

Lecture Notes in Computer Science

1679

Edited by G. Goos, J. Hartmanis, and J. van Leeuwen

Springer

Berlin

Heidelberg

New York

Barcelona

Hong Kong

London

Milan

Paris

Singapore

Tokyo

Chris Taylor Alain Colchester (Eds.)

Medical Image Computing and Computer-Assisted Intervention – MICCAI'99

Second International Conference
Cambridge, UK, September 19-22, 1999
Proceedings



Springer

Series Editors

Gerhard Goos, Karlsruhe University, Germany
Juris Hartmanis, Cornell University, NY, USA
Jan van Leeuwen, Utrecht University, The Netherlands

Volume Editors

Chris Taylor
The University of Manchester
Oxford Road, Manchester M13 9PT, UK
E-mail: ctaylor@man.ac.uk

Alain Colchester
University of Kent
Canterbury, Kent CT2 7NT, UK
E-mail: a.colchester@ukc.ac.uk

Cataloging-in-Publication Data applied for

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Medical image computing and computer-assisted intervention : second international conference ; proceedings / MICCAI '99, Cambridge, UK, September 19 - 22, 1999. Chris Taylor ; Alain Colchester (ed.) - Berlin ; Heidelberg ; New York ; Barcelona ; Hong Kong ; London ; Milan ; Paris ; Singapore ; Tokyo : Springer, 1999
(Lecture notes in computer science ; Vol. 1679)
ISBN 3-540-66503-X

CR Subject Classification (1998): I.5, I.3.5-8, I.2.9-10, I.4, J.3

ISSN 0302-9743

ISBN 3-540-66503-X Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1999
Printed in Germany

Typesetting: Camera-ready by author
SPIN: 10704282 06/3142 - 5 4 3 2 1 0 Printed on acid-free paper

Preface

This is the second MICCAI – the flagship international conference for medical image computing and computer-assisted intervention. MICCAI was created by merging three closely related and thriving conference series – VBC (Visualisation in Biomedical Computing), MRCAS (Medical Robotics and Computer Assisted Surgery) and CVRMed (Computer Vision, Virtual Reality and Robotics in Medicine) – to provide a single focus for the presentation of high-quality research in this important multi-disciplinary area. The first MICCAI was held in Boston, USA in October 1998. It attracted a large number of excellent submissions and was extremely well attended. The meeting went a long way towards meeting its ambitious objectives of bringing together the best theoretical and applied work in this rapidly emerging field, and encouraging constructive dialogue between computer scientists and clinicians.

We are delighted to report a similar level of interest in MICCAI'99. A total of 213 full-length papers were submitted, covering a broad range of topics. Of these, 133 were accepted for inclusion in the conference – 49 as oral presentations and 84 as posters. All the selected papers appear in these proceedings. Each paper was reviewed by four members of the Scientific Review Committee, selected for scientific or clinical expertise of relevance to the subject matter. Final decisions were made by the Programme Committee, following closely the advice of the reviewers. We are indebted to the members of the Scientific Review Committee for the time they devoted to the review process and for their well-informed and generally detailed feedback to authors.

The result is another volume of high-quality papers that we hope will contribute to the development of this important and exciting area. We are also indebted to the dedicated team of staff and students at Manchester who helped to put together the proceedings, particularly Angela Castledine, Alan Brett, Mike Rodgers, Danny Allen, Christine Beeston, Karen Davies, Tony Lacey, and Chris Wolstenholme. We were very pleased to welcome delegates to Cambridge and hope that you found MICCAI an enjoyable and stimulating experience. For readers unable to attend the conference, we hope that you will find this a valuable record of the scientific programme, and look forward to meeting you at MICCAI 2000, which will be held in Pittsburgh, USA.

September 1999

Chris Taylor and Alan Colchester

Industrial Liaison

Nicholas Ayache	INRIA Sophia Antipolis, France
Mike Brady	University of Oxford, UK
Bart ter Haar Romeny	University of Utrecht, Netherlands
Jocelyne Troccaz	University of Grenoble, France
Nigel John (Coordinator)	University of Manchester, UK

Local Organising Committee

Richard Prager	University of Cambridge, UK
Andrew Gee	University of Cambridge, UK

