelvis simulator with HMM and MM are discussed.

Safinaz, Mustapha

Healthcare Stakeholders' Perspective on the Use of Online Medical Record

Session: Wednesday Posters

We sought to study stakeholders' attitudes about patient's access to their medical records via the secure Internet application and their communication with healthcare providers. We run a quantitative survey among stakeholders focusing on possibility of providing online medical record for better communication in healthcare sector. We found that patients varied in their view of impotency of online medical record and having an option of online communication with healthcare staff. Meanwhile medical staff and non-medical staff have a totally opposite opinion on patients having easy access to online medical record. However, the stakeholders' believed that the use if the technology would enhance the patients' understanding of their conditions and improved their relations with the healthcare staff. The potential of online medical record to have beneficial effects through shared workload between the healthcare providers (clinical and non-clinical) and the patients.

Saha, Sunipa

Force Sensing in Robot-Assisted Surgery: Which Degrees of Freedom are Most Important?

Session: Friday AM, Session B

Studies have shown that user performance and efficiency improve when force feedback is implemented into teleoperation systems. However, there are many difficulties associated with the application of full force feedback in robot-assisted surgical systems, including the impracticality of measuring multiple degrees of freedom (DOF) of force, and the increased size and cost of force sensors. The goal of this research is to reduce the complexity of full force feedback by identifying the essential DOF of force sensing for robot-assisted surgery. Using this information, any nonessential DOF of force sensing could be eliminated and the implementation of haptic feedback in robot-assisted surgery may become more practical. Experiments with a custom da Vinci Surgical System show that axial forces and lateral torques on the surgical tool are greatest in magnitude, while axial torques and lateral forces display the greatest coefficients of variance. These results were consistent across multiple mock surgical tasks.

Satava, Richard M.

Introduction and Need for Intra-Cellular Surgery

Session: Thursday PM General Session

As technological advances push the boundaries of what is possible in surgery, one new frontier that will be breached by surgery is the world of the small - the intra-cellular level. There are new instruments (such as femtosecond lasers, optical tweezers, atomic force microscopes, etc) which will now permit interacting directly with individual components within the living cell without damage to the cell. To date, all interactions with cells has been biochemical, in terms of markers, labels, transfections, genetic transmutations, etc. Nothing has been explored in terms of the anatomy or structural and mechanical properties of cells - which is the domain of surgery. It is known that cells are in constant motion, that they 'interact' with each other across the cell membrane, and that their shapes are constantly changing. No one has explored why a cell only has a certain number of components, what arrangement they have within the cell, or what would happen if additional structures (eg Golgi apparatus, ribosomes, etc) would be introduced. With all the new tools available, the direct manipulation of cells and their components should now move out of the biology laboratory and into clinical research and medicine. By directly operating upon cells it will be possible to change the biology of the cells, and a person - the new discipline of Biosurgery.

Savitsky, Eric A.

Patient-Specific Interactive Image Visualization

Session: Wednesday Posters

This presentation will provide an overview of state-of-the-art applications that transform patient specific volumetric data sets to a polygonal format for use in medical simulations. Medical practitioners can currently view multiplanar and three-dimensional reconstructed images within minutes of patient imaging. These high quality images are created in a volumetric data format (e.g., DICOM). The computational cost of rapidly rendering these images limits their use in medical simulation applications. Labor intensive, hand-made polygonal models are the standard mode for creating photorealistic images for medical simulation purposes. Ideally, fully automated image processing algorithms would rapidly convert patient specific volumetric data sets into polygonal models. These polygonal models could then be incorporated into interactive applications (e.g., Open GL-based) for purposes of medical simulation. Current limitations to real-time, photorealistic, volumetric to polygonal data set conversion will be discussed and patient specific images generated using leading image visualization techniques will be presented.

_____

Schirski, Marc

Employing Graphics Hardware for an Interactive Exploration of the Airflow in the Human Nasal Cavity

Session: Wednesday Posters

We present an intuitive exploration method for three-dimensional flow fields within virtual environments, which employs the computational power of modern graphics hardware in order to achieve interactive frame rates. Unlike previous work, we directly use an unstructured grid instead of resampling the flow field into a regular data structure. By employing high-quality rendering methods, we achieve an unambiguous depiction of the particle trajectories, thus facilitating the understanding of the presented data. This results in an easy-to-use but very meaningful method for analyzing a given flow field. Using the airflow within a human nasal cavity as an example, we show the advantages of our approach over conventional visualization methods, especially when dealing with very dynamic flow fields.

_____

Schmidt, Elizabeth A.

Task Sequencing Effects for Open and Closed Loop Laparoscopic Skills

Session: Thursday AM, Session A

The presentation will address information on two types of motor movements representing closed loop and open loop attentional control mechanisms. An experiment will be presented in which these two control mechanisms underlying two different types of laparoscopic tasks, instrument navigation and grasping, are compared with respect to task sequencing for skill acquisition and transfer to a more complex task (cutting) involving components from both of the simple tasks. The results show that positive benefits were limited to the closed-loop to open-loop sequence. The findings suggest that practice on either form of simple task does not necessarily facilitate practice on more complex tasks.

_____

Seibel, Rainer M.M.

