Medicine Meets Virtual Reality
The Convergence of Physical & Informational Technologies: Options for a New Era in Healthcare

Edited by

James D. Westwood
Aligned Management Associates, Inc.
New London, CT, USA

Helene M. Hoffman
University of California, San Diego, CA, USA

Richard A. Robb
Mayo Foundation/Clinic, Rochester, MN, USA

Don Stredney
Ohio Computer Center, Columbus, OH, USA
Contents

Telepathology in Neurosurgery, H.R. Abbasi, R. Weigel, C. Sommer, P. Schmiedek and M. Kiessling 1

A System for the Simulation and Planning of Orthodontic Treatment using a Low Cost 3D Laser Scanner for Dental Anatomy Capturing, M. Alcaniz, V. Grau, C. Monserrat, C. Juan and S. Albalat 8

The Use of an Information Architecture Modeling Tool in the Development of Disease Management Systems, N.E. Alessi, M. Huang and P. Quintan 15

Deformation Simulation Algorithms of Elastic Tissues in "Real-Time" Based in Elasticity Theory, C. Monserrat Aranda, M.C. Juan Lizandra, M. Alcaniz Raya, V. Grau Colomer and C. Knoll 21


Automatic Modeling of Knee Joint Motion for the Virtual Reality Dynamic Anatomy (VRDA) Tool, Y. Baillot, J.P. Rolland and D.L. Wright 30

CathSim™, V.L. Barker 36

Simulation of Tissue Cutting and Bleeding for Laparoscopic Surgery using Auxiliary Surfaces, C. Basdogan, C.-H. Ho and M.A. Srinivasan 38

An Improved Stereotactic Technique for Cyst Cannulation, W.C. Bergman, V. Tse, R.A. Schulz, G.E. Geil, S.A. Shatsky and L. Bao 45

A Virtual Instrument Ergonomics Workstation to Measure Surgeons' Physical Stress, R. Bergner, C.-Y. Chen and W.D. Smith 49


Defining the Role of Haptic Feedback in Minimally Invasive Surgery, O.S. Bholat, R.S. Haluck, R.H. Kutz, P.J. Gorman and T.M. Krummel 62

Haptic Rendering of Isosurfaces Directly from Medical Images, D.J. Blezek and R.A. Robb 67

Realtime Simulation of Tissue Deformation for the Nasal Endoscopy Simulator (NES), U. Bockholt, U. Ecke, W. Müller and G. Voss 74

Preop™ Endoscopic Simulator: A PC-Based Immersive Training System for Bronchoscopy, M. Bro-Nielsen, J.L. Tasto, R. Cunningham and G.L. Merril 76


Virtual Reality: A Wholistic Approach to Rehabilitation, D. Cunningham and M. Krishack 90

Thin Walled Models for Haptic and Graphical Rendering of Soft Tissues in Surgical Simulations, S. De and M.A. Srinivasan 94
Efficient Linear Elastic Models of Soft Tissues for Real-time Surgery Simulation,  
H. Delingette, S. Cotin and N. Ayache  
100

Stereo Augmented Reality in the Surgical Microscope, P.J. Edwards, A.P. King,  
D.J. Hawkes, O. Fleig, C.R. Maurer, Jr., D.L.G. Hill, M.R. Fenlon, D.A. de Cunha,  
102

A New Hybrid Renderer for Virtual Bronchoscopy, K.-H. Englmeier, M. Haubner,  
C. Kropichler and M. Reiser  
109

Visual Clues in Minimally Invasive Surgery: Use of 2-D Versus 6-D Enhanced  
Performance of Complex Minimally Invasive Complex Skills, W.P. Geis,  
G.K. Gillian and M. Berry  
116

Evaluation of Skill Acquisition Using a Force Feedback, Virtual Reality Based  
Surgical Trainer, P.J. Gorman, J.D. Lieser, W.B. Murray, R.S. Haluck and  
T.M. Krummel  
121

An Intelligent, Interactive Platform for Ophthalmic Teaching, Telemedicine, and  
Telecollaboration: Design Considerations and Prototype Construction,  
R. Hariprasad, D.S. Shin and J.W. Berger  
124

Interactive Navigation and Bronchial Tube Tracking in Virtual Bronchoscopy,  
130

Anatomic Visualizer: Realizing the Vision of a VR-based Learning Environment,  
H. Hoffman and M. Murray  
134

Some Virtual Reality and Telemedicine Applications Useful for Long-Duration  
Spaceflight from a Systems Engineering Perspective, D. Holland and W. Barfield  
141

Presence as an Emotional Experience, M.P. Huang and N.E. Alessi  
148

Gaze Patterns in Laparoscopic Surgery, J.A. Ibbotson, C.L. MacKenzie, C.G.L. Cao  
and A.J. Lomax  
154

Virtual Endoscopy using Surface Rendering and Perspective Volume Rendering,  
D.P. Jang, M.H. Han and S.I. Kim  
161

Teleimmersion for the Doctor's Office, G. Kamberova, R. Bajcsy and D. Schmidt  
167