Scientific Review Committee

James Anderson	Johns Hopkins School of Medicine, USA
Takehide Asano	Chiba University School of Medicine, Japan
Gerard A Ateshian	Columbia University, USA
Nicholas Ayache	INRIA Sophia Antipolis, France
Isabelle Bloch	Ecole Nationale Supérieure des Télécommunications, France
Fred Bookstein	University of Michigan, USA
Mike Brady	University of Oxford, UK
Richard D Bucholz	St Louis University School of Medicine, USA
Steve Charles	University of Tennessee, USA
Philippe Cinquin	Institut Albert Bonniot, France
Ela Claridge	University of Birmingham, UK
Court Cutting	New York University, USA
Paolo Dario	ARTS Lab, Italy
Brian Davies	Imperial College, UK
Scott Delp	Stanford University, USA
Tony DiGioia	Shadyside Hospital, Pittsburgh, USA
Takeyoshi Dohi	University of Tokyo, Japan
James Scott Duncan	Yale University, USA
Norberto Ezquerra	Universidad Politécnica de Catalunya, Spain
Elliot Fishman	The Johns Hopkins Hospital, USA
J Michael Fitzpatrick	Vanderbilt University, USA
Henry Fuchs	University of North Carolina, USA
Toshio Fukuda	Nagoya University, Japan
Guido Gerig	University of North Carolina, USA
Sarah Gibson	Mitsubishi Electric Research Lab, USA
Eric L Grimson	MIT AI Lab, USA
Blake Hannaford	University of Washington, USA
Dave Hawkes	Guy's Hospital, UK
Derek Hill	Guy's Hospital, UK

VIII Conference Organising Committee

Karl Heinz Hohne	University Hospital Eppendorf, Germany
Koji Ikuta	Nagoya University, Japan
Branislav Jaramaz	UPMC Shadyside, USA
Chris Johnson	University of Utah, USA
Ferenc Jolesz	Brigham and Women's Hospital, USA
Leo Joskowicz	Hebrew University of Jerusalem, Israel
Takeo Kanade	Carnegie Mellon University, USA
Lou Kavoussi	Brady Urological Institute, USA
Peter Kazanzides	Integrated Surgical Systems, USA
Ron Kikinis	Brigham and Women's Hospital, USA
Andres Kriete	University Clinic Giessen, Germany
Stephane Lavallee	PRAXIM, France
Heinz Lemke	Technical University Berlin, Germany
Robert J Maciunas	University of Rochester Medical Center, USA
Gregoire Malandain	INRIA, France
Jean-Francois Mangin	Service Hospitalier Frederic Joliot, France
Maurilio Marcacci	Laboratorio di Biomeccanica, Italy
Dwight Meglan	Mitsubishi Electric, USA
Dimitris Metaxas	University of Pennsylvania, USA
Chuck Meyer	University of Michigan, USA
Brent D Mittelstadt	Integrated Surgical Systems, USA
Heinrich Muller	Universitat Dortmund, Germany
Alison Noble	University of Oxford, UK
Lutz-P Nolte	M.E. Muller Institute, Switzerland
Wieslaw Nowinski	Kent Ridge Digital Labs, Singapore
Michael Peshkin	Northwestern University, USA
Stephen Pizer	University of North Carolina, USA
Rob Playter	Boston Dynamics Inc (BDI), USA
Jerry L Prince	Johns Hopkins University, USA
Klaus Radermacher	Helmholtz-Institut f. Biomedizinische Technik, Germany
Richard Robb	Mayo Clinic, USA
Jean-Marie Rocchisani	Hopital Avicenne, France
Joseph Rosen	Dartmouth-Hitchcock Medical Center, USA
Ichiro Sakuma	University of Tokyo, Japan
Tim Salcudean	University of British Columbia, Canada
Kenneth Salisbury	Intuitive Surgical, Inc, USA
Rick Satava	Yale Laproendoscopic Surgery Center, USA
Achim Schweikard	TU München, Germany
H Siegfried Stiehl	University of Hamburg, Germany
Paul Suetens	KU Leuven, Belgium
Gabor Szekely	Swiss Federal Institute of Technology, Switzer- land
Mark A Talamini	Johns Hopkins University, USA
Russ Taylor	John Hopkins University, USA
Frank Tendick	University of California San Francisco, USA
Demetri Terzopoulos	University of Toronto, Canada

Jean-Philippe Thirion	FOCUS Imaging, France
Andrew Todd-Pokropek	University College London, UK
Jun-Ichiro Toriwaki	Nagoya University, Japan
Jocelyne Troccaz	Laboratoire TIMC, France
Jay Udupa	University of Pennsylvania, USA
Dirk Vandermeulen	University Hospital Gasthuisberg, Belgium
Michael Vannier	University of Iowa, USA
Baba Vemuri	University of Florida, USA
Max A Viergever	Utrecht University, Netherlands
Simon Warfield	Brigham and Women's Hospital, USA
William Wells	Massachusetts Institute of Technology, USA
Tian-ge Zhuang	Shanghai Jiao Tong University, China
James Zinreich	The Johns Hopkins Hospital, USA