Designing the Next in Medicine

Session: Wednesday AM General Session

Medicine is closely related to technological research and development. Nanotechnology, Micro Mechanics, Biotechnology and Medical Technology are the most important development areas. Also computing technology is essential for next breakthroughs in medicine.

Vice versa new methods influence technical development. When we developed new methods in Minimally Invasive Therapy and Image Guided Surgery, we also had to design new imaging systems with special features for interventions. For example at least 20 systems (CT, Angiography and MRT) have been developed in our institute together with industry during the last 20 years. Today we create 384 images per second with submillimeter resolution.

The importance of preventive medicine with the use of high end imaging is rapidly growing. First stages of coronary heart disease and stroke are diagnosed 8 to 10 years before severe symptoms occur. The wide spread use of preventive imaging centers is probably adding 10 to 15 years of life expectancy to a population.

Over all medicine will be the most important factor for GNP of industrial countries for the next decades until 2050.

_____

Sewell, Christopher

Validating Metrics for a Mastoidectomy Simulator

Session: Friday AM, Session A

An important area of research in surgical simulation is the development of metrics that can enable a simulator to be an essentially self-contained teaching tool, capable of identifying and explaining the user's weaknesses. However, it is essential that these metrics be validated in able to ensure that the evaluations provided by the "virtual instructor" match those that the real instructor would provide were he present. We have previously proposed several algorithms for providing automated feedback in the context of a mastoidecomy simulator. In this

paper, we present the results of a user study in which we attempted to establish construct validity for our simulator itself and for several of our metrics. An experienced instructing surgeon assigned a global score, and metric-specific sub-scores to 28 simulator runs by 14 subjects. We found the correlations between both the users' experience levels and metric scores with the instructor's scores to be statistically significant.

Sewell, Christopher

Evaluating Drilling and Suctioning Technique in a Mastoidectomy Simulator

Session: Thursday AM, Session A

In this paper we present several new metrics related to bone removal and suctioning technique in the context of a mastoidectomy. Similar to how many e-mail spam classification algorithm work, we assumed that voxels from the full bone voxel mesh are chosen for removal according to separate distributions for experts and novices, and have implemented a Naïve Bayes classifier that determines the most informative voxels by calculating the Kullback-Leibler divergences, and then calculates the maximum likelihood estimates for the probabilities that each voxel is removed by experts and by novices. Another metric evaluates the purposefulness of movements; an expert will usually accomplish a specific sub-goal locally and then advance to another task, while a novice may move around haphazardly. Good technique in the use of the suction to remove accumulated bone dust, and the temporal and positional coordination of drilling and suctioning are important elements of good "two-handed technique".

Shekhar, Raj

Development of Continuous CT-Guided Minimally Invasive Surgery

Session: Wednesday PM, Session B

A laparoscope is the primary tool to visualize internal anatomy and guide minimally invasive surgeries currently. Though successful, laparoscopes have a few fundamental weaknesses. One such weakness is the inability to see beneath the visible surfaces, and it is this weakness that motivates our research. This presentation will review augmented reality (AR) methods, a solution proposed to enable surgeons to see deeper inside the organs during surgery. These AR methods, however, employ preoperative images and are thus unable to display and track intraoperative tissue deformations and anatomic alterations resulting from the surgery. In our research, we are using instantaneous volumetric images from a multi-slice CT scanner to enable "live" AR. A novel high-speed nonrigid image registration-based strategy to reduce radiation dose to safe levels will be discussed. The presentation will conclude with examples of live AR and implications of our research for the future development of minimally invasive surgery.

Shilon, Ofek

Novel Surgical Simulations of Gastric Bypass and Incisional Hernia Repair Procedures

Session: Friday AM, Session A

Simbionix(r) recently launched two new LapMentor(tm) simulation modules: an Incisional Hernia Repair module, and a Gastric Bypass module. We present here some of the major challenges that were faced and addressed in simulating these two procedures. In short, such simulations call for 1D, 2D and 3D elastic objects, that are stable, fast, have high fidelity, can interact with the user tools and among themselves, are cuttable and tearable, can present bleeding, etc. etc. Moreover, a typical scene (e.g. in gastric bypass) includes a stomach, liver, spleen, lesser omentum, small intestine, pancreas, abdominal dome and more - so very efficient data structures and algorithms are needed to stand up to the burden. Since we use implicit integration for stability, highly optimized update of precomputed simulation data is needed as well, during cuts or other RT modifications of the models.

Shrivastava, Alok

Digital Video Archival and Tele-Retrieval (DIV-ART) for Robotic Surgery

Session: Thursday Posters

Video archival of minimally invasive surgeries is an important tool for training, mentoring, quality control and development of surgical steps. We have developed an automated system for archival of our robotic surgery videos - Digital Video Archival and Tele-retrieval (DIV-ART). A video acquisition suite (IngestTM Station with a barcode reader) and an automated touch-free workflow are designed to record videos with barcode scanned metadata, which are uploaded through a fiber backbone to a video archival and distribution center (ProxysTM server, RAID storage and PlasmonTM Jukebox). The system is connected to our hospital network and the videos can be accessed through a secured web based interface. Using DIV-ART, our average video retrieval time and offline media storage space requirement has reduced by 82% and 80%, respectively. We conclude that DIV-ART, a HIPPA compliant video archival system with its automated workflow has made storage and review of the surgical videos more efficient.

