Interactive Technology 
and the New Paradigm for Healthcare

January 19-22, 1995
Hyatt Regency San Diego

sponsored by:
University of California, San Diego School of Medicine
in cooperation with:
Advanced Research Projects Agency (ARPA)
and Commission of the European Union

- This is the 1st international forum for medicine and interactive technology to interface and create the future of healthcare.
- This is the 3rd in a series of international symposia focusing on the healthcare applications of virtual reality and its enabling technologies.
- This is an opportunity for participants to learn how leading-edge interactive technologies will affect the future of medical and surgical practice by improving access, quality, and continuity of healthcare, while reducing cost.
- This symposium is intended for physicians, surgeons, and all healthcare providers, researchers, developers, educators, and investors, who are interested in the advancement of minimally invasive, cost-effective healthcare practices.
- All topics will be addressed from the perspective of the end-user as well as the interface designer.

This is a multi-specialty, inter-disciplinary symposium. Virtual reality and its enabling technologies—simulation, visualization, and robotics, will be discussed both as convergent and as individual technologies. Representatives from various medical and surgical specialties, from academia and from industry, will present the latest clinical and basic science findings.

PROGRAM COMMITTEE

John E. Abele  Boston Scientific
Michael J. Ackerman PhD  National Library of Medicine
S. Merry Blumenthal PhD  GE Medical Systems, Milwaukee
Hans-Jorg Builinger PhD  Fraunhofer Institute
Steven T. Charles MD  MicroOxidizer Systems
Jens P. Christensen MSc MBA  European Commission
Anthony M. DiGiro III MD  Shady Grove Med.Ctr. & CMI
Adrie C. M. Dumay MSc PhD  VDI Physics/Electronics Lab
Nathaniel I. Durfay  Massachusetts Inst. Technology

Walter J. Greenleaf PhD  Neuravia Medical Systems
Charles Grimdade  Division Ltd.
Helene M. Hoffman PhD  Univ.California, San Diego
Ralph E. Holmes MD  Univ.California, San Diego
Norbert M. Huwel MD  Orthosurgery, J.Gutenberg U.
Willi A. Kalandar PhD  Siemens Medical
Patrick J. Kelly MD  New York Univ. Medical Center
Rudy Matthijs MSc  European Coma Standardization
Bela L. Mustita  ISS/ROBOCC™
Makoto Nonaka MD PhD  On Int'l Scientific Adv.

Glenn M. Preminger MD  Duke Univ. Medical Center
Otto Rienhoff Prof. Dr. med  Philipps-Universitat Marburg
Joseph M. Rosen MD  Dartmouth-Hitchcock Medical Center
Jay H. Sanders MD  Medical College of Georgia
Col. Richard M. Satava MD  Biomedical Technology/ARPA
Faina Shtern MD  National Cancer Institute
Hans B. Sieburg PhD  Univ.California, San Diego
Dave Warner  Lorne Linda Univ., Medical Center
Suzanne Weghorst  Univ. Washington
TECHNOLOGY TRANSFER:
The Insertion of First Generation VR Medical Applications Into Today's Healthcare Arena

Sponsored by: DoD/ARPA, DoE, NASA, NCI, NIST, NLM, NSF

Moderator: Col. Richard M. Satava MD ARPA
Panel: Donald A.B. Lindberg MD, NIH, James P. Jenkins PhD, NASA, Y. T. Chien PhD, NSF, Faina Shtern MD, NCI, Samuel G. Varnado PhD, DoE, Bettijoyce Lide, NIST

This pre-conference workshop will showcase real-world applications that demonstrate successes of the HPCC and NIH programs. Focusing on medical applications and utilizing current projects, the workshop will address two issues:

- transitioning current beta versions to the marketplace
- "reducing to practice" benchtop prototypes to beta versions in specific new start-up projects.

In two open sessions, participants will be informed of the current status of specific medical applications of VR: major barriers, paths, and solutions for near-term insertion of VR technology will be discussed. The workshop will present next generation applications and identify methods federal agencies can use to stimulate and accelerate VR technology development and deployment.