MICCAI Conference Series

MICCAI Board

Nicholas Ayache	INRIA Sofia Antipolis, France
Alan Colchester	University of Kent at Canterbury & Guy's Hospital, London, UK
Toni Digiioia	Shadyside Hospital, Pittsburgh, USA
Takeyoshi Dohi	University of Tokyo, Japan
Jim Duncan	Yale University, USA
Eric Grimson	MIT Artificial Intelligence Laboratory, USA
Karl-Heinz Höhne	University of Hamburg, Germany
Ron Kikinis	Brigham and Women's Hospital, Boston, USA
Steve Pizer	University of North Carolina, USA
Richard Robb	Mayo Clinic, USA
Russ Taylor	Johns Hopkins Hospital, Baltimore, USA
Jocelyne Troccaz	University of Grenoble, France

Table of Contents

Data-Driven Segmentation

Segmentation of Meningiomas and Low Grade Gliomas in MRI	1
<i>M. R. Kaus, S. K. Warfield, A. Nabavi, E. Chatzidakis, P. M. Black, F. A. Jolesz and R. Kikinis</i>	
Automated Segmentation of MS Lesions from Multi-channel MR Images . .	11
<i>Koen Van Leemput, Frederik Maes, Fernando Bello, Dirk Vandermeulen, Alan Colchester and Paul Suetens</i>	
Measurement of Infarct Volume in Stroke Patients Using Adaptive Segmentation of Diffusion Weighted MR Images	22
<i>A. L. Martel, S. J. Alder, G. S. Delay, P. S. Morgan and A. R. Moody</i>	
Quantitative Modelling of Microcalcification Detection in Digital Mammography	32
<i>Andreas Rick, Serge Muller, Sylvie Bothorel and Michel Grimaud</i>	
Interactive Direct Volume Rendering of Dural Arteriovenous Fistulae in MR-CISS Data	42
<i>C. Rezk-Salama, P. Hastreiter, K. Eberhardt, B. Tomandl and T. Ertl</i>	
Segmentation of White Matter Lesions from Volumetric MR Images	52
<i>S. A. Hojjatoleslami, F. Kruggel and D. Y. von Cramon</i>	
Fractional Segmentation of White Matter	62
<i>S.K. Warfield, C.-F. Westin, C.R.G. Guttmann, M. Albert, F.A. Jolesz and R. Kikinis</i>	
A Modified Fuzzy C-Means Algorithm for MRI Bias Field Estimation and Adaptive Segmentation	72
<i>M. N. Ahmed, S. M. Yamany, N. A. Mohamed and A. A. Farag</i>	
Statistical 3D Vessel Segmentation Using a Rician Distribution	82
<i>Albert C. S. Chung and J. Alison Noble</i>	
Retinal Blood Vessel Segmentation by Means of Scale-Space Analysis and Region Growing	90
<i>M. Elena Martínez-Pérez, Alun D. Hughes, Alice V. Stanton, Simon A. Thom, Anil A. Bharath and Kim H. Parker</i>	
Liver Blood Vessels Extraction by a 3-D Topological Approach	98
<i>Petr Dokládál, Christophe Lohou, Laurent Perroton and Gilles Bertrand</i>	

Segmentation Using Structural Models

Tamed Snake: A Particle System for Robust Semi-Automatic Segmentation	106
<i>Johannes Hug, Christian Brechbühler, and Gábor Székely</i>	
Interactive Medical Image Segmentation with United Snakes	116
<i>Jianming Liang, Tim McInerney and Demetri Terzopoulos</i>	
Active Shape Model-Based Segmentation of Digital X-ray Images	128
<i>G. Behiels, D. Vandermeulen, F. Maes, P. Suetens and P. Dewaele</i>	
Nonrigid 3-D/2-D Registration of Images Using Statistical Models	138
<i>M. Fleute and S. Lavallée</i>	
A New Approach to 3D Sulcal Ribbon Finding from MR Images	148
<i>X. Zeng, L.H. Staib, R.T. Schultz, H. Tagare, L. Win and J.S. Duncan</i>	
Automated Segmentation of Sulcal Regions.	158
<i>Maryam E. Rettmann, Chenyang Xu, Dzung Pham, and Jerry L. Prince</i>	
Cylindrical Echocardiographic Image Segmentation Based on 3D Deformable Models	168
<i>J. Montagnat, H. Delingette and G. Malandain</i>	
Active Model Based Carotid Ultrasonic Data Segmentation	176
<i>A. Moreau-Gaudry, P. Cinquin and J.-P. Baguet</i>	
Automatic Segmentation of Lung Fields in Chest Radiographs	184
<i>Bram van Ginneken and Bart M. ter Haar Romeny</i>	
Automatic Reconstruction of 3D Geometry Using Projections and a Geometric Prior Model	192
<i>J. Lötjönen, I. E. Magnin, L. Reinhardt, J. Nenonen and T. Katila</i>	
3D Image Matching Using a Finite Element Based Elastic Deformation Model	202
<i>M. Ferrant, S.K. Warfield, C.R.G. Guttmann, R.V. Mulkern, F.A. Jolesz, and R. Kikinis</i>	