Sierra, Raimundo

Patient Specific Simulation and Navigation of Ventriculoscopic Interventions

Session: Wednesday Posters

In this paper the status of a comprehensive framework for preoperative planning, procedural skill training, and intraopera-

tive navigation is presented. The long term goal of this research is to enable endoscopic, trans-ventricular brain tumor resection. For such an intervention, accurate planning, including patient-specific skill and complication training, as well as the intraoperative navigation, will be indispensable. The position of the camera and the instruments, located at the tip of the flexible endoscope, is tracked using a miniaturized tracking coil introduced through the working channel of the endoscope. The complete ventricular system was segmented based on the patient's pre-operative MR data. The virtual environment consists of a bird's-eye perspective for visualizing the position of the device in the ventricular system, as well as a simulated virtual endoscopic perspective. The cerebrospinal fluid, bleeding, and soft tissue deformation can be simulated in real-time.

Silverstein, Jonathan C.

Developing Performance Criteria for the e-Pelvis Simulator Using Visual Analytics

Session: Wednesday Posters

The e-Pelvis is an inanimate teaching and assessment simulator for clinical uterine examination. The system instruments a physical model with five pressure sensors (left posterior fornix, right posterior fornix, os, anterior fornix, and fundus) and records at high fidelity subjects' compression of the sensors. This study demonstrates that visual analysis of e-Pelvis data enabled distinguishing average characteristics of expert examiners. On careful review of the figures one can appreciate that on average: clinicians moved quickly, counterclockwise and superiorly, discretely compressed all areas, concluded with simultaneous fundus and posterior pressure, and spent minimal time at the os; students did none of these. These visual analytic discoveries should now enable development and confirmation of statistical classifiers and performance criteria for each. This may enable a new class of physical exam simulators with criterion performance measures because the pressure sensors are also being used for breast exam, endotracheal intubation and other simulators.

Silverstein, Jonathan C.

Immersive Virtual Anatomy Course Using Cluster of Volume Visualization Machines and Passive Stereo

Session: Thursday AM, Session B

A new novel approach to teaching human anatomy, and assessment of its use in an undergraduate class is described. This complete anatomy course was instructed using the same human anatomy textbooks cover to cover as in our medical school (including web-based media). However, large format stereo volume visualization of high-resolution clinical radiological data was directly substituted for human cadaver dissection. The system is a customized cluster of nine commodity computer graphics Linux servers running our home-grown open source scalable libraries. The stereo volume renderings and web-based textbook materials were interspersed as the instructor deemed most productive during each session. Student exams and course assessments demonstrated that the new approach was very valuable. The virtual reality system was deemed equally as valuable as the standard materials and contributed most to the framework of learning and enjoyment. It was so compelling that students invited colleagues, friends, and other professors to class.

Smith, Mark

Configurable Haptic Training System for Laparoscopy

Session: Wednesday Posters

The talk will cover details of a configurable system that progressively varies task difficulty based on estimation of skill level of the user. Systems that vary task difficulties are commonly prevalent in video games and aircraft simulation. However such systems are not being used in surgical simulation. In this paper, we propose a configurable haptic training system for laparoscopy that modifies the haptic and visual rendering parameters of the simulation based on skill estimation through hand movement analysis of the user that are fed to an intelligent tutoring algorithm.

Sørensen, Thomas Sangild

Virtual Open Heart Surgery: Obtaining Models Suitable for Surgical Simulation

Session: Thursday Posters

This presentation describes the process of obtaining morphological models of the heart suitable for surgical simulation. The presentation will present techniques for image acquisition, segmentation, and tissue modeling - each an important prerequisite for a realistic looking simulation. Using the GPU as a processor it is now possible to simulate the deformation of this complex organ in real-time. To understand some of the modeling decisions that we take, some introduction to GPU-based surgical simulation will be presented as required for the understanding of the modeling process.

Sørensen, Thomas Sangild

Virtual Open Heart Surgery: Segmentation

Session: Thursday Posters

The presentation describes a semi-automated segmentation method based on the Watershed transform. It is applied to 3D cardiac MRI to produce patient-specific models for virtual

heart surgery. This method can be used interactively and efficiently to create specific-models of individual morphology. It was used to segment the blood pool and myocardium volume semi-automatically. We have developed software dedicated to heart MRI segmentation and visualisation. Our software allows the user to explore a highly detailed view of the dataset for easy interpretation. The software can also be easily extended for other segmentation tasks, e.g. other organs and imaging modalities.

Stefan, David B.

