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# Information Processing in Medical Imaging

23rd International Conference, IPMI 2013  
Asilomar, CA, USA, June 28–July 3, 2013  
Proceedings



Springer

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James C. Gee

Kilian M. Pohl

University of Pennsylvania, Department of Radiology, Philadelphia, PA, USA

E-mail: gee@mail.med.upenn.edu; pohl.kilian@gmail.com

Sarang Joshi

University of Utah, Department of Bioengineering, Salt Lake City, UT, USA

E-mail: sjoshi@sci.utah.edu

William M. Wells

Harvard Medical School and Brigham and Women's Hospital

Department of Radiology, Boston, MA, USA

E-mail: sw@bwh.harvard.edu

Lilla Zöllei

Harvard Medical School and Massachusetts General Hospital

A.A. Martinos Center for Biomedical Imaging, Charlestown, MA, USA

E-mail: lzollei@nmr.mgh.harvard.edu

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# Preface

The 23rd International Conference on Information Processing in Medical Imaging (IPMI) was held June 28–July 3, 2013, at the Asilomar Conference Grounds near Pacific Grove, California, USA. The conference was the latest in a series of biennial scientific meetings, the last being held in July of 2011 at the Kloster Irsee in Bavaria, Germany, during which new developments in the acquisition, analysis, and use of medical images were presented. IPMI is one of the longest running conferences devoted to these topics in medical imaging. The first IPMI conference was held in 1969, when a group of young scientists working in nuclear medicine gathered to discuss the current problems in their field. Since that time the conference has expanded into other medical imaging acquisition modalities, including ultrasound, optics, magnetic resonance, and x-ray imaging techniques. IPMI is now widely recognized as one of the most exciting and influential meetings in medical imaging, with a unique emphasis on active participation from all attendees and a strong commitment to vigorous discussion and open debate.

A wide variety of topics are covered at IPMI meetings, all within a single-track format. This year 199 full-length manuscripts were submitted to the conference. Of these, 26 papers were selected for oral presentation and 38 were accepted as posters. Submissions were carefully reviewed by at least three members of the Scientific Review Committee, who evaluated the novelty, methodological development, and scientific rigor of each manuscript. The Paper Selection Committee, along with the Co-chairs, took on the difficult task of creating a meeting program. Using the rankings and detailed comments of the reviewers of each manuscript, and adding to that their own judgment of the merits of each manuscript, they designed the meeting program represented in this volume. The many high-quality manuscripts submitted for consideration made the selection process extremely difficult, and many excellent papers did not make it into the final program. This is an unfortunate inevitability of the high selectivity for which IPMI is known.

A key goal of IPMI is to encourage active participation of the most talented and promising young investigators in the field in an environment that also fosters in-depth interactions with senior researchers. To achieve this goal, all IPMI participants were involved in small study groups where they prepared for the upcoming conference presentations. After reading their assigned papers, graduate students, post-docs, and young faculty members discussed their understanding of related work in the field with senior investigators and together formulated both clarifying and probing questions for the oral presenters. The study groups thus led off the discussion of each paper, ensuring a lively and vigorous dialog. Further emphasis on the young researcher was made through the competition for the prestigious Erbsmann award. The Francois Erbsmann Prize is awarded for the best contribution by a young scientist who is the first author of a paper

and a first-time IPMI oral presenter. This year 23 of the 26 oral presenters were eligible for the Erbsmann Prize.

IPMI 2013 featured a keynote talk about the current frontiers of neuroimaging by Dr. Bruce Rosen, M.D., Ph.D., Professor in Radiology at Harvard Medical School and Director of the Athinoula A. Martinos Center for Biomedical Imaging. Dr. Rosen is the recipient of numerous awards in recognition of his contributions to the field of functional MRI, including, most recently, the 2011 Outstanding Researcher award from the Radiological Society of North America (RSNA), and the Rigshospitalet's International KFJ Prize from the University of Copenhagen/Rigshospitalet. Dr. Rosen is a Fellow and Gold Medal winner for his contributions to the field of Functional MRI from the International Society for Magnetic Resonance in Medicine, a Fellow of the American Institute for Medical and Biological Engineering, and a member of the Institute of Medicine of the National Academies.