Image Processing and Feature Detection

Quantitative Comparison of Sinc-Approximating Kernels for Medical Image Interpolation	210
<i>E. H. W. Meijering, W. J. Niessen, J. P. W. Pluim and M. A. Viergever</i>	
A Post-Processing Technique to Suppress Fluid Signal and Increase Contrast in Multispectral MR Exams of MS Patients	218
<i>J. R. Mitchell, P. Gareau, S. Karlik and B. Rutt</i>	

De-noising h_{int} Surfaces: a Physics-based Approach	227
<i>M. Yam, R. Highnam and M. Brady</i>	
ERS Transform for the Detection of Bronchi on CT of the Lungs	235
<i>F. Chabat, D. M. Hansell and G.-Z. Yang</i>	
Detection of Pulmonary Nodules on CT and Volumetric Assessment of Change over Time	245
<i>Margrit Betke and Jane P. Ko</i>	
Improving the Detection Performance in Semi-automatic Landmark Extraction	253
<i>S. Frantz, K. Rohr, and H.S. Stiehl</i>	
Automatic Classification of Linear Structures in Mammographic Images . .	263
<i>R. Zwiggelaar, C. J. Taylor and C. R. M. Boggis</i>	
Surfaces and Shape	
Conformal Geometry and Brain Flattening	271
<i>S. Angenent, S. Haker, A. Tannenbaum and R. Kikinis</i>	
Quasi-Conformally Flat Mapping the Human Cerebellum	279
<i>M. K. Hurdal, P. L. Bowers, K. Stephenson, D. W. L. Sumners, K. Rehm, K. Schaper and D. A. Rottenberg</i>	
Rendering the Unfolded Cerebral Cortex	287
<i>Junfeng Guo, Alexandru Salomie, Rudi Deklerck and Jan Cornelis</i>	
Tessellated Surface Reconstruction from 2D Contours	297
<i>C. F. Chan, C. K. Kwok, M. Y. Teo and W. S. Ng</i>	
Accurate Robust Symmetry Estimation	308
<i>Stephen Smith and Mark Jenkinson</i>	
Global Shape from Shading for an Endoscope Image	318
<i>S.Y. Yeung, H.T. Tsui and A. Yim</i>	
Measurement and Interpretation	
The Measurement of Focal Diurnal Variation in the Femoral Articular Cartilage of the Knee	328
<i>A. D. Brett, J. C. Waterton, S. Solloway, J. E. Foster, M. C. Keen, S. Gandy, B. J. Middleton, R. A. Maciewicz, I. Watt, P. A. Dieppe and C. J. Taylor</i>	
Three-Dimensional Reconstruction and Quantification of Hip Joint Cartilages from Magnetic Resonance Images	338
<i>Y. Sato, T. Kubota, K. Nakanishi, H. Tanaka, N. Sugano, T. Nishii, K. Ohzono, H. Nakamura, T. Ochi, and S. Tamura</i>	

Quantification of Cerebral Grey and White Matter Asymmetry from MRI . 348
F. Maes, K. Van Leemput, L. E. DeLisi, Dirk Vandermeulen and Paul Suetens

Quantitation of Vessel Morphology from 3D MRA 358
A.F. Frangi, W. J. Niessen, R. M. Hoogeveen, Th. van Walsum and M. A. Viergever

A Patient-Specific Computer Model for Prediction of Clinical Outcomes in the Cerebral Circulation Using MR Flow Measurements 368
M. E. Clark, M. Zhao, F. Loth, N. Alperin, L. Sadler, K. Guppy and F. T. Charbel

Exploratory Factor Analysis in Morphometry 378
A. M. C. Machado, J. C. Gee and M. F. M. Campos

Potential Usefulness of Curvature Based Description for Differential Diagnosis of Pulmonary Nodules 386
Y. Kawata, N. Niki, H. Ohmatsu, M.Kusumoto, R.Kakinuma, K.Mori, K.Eguchi, M. Kaneko and N. Moriyama