White Light Phase Profilometry Imaging: An Overview of Current and Future Medical Applications

Session: Wednesday Posters

White Light Phase Profilometry is an economical and accurate method of capturing a 3D whole body scan image. This image can be measured in various ways, and volume and surface area data is readily available (instead of dumping the subject in a water tank). Several surgeons have used a white light scanning device to scan subjects pre- and post-operatively to compare and validate surgical results. Subjects included baritric surgery candidates and reconstructive surgery candidatess. Pre and multiple post-operative scans and their associated measurements, including volume and surface area were tabulated and compared. Scans were exported in 3D modeling langauge and superimposed upon each other to view 3D physical contour changes as the subject recovered from surgery. Investigations into using the combination of linear, circuferential and height points of measurements as well as volume and surface area data have led to a set of ratios and formulas to determine the obese condition of bariatric candidates without the use of their height or weight as well as categorizing their particular medical shape. 3D pre-operative scan images exported into 3D modeling langauges also allowed the use of "human" CAD packages to accurately model and predict various reconstructive and cosmetic procedures, effectively giving guidelines to the surgeon prior to the procedure. Finally, by using volume and surface area information gleaned from the post-operative scans, a method of determining the rate of recovery for certain surgical procedures and when the subject has reached their optimal recovery point has been produced. This has been applied to monitor the effects of post-operative edema (swelling) and its dissipation as well as to monitor the rate of weight loss of bariatric patients after their surgery. The general process of scan, document, perform procedure or event, and repeat scan is now being applied to additional medical disciplines such as obese pregnant women, anorexic children and elderly individuals. There should be additional important and interesting findings by February 2007. We desire to present these findings to the body at MMVR 15.

Steiner, Karl V.

A Virtual-Reality Approach for the Treatment of Benign Paroxysmal Positional Vertigo

Session: Wednesday Posters

We present a new virtual-reality based approach to aid otolaryngologists in the treatment of a common inner ear condition called Benign Paroxysmal Positional Vertigo (BPPV). This approach utilizes a downloadable 3-D model of the inner ear utilizing true anatomical representations of the human semicircular canals in the inner ear. BPPV is a common cause of dizziness caused by calcium carbonate debris, which has collected within a part of the inner ear. BPPV is responsible for 20% of all dizziness and 50% of dizziness in the elderly. In this virtual-reality application, we present a stereoscopic representation of the inner ear that serves as the base for an interactive model to simulate the movement of calcium carbonate crystals in the semicircular canals. The model will allow physicians to demonstrate the appropriate combination of head movements required to liberate any affected semicircular canal of otoliths within it.

Stetz, Melba C.

Flight Medics' Virtual Reality Training to Enhance Performance under Combat Stress

Session: Friday AM, Session C

"Stress Inoculation Training" (SIT) is designed to mitigate the negative effects of stressors in healthy individuals. As a cognitive-behavioral therapy technique, SIT is applied in a gradual, controlled, monitored, and repeated manner with the goal of desensitizing individuals to stimuli. A priori simulated exposure can help prevent a "flight/fight/freeze" stress-response, allowing individuals to accomplish tasks at hand (e.g., putting a tourniquet on a casualty while under fire). In our study, Soldiers undergo rigorous operational medical training. Specifically, we apply virtual reality technology to SIT ("VR-SIT") to allows Soldiers perform tasks in stressful, but controlled, simulated combat casualty scenarios. Participants receive feedback on their psychological, physiological, and bio-chemical stress levels and practice coping strategies. We predict that this approach will not only improve Soldiers' performance on real tasks, but also increase their stress resilience, hopefully preventing chronic psychological decompensation (e.g., post-traumatic stress disorder). Preliminary findings and potential implications will be discussed.

Stone, John

Virtual Medical Trainer for Regional Anesthesia

Session: Wednesday Posters

During the design of this course, emphasis changed from a didactic course with simulation elements embedded for practice - to a web-based simulation with didactic content embedded for support. A major component and interaction during the virtual simulation is controlling the movement of the needle while seeing a subjective view "from the eye of the needle." The unique aspect of the design is to gradually increase the complexity of tasks while decreasing the amount of supportive information. For example, supportive information may be provided by a character of an experienced practitioner (coach). The coach will call out incorrect or skipped actions with an explanation of the potential consequences. Scoring uses specific metric values that rise or fall as the user acts within the simulation, depending on the appropriateness of his/her choices. The three metric values include: success rate, safety level, and patient satisfaction.

Sun, Bo

Medical Student Evaluation Using Augmented Standardized Patients: New Development and Results

Session: Wednesday Posters

The primary purpose of the presentation is to describe the development of the original prototype (which is presented in MMVR14 in Jan 2006) and report on its new function in a study using medical students evaluated in a required annual Observed Structured Clinical Examination (OSCE).Within our presentation and within the paper submitted for the MMVR proceedings we will provide result data and answer questions relating to the realism as perceived by experienced clinicians and to the validity of using augmented SPs as a reliable assessment tool.

Sun, Mingui

Design of the Next-Generation Medical Implants with Communication Channel and Energy Port

Session: Thursday Posters

Two critical problems exist in the engineering design of the next-generation minimally invasive implantable devices: power supply and communication. We have developed a platform technology to provide future implants with both an energy supply port and a communication channel using the human body as a natural cable to deliver signal and power. This work presents our most recent design of a convenient device for practical application of the biological volume conduction technology. This wireless device is called an "energy pad" about the size of an American quarter. It consists of an electrode-embedded adhesive foam pad for an easy establishment of electrical contact with the skin. It also contains a button battery and a dual use battery holder/circuit board. This convenient device can be used to recharge the power system within the implant at infrequent time intervals (e.g., once a week or once a month at night times) and transmit/receive signals.