Thursday, January 19

0730  Welcome and Introduction
  - The Administration's Role in Leveraging New Technology for Education: An Opportunity for Medical Education  Paul Chatelier PhD
  - HPCC and IITA  Y. T. Chien PhD
  - VR Task Force on VR  James P. Jenkins PhD

0800 - 1000  First Generation Medical Applications
  - The Visible Human: Project Update  Michael Ackerman PhD
  - Urological Surgery Simulator  Jonathan R. Merril MD
  - PreCep tor Surgical Simulator  Jack B. Stubbs
  - VIRTUAL CLINIC Surgical Simulator  Kevin McGovern
  - Surgical Simulator for Battlefield Trauma  Scott Delp PhD
  - Simulated Corpsman for Combat Casualty Care  Norman Badler PhD

1000 - 1100  Keynote Presentation  Donald A.B. Lindberg MD
  - Medical Applications on the National Information Infrastructure (NII)

1100 - 1300  Break

1300 - 1500  Second Generation Medical Applications
  - Multi-Media Synthesis for Medical Education  Helene M. Hoffman PhD
  - VR in a Physician's Clinic for Telenmedicine  Henry Fuchs PhD
  - Surgical Room of the Future  Kenneth Kaplan PhD
  - VR as an Intuitive Interface for Physicians  Suzanne Weghorst
  - Tactile Feedback for VR  Marc H. Reibert PhD, Kenneth Salisbury PhD
  - A Holographic Display for VR  Jonathan Prince DDS
  - Adding Olfaction to VR  Myron Krueger PhD
REALITY BYTES:
Psychotherapy and Virtual Reality

Sponsored by: Laboratory for Biological Informatics and Theoretical Medicine, UCSD

Moderator: Hans B. Sieburg, PhD

Thursday, January 19

1530 - 1730 This workshop will address three areas of interest:

- The Impact of VR technology on power-users
- The role of VR technology in psychotherapy
- Hard-/Software requirements for therapeutic applications

Total immersion in simulated environments over extended periods of time may alter the ability to distinguish between actual and virtual reality. However, immersion might also provide a multitude of beneficial effects, from stress reduction to the elimination of phobias. This workshop will stimulate discussion by contrasting extremes. Through role-playing, the panel will focus on one specific common anxiety disorder: fear of heights. Case discussions, possible therapeutic solutions, and discussion of program design will approach this single problem. The panel will discuss what equipment would be required for treatment, the size of simulation databases, and the most effective potential role for the therapist. Additionally, several other psychological aspects of VR will be considered: simulated situations that may trigger behaviors, including VR as entertainment. Discussants from psychology and psychiatry, hypnotherapy, hardware and software engineers, and representatives from the entertainment industry will be included.

INTERVENTIONAL INFORMATICS:
Healing with Information

Sponsored by: Human Performance Institute, Loma Linda University Medical Center

Moderators: Dave Warner, Jeff Sale

Thursday, January 19

1830 - 2030 This workshop will address Informatic Intervention, the application of virtual reality and other interactive information technologies in healthcare and education. In other words, intervening with information and information technologies to alter outcomes in healthcare and education.

This workshop will focus on the general principles of using information technologies to alter outcomes from an applications perspective. A brief historical overview of virtual reality technologies will be followed by an in-depth discussion of current efforts and near-term potential for this emerging field. The workshop will be presented from a generalist perspective, but specific case examples from several disciplines will be included:

- Pediatrics
- Surgery
- Rehabilitation Medicine
- Psychiatry
- Patient Education
- Preventive Medicine
- Obstetrics & Gynecology

Additionally, information systems for the enhanced performance of the general healthcare worker will be presented. An overview of the terminology and the key technologies relevant to this new and growing field will be included. The workshop will also cover the potential economic impact and other benefits of using information and information technology to augment medication and procedures in the healing process. The goal of this workshop is to provide participants with some fundamental heuristics for implementing interventional informatic systems in their own areas of specialization.
## PROGRAM