Pulmonary Organs Analysis Method and Its Evaluation Based on Thoracic Thin-section CT Images 394
T. Tozaki, A. Tanaka, Y. Kawata, N. Niki, H. Ohmatsu, R. Kakinuma, K. Eguchi, M. Kaneko and N. Moriyama

An Automatic Approach for 3-D Facial Shape Change Analysis by Combination of ASM and Morphometric Tools 402
Z. Mao and A. J. Naftel

Spatiotemporal and Diffusion Tensor Analysis

Segmentation of Echocardiographic Image Sequences Using Spatio-temporal Information 410
Einar Brandt, Lars Wigström and Bengt Wranne

3D Cardiac Deformation from Ultrasound Images 420
Xenophon Papademetris, Albert J. Sinusas, Donald P. Dione and James S. Duncan

Directional Representations of 4D Echocardiography for Temporal Quantifications of LV Volume 430
E. Angelini, A. Laine, S. Takuma and S. Homma

Image Processing for Diffusion Tensor Magnetic Resonance Imaging 441
C.-F. Westin, S.E. Maier, B. Khidhir, P. Everett, F.A. Jolesz, and R. Kikinis

Inferring the Brain Connectivity from MR Diffusion Tensor Data	453
<i>C. Poupon, C.A. Clark, V. Frouin, D. LeBihan, I. Bloch and J.-F. Mangin</i>	
Strategies for Data Reorientation During Non-Rigid Warps of Diffusion Tensor Images	463
<i>D. C. Alexander, J. C. Gee and R. Bajcsy</i>	
Analysis of Functional MRI Data Using Mutual Information	473
<i>A. Tsai, J.W. Fisher, C. Wible, W.M. Wells, J. Kim and A.S. Willsky</i>	
Statistical Segmentation of fMRI Activations Using Contextual Clustering	481
<i>E. Salli, A. Visa, H. J. Aronen, A. Korvenoja and T. Katila</i>	
Using Sulcal Basins for Analyzing Functional Activations Patterns in the Human Brain	489
<i>G. Lohmann and D.Y. von Cramon</i>	
Comparison of Land-Mark-Based and Curve-Based Thin-Plate Warps for Analysis of Left-Ventricular Motion from Tagged MRI	498
<i>A. A. Amini, Y. Chen, and D. Abendschein</i>	
Contour Tracking in Echocardiographic Sequences without Learning Stage: Application to the 3D Reconstruction of the Beating Left Ventricle	508
<i>M.-O. Berger, G. Winterfeldt and J.-P. Lethor</i>	
Segmentation of Echocardiographic Data. Multiresolution 2D and 3D Algorithm Based on Grey Level Statistics	516
<i>D. Boukerroui, O. Basset, A. Baskurt and A. Noble</i>	
Registration and Fusion	
Locating Motion Artifacts in Parametric fMRI Analysis	524
<i>A.J.Lacey, N.A.Thacker, E. Burton, and A.Jackson</i>	
Non-rigid Registration by Geometry-Constrained Diffusion	533
<i>Per Rønsholt Andresen and Mads Nielsen</i>	
Wavelet Compression of Active Appearance Models	544
<i>C. B. H. Wolstenholme and C. J. Taylor</i>	
Towards a Better Comprehension of Similarity Measures Used in Medical Image Registration	555
<i>A. Roche, G. Malandain, N. Ayache and S. Prima</i>	
Entropy-Based, Multiple-Portal-to-3DCT Registration for Prostate Radiotherapy Using Iteratively Estimated Segmentation	567
<i>R. Bansal, L. H. Staib, Z. Chen, A. Rangarajan, J. Knisely, R. Nath and J. S. Duncan</i>	

Registration of Video Images to Tomographic Images by Optimising Mutual Information Using Texture Mapping 579
M. J. Clarkson, D. Rueckert, A. P. King, P. J. Edwards, D. L. G. Hill and D. J. Hawkes

Brain Atlas Deformation in the Presence of Large Space-Occupying Tumors 589
B. M. Dawant, S. L. Hartmann and S. Gadamsetty

Understanding the “Demon’s Algorithm”: 3D Non-Rigid Registration by Gradient Descent 597
Xavier Pennec, Pascal Cachier and Nicholas Ayache

Multi-variate Mutual Information for Registration 606
J. L. Boes and C. R. Meyer

Automatic Identification of a Particular Vertebra in the Spinal Column Using Surface-Based Registration 613
J. L. Herring and B. M. Dawant