Sun, Mingui

Computer Simulation of Corticospinal Activity During Transcranial Electrical Stimulation in Neurosurgery

Session: Wednesday PM, Session B

We present a computer simulation method using a finite element model of the human head to visualize the electrical potential and current distributions in the brain during transcranial electrical stimulation (TES), an intraoperative monitoring technique often employed during neurosurgery to monitor the integrity of the motor pathways. We also present a model of the corticospinal tract (CST), computed using diffusion tensor imaging. We discuss the techniques used to computationally predict the sites of activation (action potential generation) during TES using our models, our insights on how the curvature of the CST affects activation, and comparisons of our simulations results to clinical data. Our computational prediction of the sources of TES-elicited action potentials is a major step in better understanding the effects of electrical stimulation of the brain and forms a basis for optimizing the TES procedure.

Sun, Yu

MEMS and Microrobotics for Intra-Cellular Surgery

Session: Thursday PM General Session

Intra-cellular surgery involves the direct manipulation of biomolecules for regulating cellular metabolism and fate. Over the years, many tools based on micro and nanotechnologies, such as atomic force microscopes, micro-nanoelectromechanical systems (MEMS/NEMS), and micro-nanorobots have been developed and applied to cellular structure characterization and intra-cellular surgery. Within the general area of intra-cellular surgery, introducing foreign materials into individual cells is the most common embodiment. These foreign materials include nanoparticles (e.g., quantum dots and gold nanoparticles), genetic materials (e.g., sperms, DNA, RNA, RNAi, and morpholinos), proteins, and drug compounds, which are introduced into individual cells through biochemical means (e.g., via calcium phosphate and viral vectors) or through physical means (e.g., diffusion and mechanical injection) for genetic studies, cancer therapy, assisted reproduction,

and drug discovery. This presentation will focus on introducing our research at the University of Toronto in the development of microrobotic systems and MEMS devices for characterizing physical properties of individual cells and for fully automated cell injection. The cell lines under current study are zebrafish embryos, mouse oocytes and embryos, and human oocytes. Biological materials in use include DNA and morpholinos for genetic studies, sperms for in-vitro fertilization, and Bcl-2 family proteins for improving embryonic survival.

Suzuki, Naoki

Development of a Surgical Robot System for Endovascular Surgery with Augmented Reality Function

Session: Thursday PM General Session

We have previously developed a small robot surgery system for endoscopic surgery. We attempted to expand the ability of the robot for endovascular surgery. To perform surgical activities in the aortic region, we had to overcome two problems;. reducing the size of the robot to enable smooth mobility in the aorta, and obtaining a clear view within a blood flow. First, we applied a small-sized stereo-paired CCD camera system and reduced the size of the manipulator. Second, to acquire a clear surgical field image, we planned to inject saline into the artery through an instrumental channel. To recognize the 3D location of the robot, we utilized an augmented reality function. The function enabled surrounding tissue models to be superimposed onto the CCD camera images in real-time. Moreover, we integrated a four-dimensional (4D) ultrasound imaging system to obtain a situation representing the surgical field as time sequential volume datasets in real-time.

Suzuki, Shigeyuki

Surgery Simulation Using Patient-Specific Models for Laparoscopic Colectomy

Session: Thursday Posters

Laparoscopic colorectal surgery has become an option for patients with colorectal lesions, but there remain some difficulties common to all laparoscopic procedures. Hence simulated lower digestive tract surgery, which would enable surgical procedures to be practiced prior to an actual operation, would provide an important option for surgeons. Our study aimed to develop a simulation system for lower digestive tract surgery to allow surgeons to practice and plan surgical procedures in laparoscopic colectomy. For this system, we focused on the tissue deformation caused by laparoscopic right hemicolectomy manipulations, and applied a soft tissue model with anisotropic properties and a sphere-filled method. As a result, the surgical maneuvers of laparoscopic colectomy such as pushing, grasping and cutting of the mesentery and its vessels could be simulated. Additionally, this system could be implemented within routine clinical work.

Tuchschmid, Stefan

Objective Assessment of Surgical Performance in Hysteroscopy Simulation

Session: Thursday AM, Session A

We present robust methods for objective, structured, and automated assessment of surgical performance in the case of virtual hysteroscopic interventions. Based on the definition of an ideal surgical procedure by the clinical experts, more than 20 different global performance metrics such as the total percentage of uterine surface visualized, the amount of distension media used, and various indicators connected to efficiency and economy of movement were implemented in the simulator. The developed assessment methods have been integrated into a test setup to measure learning curves for both novice residents and expert clinicians. We show visual examples, where the path lengths of the master surgeon are significantly shorter while providing optimal surface coverage, while the novice surgeon first exhibits poor economy of movement and insufficient surface coverage, but later on improves performance. More information about the hysteroscopy simulator project can be found on our webpage http://www.hystsim.ethz.ch.

Tuchschmid, Stefan

Haptic Interface Module for Hysteroscopy Simulator System

Session: Thursday Posters

A fundamental element of a surgical simulator system aiming at high fidelity is the interface to the simulation. Input device, as well as haptic feedback from the system should resemble the real environment. In this paper we describe all elements of the haptic interface module developed for hysteroscopy simulation. An actual surgical instrument has been modified in order to allow natural control of the intervention. Moreover, a haptic mechanism providing force-feedback and allowing complete removal of the instrument has been developed. A control scheme is proposed, which also takes into account limits of human perception. Furthermore, strategies for friction and gravity compensation are outlined. Finally, a haptic rendering framework has been created, which provides the coupling between the tissue deformation computation and the haptic hardware.