**Friday, January 20**  
**Moderator:** Jack C. Fisher MD

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<td>0800</td>
<td>Start</td>
<td>Welcome &amp; Introduction</td>
<td>Ralph E. Holmes MD</td>
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<tr>
<td>0805</td>
<td>Session A</td>
<td>The Long and Winding Road to the Real (Not Virtual) Marketplace</td>
<td>Diane S. Millman JD</td>
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<tr>
<td>0820</td>
<td>Session B</td>
<td>FDA Regulatory Concerns with Medical Software</td>
<td>Harvey Rudolph PhD</td>
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<td>0835</td>
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<td>Discussion</td>
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<td>0845</td>
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<td>Augmented Reality in Endoscopic Surgery</td>
<td>Michael Trupe MD</td>
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<td>0900</td>
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<td>Laser-Based 3D Volumetric Display (2nd Generation)</td>
<td>Parviz Solton MS</td>
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<td>0915</td>
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<td>Virtual Reality Meets Radiologic Imaging</td>
<td>Faina Shtrun MD</td>
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<td>0930</td>
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<td>Novel Imaging for Novel Therapy</td>
<td>S. Morry Blumenfeld PhD</td>
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<td>0945</td>
<td></td>
<td>Clinical Applications of a High Performance Computing System for Visualizing and Monitoring Human Labor and Birth</td>
<td>John P. Brennan MD</td>
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<td>1000</td>
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<td>Break</td>
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<td>1030</td>
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<td>Recent Advances in Visualizing Real-Time Ultrasound</td>
<td>Henry Fuchs PhD</td>
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<td>1040</td>
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<td>image-Guided Interventions for Cancer Paliation and/or MRI</td>
<td>Dietrich H.W. Grönnemeyer MD</td>
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<tr>
<td>1100</td>
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<td>Neuronavigation in the Daily Routine: Multi-Coordinate Manipulator and Microscope</td>
<td>Norbert M. Huwel MD</td>
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<td>1115</td>
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<td>Medicine is Dead Long Live Medicine</td>
<td>Col. Richard M. Satava MD</td>
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<td>1130</td>
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<td>Discussion</td>
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<td>1145</td>
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<td>Keynote Address: Riding the Infobahn Journey Through Knowledge</td>
<td>James Burke</td>
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<td>Author, Science Historian, Television Host, Writer, Producer</td>
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<td>Mr. Burke’s appearance is sponsored by Ethicon, Inc.</td>
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<td>1230</td>
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<td>Break</td>
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### SESSION A

**Moderator:** David J. McIntyre MD

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<tr>
<td>1330</td>
<td>Exploration of Cross-Sectional Data with a Virtual Endoscope</td>
<td>William E. Lorrens MD</td>
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<tr>
<td>1345</td>
<td>VR &amp; Laparoscopic Intervention: Activities at the UK Welfson Centre for Minimally Invasive Therapy, Prof. Bob Stone</td>
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<td>1400</td>
<td>Update on the Dexterity Enhancement Project</td>
<td>Steven T. Charles MD</td>
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<td>1415</td>
<td>Virtual Surgery for Fracture of the Mandible</td>
<td>Masahiro Kobayashi MD</td>
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<td>1430</td>
<td>A Fully Immersive Simulation of Open Cholecystectomy</td>
<td>Ann Lasko-Harvill MSE</td>
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<tr>
<td>1445</td>
<td>Use of a Holographic Projection System in Stereo-Endoscopic and Telesurgery</td>
<td>Christophe R. Laurent MD</td>
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<tr>
<td>1500</td>
<td>Integration of Preoperative Planning, Surgical Simulations and Robotics in Orthopaedic Surgery</td>
<td>Anthony M. DiGioia III MD</td>
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<tr>
<td>1515</td>
<td>VR Surgical Simulation in Urology</td>
<td>Glenn M. Preminger MD</td>
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<td>1530</td>
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<td>1545</td>
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<td>Virtual Reality Assisted Surgery Program</td>
<td>Richard A. Robb PhD</td>
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<td>1600</td>
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<td>Synchronization of Events During Surgery</td>
<td>Thomas J. Impelluso PhD</td>
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<td>1615</td>
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<td>Interactive Fluoroscopic Controlled Anterior Cruciate Ligament Reconstruction</td>
<td>Tiburtius V.S. Klos MD</td>
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<td>1630</td>
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<td>Surgical Simulation Support System</td>
<td>Hiroshi Oyama MD</td>
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**Saturday, January 21**  
**Moderator:** Col. Richard M. Satava MD

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<tr>
<td>0800</td>
<td>Factors Affecting Presence and Performance in Virtual Environments</td>
<td>Woodrow Barfield PhD</td>
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<td>0815</td>
<td>Analysis for Optimization of Stereoscopic Visualization</td>
<td>Cietus von Pichler Dipl.-Ing.</td>
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<td>0830</td>
<td>Evaluation of the Utility and Accuracy of a Frameless Navigation System in Neurosurgical Procedures</td>
<td>S. James Zinklech MD</td>
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<td>0845</td>
<td>Combinatorial VR: Instruments, Landscapes, and Tactile Graphics</td>
<td>David Hon</td>
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<td>0900</td>
<td>The Responsive Workbench: A Virtual Working Environment</td>
<td>Bemd Fohlinh PhD</td>
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<td>0915</td>
<td>A New Robot for High Dexterity Microsurgery</td>
<td>Paul S. Schirnker PhD</td>
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<td>0930</td>
<td>From Surgical Planning to Performance Machines</td>
<td>Joseph M. Rosen MD</td>
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<td>0945</td>
<td>Diagramming Registration Connectivity and Structure</td>
<td>John T. Lea</td>
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### Session B