3-D Deformable Registration of Medical Images Using a Statistical Atlas . . 621
M. Chen, T. Kanade, D. Pomerleau and J. Schneider

Probabilistic Brain Atlas Construction: Thin-Plate Spline Warping via Maximization of Mutual Information 631
C. R. Meyer, J. L. Boes, B. Kim and P. H. Bland

Out-of-Plane Non-linear Warping of a Slice into Volume 638
B. Kim, J. L. Boes, P.H. Bland and C. R. Meyer

Tree Representation and Implicit Tree Matching for a Coarse to Fine Image Matching Algorithm 646
J. Mattes and J. Demongeot

Gray-Value Based Registration of CT and MR Images by Maximization of Local Correlation 656
J. Weese, P. Rösch, T. Netsch, T. Blaffert and M. Quist

Fully Automatic 3D/2D Subtracted Angiography Registration 664
E. Kerrien, M.-O. Berger, E. Maurincomme, L. Launay, R. Vaillant and L. Picard

Multi-modal Medical Volumes Fusion by Surface Matching 672
A. M. Eldeib, S. M. Yamany and A. A. Farag

Medical Image Registration with Robust Multigrid Techniques 680
Pierre Hellier, Christian Barillot, Etienne Mémin and Patrick Pérez

Camera-Augmented Mobile C-arm (CAMC) Application: 3D Reconstruction Using a Low-Cost Mobile C-arm 688
N. Navab, M. Mitschke and O. Schütz

Image Analysis of Nailfold Capillary Patterns from Video Sequences	698
<i>P.D. Allen, C.J. Taylor, A. L. Herrick and T. Moore</i>	

Visualisation

Modeling Spectral Changes to Visualize Embedded Volume Structures for Medical Image Data	706
<i>H.J. Noordmans, H.T.M. van der Voort and M.A. Viergever</i>	
Non-Planar Reslicing for Freehand 3D Ultrasound	716
<i>A. Gee, R. Prager and L. Berman</i>	
The Perception of Transparency in Medical Images	726
<i>Reza Kasrai, Frederick A. A. Kingdom and Terry M. Peters</i>	
Localisation of Subdural EEG Electrode Bundles in an Interactive Volume Rendering Framework	734
<i>H. J. Noordmans, C. W. M. van Veelen and M. A. Viergever</i>	
System of Modeling and Visualization of Domain of the Heart Excitation .	742
<i>D. I. Belov</i>	
A 3d Puzzle for Learning Anatomy	750
<i>Bernhard Preim, Felix Ritter and Oliver Deussen</i>	

Image-Guided Intervention

3D Functional Database of Subcortical Structures for Surgical Guidance in Image Guided Stereotactic Neurosurgery	758
<i>K.W. Finnis, Y.P. Starreveld, A.G. Parrent, A.F. Sadikot and T.M. Peters</i>	
Automated Registration of Ultrasound with <i>CT</i> Images: Application to Computer Assisted Prostate Radiotherapy and Orthopedics	768
<i>G. Ionescu, S. Lavallée and J. Demongeot</i>	
A Robust 3-D Reconstruction System for Human Jaw Modeling	778
<i>S. M. Yamany, A. A. Farag, D. Tasman and A. G. Farman</i>	
Level-Set Surface Segmentation and Fast Cortical Range Image Tracking for Computing Intrasurgical Deformations	788
<i>M.A. Audette, K. Siddiqi, and T.M. Peters</i>	
A Single Image Registration Method for <i>CT</i> Guided Interventions	798
<i>R. C. Susil, J. H. Anderson and R. H. Taylor</i>	
An Integrated Visualization System for Surgical Planning and Guidance Using Image Fusion and Interventional Imaging	809
<i>David T. Gering, Arya Nabavi, Ron Kikinis, W. Eric L. Grimson, Noby Hata, Peter Everett, Ferenc Jolesz and William M. Wells</i>	

Exploiting 2-D to 3-D Intra-Operative Image Registration for Qualitative Evaluations and Post-Operative Simulations 820
André Guézic, Kenong Wu, Bill Williamson, Peter Kazanzides, Robert Van Vorhis, and Alan Kalvin

LOCALITE - a Frameless Neuronavigation System for Interventional Magnetic Resonance Imaging Systems 832
K. Kansy, P. Wisskirchen, U. Behrens, T. Berlage, G. Grunst, M. Jahnke, R. Ratering, H.-J. Schwarzmaier and F. Ulrich