Tuer, Kevin

Deployment and Evaluation of a Prototype Laparoscopic Surgery Simulator with Haptics and Telementoring

Session: Thursday Posters

We evaluated a prototype laparoscopic surgery simulator with haptic go/no-go zones, gradable haptic feedback and a haptic telementoring capability during the NASA Extreme Environment Mission Operations (NEEMO) 9 mission. A dedicated network connected the instructor's workstation in Hamilton, Canada and the student's workstation in the underwater Aquarius lab located off the Florida coast. The evaluation involved identifying the presence of no-go-zones and evaluating the efficacy of guiding a procedure remotely, in real-time, in a haptic enabled telementoring mode of operation. Aquarius crewmembers were successful in identifying the presence or absence of no-go-zones created by the instructor, and the instructor was able to guide the crewmembers' movements remotely, in real-time, in the haptic enabled telementoring mode of operation. The proSENSE TiDeC algorithm effectively compensated for network latency, which varied between 50 and 400 msec. This technology may be invaluable in creating robotic training consoles for safe acquisition of surgical skills.

---

van Herzeele, Isabelle

Carotid Artery Stent Procedures: Evidence-Based Virtual Reality Simulation for Training and Assessment of Technical skills

Session: Thursday AM, Session A

Though endovascular treatment of carotid disease is rapidly gaining acceptance, it is paramount to ensure that practitioners performing carotid artery stent (CAS) procedures are technically proficient. The use of virtual reality (VR) simulation should enable an individual's skills to be assessed on a standardised case in an objective manner, though this has yet to be scientifically proven. The aim of this study was to determine the construct validity of the carotid VR module on a commercially available simulator (VIST, Mentice, Sweden). 42 practitioners experienced in generic endovascular procedures (>100 cases) and with varying degrees of experience in CAS were recruited. All subjects performed a virtual right internal CAS procedure. The simulator enables the use of real endovascular tools and provides a fluoroscopic image of the virtual patient. Performance was assessed by metrics recorded objectively and instantly by the simulator. The participants also rated the face validity of the VR simulator.

---

van Herzeele, Isabelle

Expert Clinician-Based Weighting of Error Scores on a Virtual Reality Endovascular Simulator

Session: Wednesday Posters

The use of high-fidelity virtual reality (VR) simulation for carotid artery stent (CAS) procedures should enable physicians at any level to improve their technical skills. Performance assessment on a standardized case is possible, though error scores are not weighted upon their seriousness. The aim of this study was to weight the differential metrics recorded by a commercially available simulator (VIST, Mentice, Sweden). Endovascular experts (>100 endovascular procedures) completed a questionnaire and rated the errors that may be made during a CAS procedure. No errors were rated as unimportant (i.e. 1) and only 2 were rated as minor. Four errors were rated as life-threatening.. This study has for the first time delivered a scale for the weighting of different errors on a VR simulator, enabling clinicians to more accurately assess their progress during the learning curve, and software writers to further develop VR modules according to sound clinical opinion.

Vespa, Paul M.

Robotic Telepresence in Intensive Care Improves Physician Response Time

Session: Thursday Posters

The delivery of intensive care in intensive care units (ICU) requires frequent evaluation of patient status. This evaluation typically occurs using a variety of communication methods including in person evaluation/discussions, telephone calls, electronic computerized data streams, and recently telemedicine applications. This evaluation and treatment occurs many times throughout the 24 hour cycle and is an integral part of clinical care. However, during nighttime/off-hours, communication is often limited to telephone discussions without an actual set of rounds. This can result in an incomplete exchange of information. Given this limitation, we and others have relied increasingly on telemedicine methods to improve our nighttime/off-hours evaluation of patients. We have used a variety of telemedicine methods in the ICU in the past, but have recently adopted the use of a new mobile, robotic telemedicine system called the Telepresence Robot.

Villard, Caroline

Precise Determination of Regions of Interest for Hepatic RFA Planning

Session: Wednesday PM, Session B

Percutaneous radiofrequency ablation of liver tumors is a recent technique that consists in a destruction of tumors

by heat. A correct insertion and placement of the needle is critical and conditions the success of the operation. We are developing a software that uses patients data to help the physician plan the operation. This program integrates the expertise of the physician to propose an optimal strategy and to give interesting information allowing to adjust the final choice. In this context, we developed a method that computes automatically, quickly and accurately the possible insertion areas on the skin, i.e. those that guarantee a safe access to the tumor. The borders of the 3D mesh representing insertion areas are refined for a higher precision. Resulting zones are then used to restrict the research domain of the optimization process, and are visualized on the reconstructed patient as an indication for the physician.

