

Symposium on
Haptic Interfaces for Virtual Environment and
Teleoperator Systems 2006

Alexandria, Virginia, USA

March 25 - 26, 2006

Proceedings

Edited by

Blake Hannaford

Jan Weisenberger

Brent Gillespie



Copyright © 2006 by the Institute of Electrical and Electronics Engineers, Inc.
All rights reserved.

Copyright and Reprint Permission: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through:

Copyright Clearance Center
222 Rosewood Drive
Danvers, MA 01923

For other copying, reprint or republication permission, write to:
IEEE Copyrights Manager
IEEE Operations Center
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331

The papers in this book comprise the proceedings of the meeting mentioned on the cover and title page. They reflect the authors' opinions and, in the interests of timely dissemination, are published as presented and without change. Their inclusion in this publication does not necessarily constitute endorsement by the editors, the IEEE Computer Society Press, or the Institute of Electrical and Electronics Engineers, Inc.

ISBN: 1-4244-0226-3
Library of Congress: 2006921074

Additional copies may be ordered from the IEEE Service Center:
IEEE Catalog Number: 06EX1322
IEEE Service Center
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331 USA

Telephone (toll-free): 1-800-678-IEEE
Telephone (direct): +1-732-981-0060
Fax: +1-732-981-9667
E-mail: customer-service@ieee.org

Contents

Preface	viii
IEEE Computer Society Visualization and Graphics Technical Committee	ix

Papers

Session 1: Psychophysics

Discrimination of Real and Virtual High-Definition Textured Surfaces	3
Hong Z. Tan, Bernard D. Adelstein, Ryan Traylor, Matthew Kocsis, E. Dan Hirtleman	
Evaluating the Role of Force Feedback for Biomanipulation Tasks	11
Anand Pillarisetti, Maxim Pekarev, Ari D. Brooks, Jaydev P. Desai	
Assessing the Fidelity of Haptically Rendered Deformable Objects	19
Peter Leškovský, Matthias Harders, Gábor Székely	
Determining the Feasibility of Forearm Mounted Vibrotactile Displays	27
Ian Oakley, Yeongmi Kim, Junhun Lee, Jeha Ryu	
A Psychophysically Motivated Compression Approach for 3D Haptic Data	35
Peter Hinterseer, Eckehart Steinbach	
Force Feedback in a Three-Dimensional Ultrasound-Guided Surgical Task	43
Christopher R. Wagner, Nikolay Vasilyev, Douglas P. Perrin, Pedro J. del Nido, Robert D. Howe	

Session 2: Hardware I

Two-dimensional Active Type Surface Acoustic Wave Tactile Display On A Computer Screen.....	49
Masaya Takasaki, Hiroyuki Kotani, Takaaki Nara, Takeshi Mizuno	
Controlling the Perceived Vibrational Frequency and Amplitude of a Voice-Coil-Type Tactor	55
Masataka Niwa, Haruo Noma, Yasuyuki Yanagida, Kenichi Hosaka, Robert W. Lindeman	
Two-dimensional Scanning Tactile Display using Ultrasound Radiation Pressure.....	57
Takayuki Iwamoto, Hiroyuki Shinoda	
A Shear Stress Sensing for Robot Hands - Orthogonal arrayed Piezoresistive Cantilevers standing in Elastic Material.....	63
Kentaro Noda, Isao Shimoyama	
Compact, Portable, Modular, High-performance, Distributed Tactile Transducer Device Based on Lateral Skin Deformation	67
Qi Wang, Vincent Hayward	
Initial Results using Eddy Current Brakes as Fast Turn-On, Programmable Physical Dampers For Haptic Rendering...	73
Gianni Campion, Andrew H. Gosline, Vincent Hayward	