Telepresence Surgery System Enhances Medical Student Surgery Training,  
C. Kaufmann, P. Rhee and D. Burris  
174

New Software Applications for Interchangeable Instrumentation in Spinal Stereotaxis,  
K.D. Kim, J.P. Johnson, O. Bloch, J.E. Masciopinto, M.J. Saracen and  
J.P. Villablanca  
179

Virtual Reality on the Web: The Potentials of Different Methodologies and  
Visualization Techniques for Scientific Research and Medical Education,  
T. Kling-Petersen, R. Pascher and M. Rydmark  
181

Planning of Skull Base Surgery in the Virtual Workbench: Clinical Experiences,  
R.A. Kockro, L. Serra, T.T. Yeo, C. Chan, Y.-Y. Sitoh, G.-G. Chua, H. Ng, E. Lee,  
Y.H. Lee and W. Nowinski  
187

Knowledge Optimization®: Theory and Application to Point-of-Care Testing,  
G.J. Kost  
189

"KnowWare™: Virtual Reality Maps for Blind People", M.W. Krueger and D. Gilden  
191

Dynamic Volume Texture Mapping and Model Deformation for Visually Realistic  
Surgical Simulation, W.-T. Lin and R.A. Robb  
198

Universal Interfacing System for Interactive Technologies in Telemedicine,  
Disabilities, Rehabilitation, and Education, E. Lipson, D. Warner and Y.-J. Chang  
205
Interactive Visualization of 3D Fields and Images on Inexpensive Workstations Using VRML, B.S. Marovic, D.J. Valentino, W.J. Karplus and Z. Jovanovic 219
Virtual Arthroscopy Training: Do the "Virtual Skills" Developed Match the Real Skills Required?, A. McCarthy, P. Harley and R. Smallwood 221
BRAVO/Teletrend: A Comprehensive WWW-based Neuromonitoring System for the Neurosurgery ICU, V.I. Nenov, F. Buxey and Y. Yamaguchi 228
Virtual 3D Cutting for Bone Segment Extraction in Maxillofacial Surgery Planning, P. Neumann, D. Siebert, G. Faulkner, M. Krauss, A. Schulz, C. Lwowsky and T. Tolxdorff 235
Immersive Surgical Robotic Interfaces, P. Oppenheimer, S. Weghorst, M. MacFarlane and M. Sinanan 242
PET Supports the Hypothesized Existence of a Male Sexual Brain Algorithm which may Respond to Treatment Combining Psychotherapy with Virtual Reality, G. Optale, F. Chierichetti, A. Munari, A. Nasta, C. Pianon, G. Viggiano and G. Ferlin 249
The Wearable Motherboard*: A Flexible Information Infrastructure or Sensate Liner for Medical Applications, S. Park, C. Gopalsamy, R. Rajamanickam and S. Jayaraman 252
Semi-Automated Analysis for MRI of Breast Tumors, S.C. Partridge, E.J. Heumann and N.M. Hylton 259
PC-based Telerehabilitation System with Force Feedback, V. Popescu, G. Burdea, M. Bouzit, M. Girone and V. Hentz 261
Digital Image Recording: An Integral Aspect of Video Endoscopy, G.M. Preminger, F.C. Delvecchio and J.M. Birnbach 268
A Telementored Trans-Rectal Ultrasound Guided Prostate Biopsy, T.L. Purkable and J.J. Bauer 275
The Ergonomics of Virtual Reality: Human Factors in Developing Clinical-Oriented Virtual Environments, G. Riva and G. Mantovani 278
Surgeon-Tool Force/Torque Signatures - Evaluation of Surgical Skills in Minimally Invasive Surgery, J. Rosen, M. MacFarlane, C. Richards, B. Hannaford and M. Sinanan 290
New Approaches to Virtual Environment Surgery, M.D. Ross, A. Twombly, A.W.F. Lee, R. Cheng and S. Senger 297
Tests on Reliability of a Prostate Biopsy Telerobotic System, A. Rovetta 302
Limitations of Distributed Segmentation for Three-Dimensional Radiological Modeling, J.C. Rubenstein, J.C. Silverstein and W.B. Panko 308
Laser 3-D Scanning for Surface Rendering in Biomedical Research and Education, M. Rydmark, J. Brodendal, P. Folkesson and T. Kling-Petersen 315
A Portable Virtual Environment Knee Arthroscopy Training System with Objective Scoring, K.P. Sherman, J.W. Ward, D.P.M. Wills and A.M.M.A. Mohsen 335

Early Experience and Validation Work with Procedicus VA - The Prosolvia Virtual Reality Shoulder Arthroscopy Trainer, S. Smith, A. Wan, N. Taffinder, S. Read, R. Emery and A. Darzi 337


CathSim™: An Intravascular Catheterization Simulator on a PC, M. Ursino, J.L. Tasto, B.H. Nguyen, R. Cunningham and G.L. Merril 360


Virtual Cutting of Anatomical Structures, G. Voß, J.K. Hahn, W. Müller and R. Lindeman 381


The Correction of MR Images Distortion with Phantom Studies, J.H. Woo, Y.S. Kim and S.I. Kim 388


Author Index 393