---

von Spiczak, Jochen

Device Connectivity for Image-Guided Medical Applications

Session: Thursday Posters

This paper describes a novel device interface that facilitates multi-modal event streams for high-performance image-guided medical applications that require both high-bandwidth event streaming and support for multiple heterogeneous devices. The proposed framework interconnects tracking and navigation systems, peripheral devices, image acquisition, image visualization, and data logging devices with image-guided medical software applications by means of a unified software framework that facilitates high-frequency streaming of multi-modal events with generic data types. This software architecture is capable of dynamically introducing any number of arbitrarily-typed event attributes with late type binding during runtime. This approach provides significant functional advantages over hard-coded, fixed event data structures, and is more flexible than simpler generic approaches that determine event data types at compile time. Several clinically relevant applications were successfully developed using the approach proposed in this paper, and a number of performance tests were performed in order to demonstrate its flexibility and effectiveness.

Vosburgh, Kirby G.

Natural Orifice Translumenal Endoscopic Surgery (NOTES): An Opportunity for Augmented Reality Guidance

Session: Wednesday PM, Session B

To further reduce the invasiveness of peritoneal access, the next logical step beyond laparoscopy is to eliminate the incision through the abdominal wall using natural orifices as entry points. This Natural Orifice Transluminal Endoscopic Surgery (NOTES) approach, through the mouth and then the stomach wall, for example, has the potential to replace or augment current surgical techniques. Compared with laparoscopy, transgastric endoscopy must accommodate additional complexities: (1) The flexibility of the endoscope tip complicates the understanding of its distal orientation. (2) Several surgical targets lie in a retrograde position with respect to an incision in the stomach wall. (3) Since there is limited direct access to the abdomen, iatrogenic injuries, such as the accidental cutting of an artery, will be more dangerous and difficult to manage. Similar challenges characterize transcolonic or transvaginal approaches. We are working to mitigate these limitations in NOTES though augmented reality techniques using pre-procedure CT or MRI imaging, real time tracking with position registration, and display to the operating physician. Recent results will be presented. We expect that the real time display of endoscope position, orientation, and shape in a 3D patient-specific model will provide the NOTES operator with an easier to use, safer, and more efficient interface. It is anticipated that such augmentation will make intra-cavitary interventional techniques easier to master and use in practice, and thus more likely to be widely adopted.

Ward, James W.

Immersive Visualization with Automated Collision Detection for Radiotherapy Treatment Planning

Session: Thursday AM, Session B

Intensity modulated radiotherapy (IMRT) is a technique for treating cancer tumours using external delivery of radiation. To create a plan the directions of the external radiation beams (typically 5 to 9) need to be specified. Frequently all the beams are chosen to be coplanar as it is difficult to determine whether a particular non-coplanar beam is beneficial. Furthermore it may be impossible to implement a beam due to a collision between the patient and the equipment. RTStar provides a virtual world simulation of a radiotherapy treatment room that provides visualizations that help a treatment planner choose non-coplanar beam directions. Furthermore, it automatically warns the planner when a beam will cause a collision. A study was conducted on 12 prostate IMRT cancer patients using RTStar to create RT plans using non-coplanar beams. These were compared with coplanar plans. The study concluded that better dose distribution is achieved using non-coplanar beams.

Warner, Dave

Designing the Future: Unnatural Selection in the Emerging Bio-Verse

Session: Wednesday AM General Session

Molecular surgery, genetic recoding, individualized medicine, global public health tracking and universal health care are just a few of the promised modern medical wonders of the early 21st century. Biologic systems that have naturally evolved, survived, stabilized and thrived over very extended periods of time are about to get shock to the system as humans get closer and closer to manipulating the very fabric of life itself. Will this be a paradise—or a Pandora's box—or both? The intent of this presentation is not to forecast doom and gloom, nor to predict a perfect future, but rather to address design considerations in some of the un-natural yet truly radical and revolutionary opportunities emerging from the convergence and fusion of bio-info-tronics and the global communications infrastructure.

Williams, James R.

Virtual Reality for Pain Management: Demonstration of EMS Feasibility

Session: Thursday Posters

This presentation will overview a feasibility study named Project EMSVR (Emergency Medical Services Virtual Reality) being conducted in Southeastern New Mexico to determine the possibility of using Virtual Reality (VR) in the pre-hospital setting as a means to manage pain. Pain is one of the most common symptoms seen, yet is the most under treated by pre-hospital care providers. The presentation will cover issues of pain management in EMS, the concept of VR in EMS for pain management, and the results of the feasibility study. This study is being conducted through the University of New Mexico by Ernie Wheeler, NREMT-P, Operations Commander of the Hobbs Fire Department, James Williams, NREMT-P, Deputy Fire Chief of the Lovington Fire Department Michael Richards, M.D., M.P.A. of UNM and State of New Mexico EMS Medical Director, Dale Alverson, M.D. of UNM, and Hunter Hoffman, Cognitive Psychologist of the University of Washington in Seattle.

Wilson, Bradford R.

A Collaborative 3D Tele-Immersive Environment for Remote Medical Consultation

Session: Friday AM, Session B

The emerging medium of tele-immersion, a powerful synthesis of networking, computer vision, and 3D multi-media technologies, enables cooperative interaction among geographically remote participants by projecting them into the same virtual environment. In this virtual space, people can emote, talk and share experiences in real-time with a mutual sense of presence, as if they were together in the same room. Synthetic virtual objects, such as MRI volumetric images, can also be introduced and visualized in the virtual space. Participants can explore and examine these virtual images from any point of view and even manipulate them using their hand, without the use of special gloves or instrumentation. Fingers can be used as scalpels to carve through volumetric data and highlight areas of interest, allowing for dramatic new modes of remote collaboration for research purposes, consultation, and treatment planning.