Session 3: Hardware II

Unwarping Encoder Ripple in Low Cost Haptic Interfaces	75
Dale A. Lawrence, Lucy Y. Pao, Sutha Aphanuphong	
A Network-ready Multi-lateral High Fidelity Haptic Probe	81
Hsin-Yun Yao, Vincent Hayward	
Harness Design and Coupling Stiffness for Two-Axis Torso Haptics.....	83
David I. Grow, John M. Hollerbach	

A Sensitive Skin Based on Touch-Area-Evaluating Tactile Elements	89
Takayuki Hoshi, Hiroyuki Shinoda	
Design and Development of a General Purpose 7 DOF Haptic Device	95
Gregory Tholey, Jaydev P. Desai	
Control and Performance of the Rotational-to-Linear Cobotic Transmission.....	103
Eric L. Faulring, J. Edward Colgate, Michael A. Peshkin	
Session 4: Control/Dynamics/Biomechanics	
Effect of Hand Dynamics on Virtual Fixtures for Compliant Human-Machine Interfaces.....	109
Panadda Marayong, Gregory D. Hager, Allison M. Okamura	
Event-Based Haptic Tapping with Grip Force Compensation.....	117
Jonathan Fiene, Katherine J. Kuchenbecker, Günter Niemeyer	
Measuring Fingertip Forces by Imaging the Fingernail	125
Yu Sun, John Hollerbach, Stephen Mascaro	
Material Property Recognition by Active Tapping for Fingertip Digitizing.....	133
Young-Seok Kim, Thenkurussi Kesavadas	
The Sampling Position Within, Not the Undulating Geometry of, Fingertip Skin Microstructure May Amplify the Sensation of Edges	141
Gregory J. Gerling	
Adaptation of Haptic Interfaces for a LabVIEW-based System Dynamics Course	147
Kevin Bowen, Marcia K. O'Malley	
Session 5: Control/Dynamics II	
Stabilization Through Gyration: A Wave Variable Approach to High Frequency Force Feedback in Telerobotics	153
Neal A. Tanner, Günter Niemeyer	
The Role of Prototyping Tools for Haptic Behavior Design.....	161
Colin Swindells, Evgeny Maksakov, Karon E. MacLean, Victor Chung	
Pseudo-admittance Bilateral Telemanipulation with Guidance Virtual Fixtures.....	169
Jake J. Abbott, Allison M. Okamura	
Sensor Modeling in Parallel Force Feedback Haptic Interfaces	177
Nicholas L. Bernstein, Dale A. Lawrence, Lucy Y. Pao	
Wave Haptics: Providing Stiff Coupling to Virtual Environments	185
Nicola Diolaiti, Günter Niemeyer	
Performance/Stability Robustness Tradeoffs Induced by the Two-Port Virtual Coupler.....	193
Paul G. Griffiths, R. Brent Gillespie, Jim S. Freudenberg	
Session 6: Rendering/Modeling/Applications	
Visual and Haptic Simulation of Linear Viscoelastic Tissue Behavior Based on Experimental Data	201
Mert Sedef, Evren Samur, Cagatay Basdogan	
Impulse Response Deformation Model: an Approach to Haptic Interaction with Dynamically Deformable Object	209
Kazuyoshi Tagawa, Koichi Hirota, Michitaka Hirose	
A Limit-Curve Based Soft Finger god-object Algorithm	217
Antonio Frisoli, Federico Barbagli, Emanuele Ruffaldi, Kenneth Salisbury, Massimo Bergamasco	
Standardized Evaluation of Haptic Rendering Systems	225
Emanuele Ruffaldi, Dan Morris, Timothy Edmunds, Federico Barbagli, Dinesh K. Pai	

Energy-Field Optimization and Haptic-Based Molecular Docking and Assembly Search System for Computer-Aided Molecular Design (CAMD).....	233
Susana K. Lai-Yuen, Yuan-Shin Lee	
A Study on Haptic Rendering in a Simulated Surgical Training Environment	241
Paul Marshall, Shahram Payandeh, John Dill	