Design and Evaluation of a System for Microscope-Assisted Guided Interventions (MAGI) 842
Philip J. Edwards, Andrew P. King, Calvin R. Maurer, Jr., Darryl A. de Cunha, David J. Hawkes, Derek L. G. Hill, Ron P. Gaston, Michael R. Fenlon, Subhash Chandra, Anthony J. Strong, Christopher L. Chandler, Aurelia Richards and Michael J. Gleeson

Percutaneous Posterior Stabilization of the Spine 852
N. Glossop, R. Hu, D. Young, G. Dix and S. DuPlessis

Image-based Planning and Validation of C1-C2 Transarticular Screw Fixation Using Personalized Drill Guides 860
K. Martens, K. Verstreken, J. Van Cleynenbreugel, K. Van Brussel, J. Goffin, G. Marchal and P. Suetens

POP: Preoperative Planning and Simulation Software for Total Hip Replacement Surgery 868
C. Nikou, B. Jaramaz, A. M. DiGioia III, M. Blackwell, M. E. Romesberg, and M. M. Green

CupAlign: Computer-Assisted Postoperative Radiographic Measurement of Acetabular Components Following Total Hip Arthroplasty 876
B. Jaramaz, C. Nikou, T. J. Levison, A. M. DiGioia III, and R. S. LaBarca

Computer - Aided Implant Dentistry — An Early Report — 883
W. Birkfellner, P. Solar, A. Gahleitner, K. Huber, F. Kainberger, J. Kettenbach, P. Homolka, M. Diemling, G. Watzek, and H. Bergmann

Surface Registration for Use in Interactive Image-Guided Liver Surgery . . . 892
A. J. Herline, J. L. Herring, J. D. Stefansic, W. C. Chapman, R. L. Galloway and B. M. Dawant

Model-Updated Image-Guided Neurosurgery Using the Finite Element Method: Incorporation of the Falx Cerebri 900
M. I. Miga, K. D. Paulsen, F. E. Kennedy, A. Hartov and D. W. Roberts

Assessment of Intraoperative Brain Deformation Using Interventional MR Imaging	910
<i>D. L. G. Hill, C. R. Maurer, Jr., A. J. Martin, S. Sabanathan, W. A. Hall, D. J. Hawkes, D. Rueckert and C. L. Truwit</i>	
Ultrasound Probe Tracking for Real-Time Ultrasound/MRI Overlay and Visualization of Brain Shift	920
<i>David G. Gobbi, Roch M. Comeau and Terry M. Peters</i>	
A Volumetric Optical Flow Method for Measurement of Brain Deformation from Intraoperative Magnetic Resonance Images	928
<i>N. Hata, A. Nabavi, S. Warfield, W. Wells, R. Kikinis and F.A. Jolesz</i>	
Spotlights: A Robust Method for Surface-Based Registration in Orthopedic Surgery	936
<i>B. Ma, R. E. Ellis, and D. J. Fleet</i>	
Automated Registration and Fusion of Functional and Anatomical MRI for Navigated Neurosurgery	945
<i>T. Rohlfing, J. Beier, J. B. West, U.-W. Thomale, T. Liebig and C. A. Taschner</i>	
AcouStick: A Tracked A-Mode Ultrasonography System for Registration in Image-Guided Surgery	953
<i>C. R. Maurer, Jr., R. P. Gaston, D. L. G. Hill, M. J. Gleeson, M. G. Taylor, M. R. Fenlon, P. J. Edwards, and D. J. Hawkes</i>	
Synthetic Image Modalities Generated from Matched CT and MRI Data: A New Approach for Using MRI in Brachytherapy	963
<i>R. Krempien, H. A. Grabowski, W. Harms, F. W. Hensley, S. Hassfeld, U. Mende, M. Treiber and M. Wannemacher</i>	
3D Interventional Imaging with 2D X-Ray Detectors	973
<i>L. Desbat, G. Champeboux, M. Fleute, P. Komarek, C. Mennessier, B. Monteil, T. Rodet, P. Bessou, M.Coulomb and G.Ferretti</i>	
Reconstruction of 3D Catheter Paths from 2D X-ray Projections	981
<i>H.-J. Bender, R. Manner, C. Poliwoda, S. Roth and M. Walz</i>	
Automatic Extraction of Implanted Electrode Grids	990
<i>Oskar M. Škrinjar and James S. Duncan</i>	
The Potential Use of an Autostereoscopic 3D Display in Microsurgery	998
<i>P. Chios, A. C. Tan, A. D. Linney, G. H. Alusi, A. Wright, D. Ezra and G. J. Woodgate</i>	