Wood, Dennis Patrick

Combat Related Post Traumatic Stress Disorder: A Case Report Using Virtual Reality Exposure Therapy with Physiological Monitoring

Session: Friday AM, Session C

Post-Traumatic Stress Disorder (PTSD) is one of the most serious psychological conditions affecting both the active duty and veteran populations. Research has suggested that virtual reality exposure (VRE) therapy is an effective medium of therapy for treating veterans with PTSD.

Virtual Reality Medical Center (VRMC) has been awarded an Office of Naval Research (ONR) grant to complete a randomized study, at Naval Medical Center San Diego, comparing the effects of VRE therapy with Cognitive Behavioral group therapy on active-duty combat personnel diagnosed with PTSD.

VRMC has just completed the treatment on our first patient who was deployed to Iraq in 2004. During his deployment he was wounded in an IED blast. He was diagnosed with PTSD in January 2006 and he initiated VRE therapy in April 2006. We will report concerning the status of the successful VRE treatment of this warrior and we will discuss the VRE treatment protocol utilized in the treatment of this warrior.

Xie, Yongming

GPU-Friendly Marching Cubes for Visualizing Translucent Isosurfaces

Session: Wednesday Posters

Marching cubes has long been employed as a standard indirect volume rendering approach to extract isosurfaces from 3D volumetric data. This paper presents a GPU-friendly MC implementation. Besides the cell indexing, we propose to calculate vertex and normal interpolations by precomputing

the expensive equations and looking up these values during runtime. Upon a commodity GPU, our implementation can rapidly extract isosurfaces from a high-resolution volume and render the result. With the proposed parallel marching cubes algorithm, we can naturally generate layer-structured triangles, which facilitate the visibility-correct visualization of multiple-layer translucent isosurfaces without performing computational expensive sorting. The algorithm extracts and draws triangles, in a layer by layer fashion, from back to front. With the painter's algorithm, the visibility of multi-layer translucent isosurfaces is resolved naturally.

Yamauchi, Yasushi

Can We Remember Stiffness?

Session: Thursday Posters

Aim: This study aims at evaluating how exactly we can understand and remember given force information. Methods: A forceps is attached to the PHANToM Omni 6DOF stylus. By manipulating the forceps one can touch virtual objects. Nine subjects participated in this study. First, an object with certain stiffness k is presented: the subject can touch and learn its stiffness for 15 seconds. Then, following 15 seconds intermission, 20 objects with gradually different stiffness are presented. The subject touches these objects and chooses one of them, that has the same stiffness as the object presented before the intermission. This test is repeated 16 times for different k.
Results: The “remembered”stiffness kr is in close agreement with the given stiffness k, but its variation is not small (0.12<SD/k<0.60).
Conclusions: We can roughly remember the objectís stiffness from haptic feedback through a forceps.

Youngblood, Patricia

Virtual Worlds for Teaching the New CPR to High School Students

Session: Wednesday PM, Session A

In this project, the research team designed, developed and evaluated a new approach to training laypersons to conduct CPR, using Forterra Systems, Inc.'s OLIVE (On-Line, Interactive, Virtual Environment) game development platform. In Massively, Multi-player, Online Simulation (MMOS), also called "virtual worlds", students/trainees play the role of a character ("avatar") in a scenario. Students interact with other characters ("avatars") in the virtual world by using the keyboard and mouse to control their avatar's actions/movements and headsets with voice over IP to communicate in real time with the other players. After the role play, trainees participate in an instructor-led discussion of their performance in the scenario.

Youngblood, Patricia

Assessing Performance in a Virtual Worlds Mass Casualty Simulation

Session: Wednesday Posters

Simulation-based training with Virtual 3D Worlds technology promises to be a valuable complement to traditional training for healthcare personnel. However, objective assessment of trainee performance in Virtual Worlds remains a challenge. In this presentation we will describe our simulation-based approach to assessing Emergency Department (ED) personnel's ability to manage mass casualty events in the ED when multiple victims arrive after exposure to sarin gas or a dirty bomb explosion. We will report preliminary results of our pilot study with the ED physicians and nurses at two major hospitals in northern California in late 2006.

Zelek, John S.

Towards an Understanding of Conventional Surgical Haptics Experience for Use in MIS

Session: Wednesday Posters

The sense of touch (haptics) is a complex experience, arising from sensory receptors in the skin of the fingers pads, together with information arising in the joint and muscle receptors. Many robot-like devices currently exist which provide force feedback resolved to a single point. We are interested in producing wearable haptics for application in MIS using technology we have developed. In order to know what haptic experience to provide for MIS, we first need to quantify what the haptic experience is in conventional surgery. Basic categories of surgical instruments include specialized implements for the functions of cutting, grinding, and dissecting; clamping; grasping and holding; probing; dilating or enlarging; retracting; and suctioning. Preliminary investigations with a grasper and prober have shown that different types of haptics (single, multiple point) are appropriate depending on the instrument and task. There is a role for our wearable technology but not for all applications.

Presenter Index