**Moderator:** Bela L. Musits

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<tr>
<td>1330</td>
<td>VR Medical Support System for Cancer Patients</td>
<td>Hiroshi Oyama MD</td>
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<td>1345</td>
<td>Enabling Interactive Technology: Workstation Trends</td>
<td>John Flynn PhD</td>
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<tr>
<td>1400</td>
<td>Diagramming Registration Connectivity and Structure</td>
<td>Jon Lea</td>
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<td>1415</td>
<td>Emergency Medicine Internetwork</td>
<td>Kevin Ritger MD</td>
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<td>1430</td>
<td>ATM-Based Local Communication System for Telesurgery</td>
<td>Elmar Hofer PhD</td>
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<td>1445</td>
<td>Using a Dataglove for the Ergonomic Assessment of Instruments in Endoscopy</td>
<td>Wilhelm Bauer Dipl.-Ing.</td>
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<td>1500</td>
<td>CAD Modelling of Birth Process</td>
<td>Yanxi Liu PhD</td>
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<td>1515</td>
<td>The SpiderWeb Algorithm for Extracting 3D Surface Models</td>
<td>Dan Karron PhD</td>
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<td>1545</td>
<td></td>
<td>Virtual Computer Display for Visually Impaired Users</td>
<td>Arthur L. Zwen MBA</td>
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<td>1600</td>
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<td>Immersive VR for the Retraining of Acquired Cognitive Defects</td>
<td>Luigi Pugnetti MD</td>
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<td>1615</td>
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<td>The Emotional Dimension of Experience in Information Environments</td>
<td>Timothy Manning</td>
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<td>The Virtual Hospital Networks of Information</td>
<td>Stuart L. Meyer PhD</td>
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<td>Use of Musical Simulation for Treatment of Urinary Incontinence</td>
<td>Cyril J. Gedec MD</td>
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<td>1700</td>
<td>Magnobrains: Mapping the Brain. The Brain Database. The BRAINCOERRY Experiment</td>
<td>Maria Kakchiadu</td>
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<td>Discussion</td>
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<td>Adjourn</td>
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### Keynote Address: Riding the Infobahn Journey Through Knowledge

**James Burke**  
Author, Science Historian, Television Host, Writer, Producer  
Mr. Burke’s appearance is sponsored by Ethicon, Inc.
Moderator: Dave Warner

1100 The Visible Human Male: Real Anatomy for the Virtual World
Michael J. Ackerman PhD and Victor M. Spitzer PhD

1130 Virtual Human: An Anatomical Virtual Environment for Computer-Aided Instruction and Biomechanical Analysis
Michael S. Selberg

1145 Development of a Commercial Surgical Simulator for Laparoscopic Training
Jonathan R. Merrif MD

1200 Do 3D Video Systems Improve Laparoscopic Task Performance?
Daniel B. Jones MD

1215 Medical Education Meets Virtual Reality
Helene M. Hoffman PhD

1230 Discussion

1300 Break

Session A

Moderator: Hans B. Sieburg PhD

1400 Minimally Invasive Laser Discectomy
Reiner M.M. Seitel MD

1415 The Development of a Remotely Controlled Laparoscopic Manipulator
Markus H. Grinstch FRCS

1430 Triage Simulation in a Virtual Environment
Adrie C.M. Dunay PhD

1445 The Cybermensch Environment for the Rational Design of Clinical Trials
Hans B. Sieburg PhD

1500 Rehabilitation and Disability Solutions
Walter J. Greenleaf PhD

1515 Augmented Reality and Parkinson's Disease: Further Observations
Suzanne Weghorst

1530 Emergent Technologies from Human-Dolphin Interaction
David M. Cole

1545 Virtual Reality Technology Applied to Anesthesiology
John S. McDonald

1600 Break

1615 Health & Safety Issues in Virtual Reality: A Role for Physicians
Erik Vilaire MD, PhD

1630 Integrating Anatomy and Physiology for Behavior Modeling
Dimitr Metaxas PhD

1645 DETOUR: Brain Deconstruction Utilizing VR to Experience Perceptual Phenomenology
Rita Addison MA

1700 Interactive Design of the Operating Room of the Future
Georges Grinstein PhD

1715 Simulation and Assessment of Musculoskeletal Trauma Due to Missile Penetration
Robert D. Eifler

1730 The Virtual Clinic: Advanced Endosurgical Skills Simulator
Kevin T. McGovern

1745 Discussion

1800 Adjourn

Session B

Moderator: Patrick J. Kelly MD

1400 Planning Orthopaedic Surgery in Virtual Environments: An Osteotomy Operation Example.
Hans-Jorg Bullinger Dipl.-Ing.