Posters

Session 1: Applications

3D Stereo Viewing Evaluation for the Virtual Haptic Back Project	251
Wei Ji, Robert L. Williams II, John N. Howell, Robert R. Conatser Jr.	
In situ Measurement of Cadaveric Soft Tissue Mechanical Properties and Fulcrum Forces for Use in Physics-Based Surgical Simulation	259
Yi-Je Lim, Suvranu De, Daniel B. Jones, Tejinder P. Singh	
Haptic-Based Biometrics: A Feasibility Study	265
Yednek Asfaw, Mauricio Orozco, Shervin Shirmohammadi, Andy Adler, Abdulmotaleb El Saddik	
Microfabricated Instruments for Fetal Cardiac Surgery: Experiments on Haptic Tissue Recognition	273
Anna Eisenberg, Oliver Tonet, Giovanna Macri, Maria Chiara Carrozza, Paolo Dario	
Tandem Canoeing over the Internet using Haptic Feedback	281
Jonathan Tang, Craig Carignan, Pontus Olsson	
Haptically Annotated Movies: Reaching Out and Touching the Silver Screen	287
Derek Gaw, Daniel Morris, Kenneth Salisbury	
The Application of a Haptic Interface on Microassembly	289
C.J. van Strijp, H. H. Langen, M. Onosato	

Session 2: Control/Dynamics/Biomechanics

Realization of Human Skin-like Texture by Emulating Surface Shape Pattern and Elastic Structure.....	295
Hirokazu Shirado, Yoshimune Nonomura, Takashi Maeno	
Mechanical Responses of the Fingerpad and Distal Phalanx to Friction of a Grooved Surface: Effect of the Contact Angle	297
François Martinot, Aladine Houzefa, Mélisande Biet, Christophe Chaillou	
Environment Parameter Estimation during Bilateral Telemanipulation	301
Sarthak Misra, Allison M. Okamura	
Sensor/Actuator Asymmetries in Telemanipulators: Implications of Partial Force Feedback.....	309
Lawton N. Verner, Allison M. Okamura	
Dynamical Issues at the Low level of Human / Virtual Object Interaction.....	315
Jean-Loup Florens, Daniela Urma	

Session 3: Hardware

Portable Haptic Display for Large Immersive Virtual Environments	321
Enkhtuvshin Dorjgotov, Seungmoon Choi, Steven R. Dunlop, Gary R. Bertoline	
Demonstration of a Large Dissipative Haptic Environment	329
Mike Vande Weghe, Brian Dellon, Sean Kelly, Richard Juchniewicz, Yoky Matsuoka	
Mechanical Design of Haptic Forceps for Robotic Surgery	331
Peter R. Rizun, Dylan C. Gunn, Brian L. Cox, Garnette R. Sutherland	