Robotic Systems

A Progressive Cut Refinement Scheme for Revision Total Hip Replacement Surgery Using C-arm Fluoroscopy	1010
<i>J. Yao, R. H. Taylor, R. P. Goldberg, R. Kumar, A. Bzostek, R. Van Vorhis, P. Kazanzides, A. Gueziec and J. Funda</i>	
MR Compatibility of Mechatronic Devices: Design Criteria	1020
<i>K. Chinzei, R. Kikinis, and F.A. Jolesz</i>	
A Steady-Hand Robotic System for Microsurgical Augmentation	1031
<i>R. Taylor, P. Jensen, L. Whitcomb, A. Barnes, R. Kumar, D. Stoianovici, P. Gupta, Z. X. Wang, E. deJuan and L. Kavoussi</i>	
Optimising Operation Process for Computer Integrated Prostatectomy . .	1042
<i>Q. Mei, S. J. Harris, R. D. Hibberd, J. E. A. Wickham and B. L. Davies</i>	
A Passive Positioning and Supporting Device for Surgical Robots and Instrumentation	1052
<i>A. Grey Lerner, D. Stoianovici, L. L. Whitcomb and L. R. Kavoussi</i>	
Robot-assisted Diagnostic Ultrasound - Design and Feasibility Experiments.	1062
<i>S.E. Salcudean, G. Bell, S. Bachmann, W.H. Zhu, P. Abolmaesumi and P.D. Lawrence</i>	
Accuracy and Repeatability of Joint Centre Location in Computer-Assisted Knee Surgery	1072
<i>K. B. Inkpen and A. J. Hodgson</i>	
Microscale Tracking of Surgical Instrument Motion	1080
<i>C. N. Riviere and P. K. Khosla</i>	
On the Feasibility of a Moving Support for Surgery on the Beating Heart	1088
<i>A. L. Trejos, S. E. Salcudean, F. Sassani and S. Lichtenstein</i>	
A Testbed System for Robotically Assisted Percutaneous Pattern Therapy	1098
<i>A. Bzostek, A. C. Barnes, R. Kumar, J. H. Anderson and R. H. Taylor</i>	
Performance of Robotic Augmentation in Microsurgery-Scale Motions . . .	1108
<i>R. Kumar, T. M. Goradia, A. C. Barnes, P. Jensen, L. L. Whitcomb, D. Stoianovici, L. M. Auer and R. H. Taylor</i>	
Intra-operative Application of a Robotic Knee Surgery System	1116
<i>S.J.Harris, M.Jakopec, J.Cobb and B.L.Davies</i>	
Image-Based Control of Interactive Robotics Systems	1125
<i>A. Hein and T.C. Lueth</i>	

Biomechanics and Simulation

Extracting Features from Tactile Maps	1133
<i>P. S. Wellman and R. D. Howe</i>	
Finite Element Model of a Fetal Skull Subjected to Labour Forces	1143
<i>R. J. Lapeer and R. W. Prager</i>	
Modeling the Dynamics of a Human Liver for a Minimally Invasive Surgery Simulator	1156
<i>F. Boux de Casson and C. Laugier</i>	
EyeSi – A Simulator for Intra-ocular Surgery	1166
<i>M. A. Schill, C. Wagner, M. Hennen, H.-J. Bender and R. Männer</i>	
The Mesh-matching Algorithm : A New Automatic 3D Mesh Generator for Finite Element Analysis	1175
<i>Béatrice Couteau, Yohan Payan, Stéphane Lavallée and Marie-Christine Hobatho</i>	
Optimization Approaches for Soft–Tissue Prediction in Craniofacial Surgery Simulation	1183
<i>M. Teschner, S. Girod and B. Girod</i>	
Modeling the Dynamics of the Human Thigh for a Realistic Echographic Simulator with Force Feedback	1191
<i>D. d’Aulignac, M. C. Cavusoglu and C. Laugier</i>	
Visualization for Planning and Simulation of Minimally Invasive Neurosurgical Procedures	1199
<i>L. M. Auer, A. Radetzky, C. Wimmer, G. Kleinszig, F. Schroecker, D. P. Auer, H. Delingette, B. Davies and D. P. Pretschner</i>	
A Simulation Environment for Maxillofacial Surgery Including Soft Tissue Implications	1210
<i>F. Schutyser, J. Van Cleynenbreugel, J. Schoenaers, G. Marchal and P. Suetens</i>	
Surgical Forces and Tactile Perception During Retinal Microsurgery	1218
<i>P. K. Gupta, P. S. Jensen and E. de Juan</i>	
A Novel Technique for Simulating Transcranial Doppler Examinations <i>In Vitro</i>	1226
<i>R. Hart, P. D. Hart and S. Bunt</i>	
Author Index	1235