1415 A 3D Imaging System in Plastic and Reconstructive Surgery
Michael Fader

1430 Feasibility of a Controller Operated Endoscopic Camera
Hugh S. Lustig MD

1445 Telemedical Assisted Laparoscopic Genitourinary Surgery
Robert G. Moore MD

1500 A Tactile Sensing and Display System for Surgical Applications
William J. Palen

1515 Force Feedback Issues in Minimally Invasive Surgery
Narendra P. Reddy PhD

1530 A $100 Surgical Simulator for the IBM PC
Stephen Drain MD

1545 Image Overlay for Surgical Enhancement and Telemedicine
Anthony M. DiGirola III MD

1600 Break

1615 A Computer-Controlled Modular Endoscope System
Elmer Holler PhD

1630 Force Feedback and Medical Simulation
Bernie G. Jackson

1645 Tissue Cutting in Virtual Environments
Narender P. Reddy PhD

1700 A Stereotactic Robotic System for Pedicle Screw Placement
Julio J. Santos-Munoz

1715 Virtual Similarity Simulation in Laparo-Endoscopic Training
D. A. Tolley MD

1730 Human Interface Hardware for Virtual Laparoscopic Surgery
Louis B. Rosenberg PhD

1745 Discussion

1800 Adjourn

Sunday, January 22

Moderator: David J. McIntyre MD

0900 A Multimedia Workstation for the Regional Telemedicine System
Yongmin Kim PhD

0915 The Promise of Visual Telepresence for Medical Consultation
Henry Fuchs PhD

0930 Telematics Applications Programme: A Shift of Paradigm
Jens P. Christensen MSc, MBA

0945 Advanced Concepts for Distributed Rehabilitation Using VR
Hans-Jorg Bullinger Dipl.-Ing.

0900 Telemedicine in a Prison and Rural Hospital in North Carolina
David Balch

0915 Improved Access, Continuity, and Reduced Cost of Rural Health Care Through a Telemedicine Pilot Project
Penny A. Jeffett PhD

0930 Transmission of Olfactory Information for Telemedicine
Paul E. Keller PhD

0945 Future Health: The Electronic House Call and Digital Doc
Jay H. Sanders MD

1000 Assessing the Need for Gigabit Speed Wide-Area Networks
Walid G. Tohme PhD

1015 Global Information Society: Interaction with Information
Rudy Matheus MSc

1030 Discussion

1045 Summary Panel Discussion:
Y. T. Chian PhD, Jens P. Christensen MSc, MBA; Henry Fuchs PhD, Walter J. Greenleaf PhD, Patrick J. Kelly MD, Talina Shtern MD, Col. Richard M. Salato MD

1200 Adjourn

POSTER/VIDEO PRESENTATIONS

A Comparison of Upper Extremity Muscle Function During Simulated Laparoscopy & Open Surgical Tasks Using Surface Electromyography
Yaron Bergou MD

Interactive Video Games Designed to Enhance Children's Prevention and Self-Care
Stephen Brown

An Interactive Book for Learning TEE for Children
Thomas Engel MD

Computer-Aided Neurosurgery for Infants and Young Children
Jean-Francois Hirsch MD and Oleg Tredlowski PhD

A New Implantable Multisensor Device for Cardiac Recipients
Johannes Mueller MD

Evaluation of the Sensation of Immersion
Bruce Nappi

Development of a VR Microsurgical Simulator
R. Putze MD

Linearization of Fluoroscopic Images
Julio J. Santos-Munoz

Multifunctional Pedal Switch Control System for MIS Devices
Gunter Schaller MD

Using Multimedia Computing for Decision Making in Treating Breast Cancer
Timothy Manning MS and Richard L. Siret Jr. PhD

Developing a Medication Information Workstation for Patients
T. Bradley Tanner MD

Tactile Feedback for Endoscopic Surgery
R. Trapp Dipl.-Ing.

Diagnosing Coronary Artery Disease: a Backpropagation Neural Network
David D. Turner MS