The TactaPack: A Wireless Sensor/Actuator Package for Physical Therapy Applications.....	337
Robert W. Lindeman, Yasuyuki Yanagida, Kenichi Hosaka, Shinji Abe	
A Study of Mounting Methods for Tactors Using an Elastic Polymer.....	343
Haruo Noma, Yasukimi Hashida, Yasuyuki Yanagida, Robert W. Lindeman, Kenji Susami, Kenichi Hosaka, Yuichiro Kume	
Dielectric Elastomer Spring Roll Actuators for a Portable Force Feedback Device	347
Rui Zhang, Andreas Kunz, Patrick Lochmatter, Gabor Kovacs	
Development of a High-resolution Surface Type Haptic interface for Rigidity Distribution Rendering	355
Hiroaki Yano, Keita Komine, Hiroo Iwata	
Haptic Manipulation of Microspheres Using Optical Tweezers	361
Ibrahim Büküsoglu, Cagatay Basdogan, Alper Kiraz, Adnan Kurt	
Free Hand Haptic Interfaces Based on Magnetorheological Fluids.....	367
Nicola Sgambelluri, Rocco Rizzo, E. Pasquale Scilingo, Marco Raugi, Antonio Bicchi	
Fingertip Vibratory Transducer for Detecting Optical Edges Using Regenerative Feedback.....	373
Kimberly Zawrotny, Apryl Craig, David Weiser, Roberta Klatzky, George Stetten	
Performance Enhancement of a Haptic Arm Exoskeleton	375
Alan Sledd, Marcia K. O'Malley	
 Session 4: Psychophysics	
Tactual Frequency and Amplitude Discrimination with Fixed and Roving Background	383
Ali Israr, Hong Z. Tan, Charlotte M. Reed	
Psychophysics and Perceiving Granularity.....	387
Franziska K. B. Freyberger, Berthold Färber	
Inverse Piano Technique: a New Tool to Study Finger Interdependence	395
Mark K. Budgeon, Zong-Ming Li, Mark L. Latash, Vladimir M. Zatsiorsky	
Analysis of Spatially Constrained Reaching Movements in Haptic Environments.....	399
Igor Goncharenko, Mikhail Svinin, Yutaka Kanou, Shigeyuki Hosoe	
Effects of Haptic Feedback on Exploration	407
Mengnan (Mary) Wu, Allison M. Okamura	
Vibrotactile Targeting in Multimodal Systems: Accuracy and Interaction	413
Roger W. Cholewiak, Christopher McGrath	
Effects of Stiffness on Tapping Performance.....	421
Damien Couroussé, Jean-Loup Florens, Annie Luciani	
An Evaluation of Human Sensibility on Perceived Texture under Variation of Vibrotactile Stimuli using a Tactile Display System.....	429
Seung-Chan Kim, Ki-Uk Kyung, Jin-Hun Sohn, Dong-Soo Kwon	
Perceptual Analysis of Haptic Icons: an Investigation into the Validity of Cluster Sorted MDS.....	437
Jerome Pasquero, Joseph Luk, Shannon Little, Karon Maclean	
Towards Effective Information Display Using Vibrotactile Apparent Motion.....	445
Luv Kohli, Masataka Niwa, Haruo Noma, Kenji Susami, Yasuyuki Yanagida, Robert W. Lindeman, Kenichi Hosaka, Yuichiro Kume	
Haptic Attributes and Human Motor Skills	453
Govindarajan Srimathveeravalli, Venkatraghavan Gourishankar, Kesavadas Thenkurussi	

Session 5: Rendering/Modeling

Thermal Model for Hand-Object Interactions.....	461
Hsin-Ni Ho, Lynette A. Jones	
Stochastic and Deterministic Models for Haptic Pseudo-Textures	469
Tuncer C. Aysal, Kenneth E. Barner	
Physics-based s-Adaptive Haptic Simulation for Deformable Object.....	477
Seongki Jun, Jinbok Choi, Maenghyo Cho	
A Virtual Reality Toolkit for Path Planning and Manipulation at Nano-scale	485
Aydin Varol, Ihsan Gunev, Cagatay Basdogan	
Low-Force Kinesthetic Guidance For Accurate Positioning and Tracking	491
Ryo Kikuwe, Takahiro Yamamoto, Hideo Fujimoto	
A Displacement Driven Real-Time Deformable Model For Haptic Surgery Simulation	499
Pei Chen, Kenneth E. Barner, Karl V. Steiner	
Future Haptic Science Encyclopedia: An Experimental Implementation of Networked Multi-Threaded Haptic Virtual Environment	507
M. Osama Alhalabi, Vytautas Daniulaitis, Haruhisa Kawasaki, Mouri Tetsuya, Yoshio Ohtuka	
The Effect of Prediction on Collaborative Haptic Applications	515
A. Boukerche, Shervin Shirmohammadi, Abu Hossein	
Haptic Force Shading Parameter Effects on Path Tracing Accuracy	517
Youngung Shon, Sara McMains	
The Proxy Chain Method and Its Application to Scientific Visualization	525
Milan Ikits, Charles D. Hansen	
Geometric Properties of Contacts Involving a Deformable Object	533
Qi Luo, Jing Xiao	