The IPMI 2013 conference featured the traditions that past IPMI attendees have come to expect as part of the unique character of the meeting. Most importantly, each oral presentation was allowed unlimited time for discussion to give the audience the opportunity to resolve all questions regarding the methods and results. IPMI discussions can go on for hours, involving virtually every attendee in the room! Session Chairs play a key role at IPMI as they strive to ensure that these extended discussions are productive and continuing to add to the group's understanding of the nature and significance of each presentation's original contribution.

IPMI is traditionally held in a small and sometimes remote location. This year's venue, the Asilomar State Beach and Conference Grounds, is a breathtaking 107 acres of ecologically diverse beachfront land that is situated within the quaint and scenic town of Pacific Grove, CA, USA.

Attendees were housed in rustic accommodations and enjoyed communal meals in a common dining hall, as well as late-night conversations at the reception, conference banquet, bonfire events, and nearby watering holes. On Tuesday afternoon, the traditional IPMI soccer match was held, pitting the American team against "the rest of the world." As you may have heard, at the last IPMI, the American team ended a prolonged losing streak, which significantly ups the ante on this long-running rivalry. At the time of this writing the outcome of the latest match is uncertain.

These proceedings contain the IPMI 2013 papers in the order they were presented at the meeting. We hope that this volume serves as a valuable source of information for the participants, as well as a reminder of the great conference experience that we had. For those who were not able to attend the conference, we hope that these proceedings provide you with an excellent summary of the latest research contributions to the medical imaging field. We look forward to

the next IPMI conference, which is currently planned for 2015 on the Isle of Skye, Scotland, UK. More information will be posted on [www.ipmi-conference.org](http://www.ipmi-conference.org) as it becomes available.

July 2013

William M. Wells  
Sarang Joshi  
Kilian M. Pohl

# Acknowledgments

The organization of the 23rd IPMI conference was only possible through the efforts and contributions of several organizations and many individuals. First of all, the IPMI 2013 Co-chairs would like to thank the members of the Scientific Review Committee for providing so many high-quality reviews within a very limited time frame; because of these reviews, we were able to make a fair selection of the best papers for the final program. We also express our gratitude to the Paper Selection Committee members, who each read many papers and their reviews and traveled to Salt Lake City for a marathon organizational meeting that resulted in an outstanding final program. We also thank previous IPMI organizers, particularly James Duncan, Jerry Prince, Horst Hahn, Stephen Pizer, and Gábor Székely, for sharing their experiences and insights with us.

We thank Trey Campbell at Brigham and Women's Hospital for his invaluable assistance in the preparation of our R13 proposal to the NIH. For expert help with our IPMI website, we are grateful to Bilwaj Gaonkar. We thank as well Jeffrey Duda and Benjamin Kandel for their essential help in preparing this proceedings volume. Thanks also to Microsoft Corporation for assistance with their excellent CMT conference management system, which we used for the automation of submissions and review of manuscripts. We also thank Jerry Prince for providing the template for this front matter.

Finally, we are grateful to the following organizations for their generous financial support:

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National Institute of Biomedical Imaging and Bioengineering (NIBIB) <sup>1</sup>



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## Francois Erbsmann Prizewinners

1987 (Utrecht, the Netherlands): **John M. Gauch**, University of North Carolina, Chapel Hill, NC, USA.

*J.M. Gauch, W.R. Oliver, S.M. Pizer: Multiresolution shape descriptions and their applications in medical imaging.*

1989 (Berkeley, CA, USA): **Arthur F. Gmitro**, University of Arizona, Tucson, AZ, USA.

*A.F. Gmitro, V. Tresp, V. Chen, Y. Snell, G.R. Gindi: Video-rate reconstruction of CT and MR images.*

1991 (Wye, Kent, UK): **H. Isil Bozma**, Yale University, New Haven, CT, USA.

*H.I. Bozma, J.S. Duncan: Model-based recognition of multiple deformable objects using a game-theoretic framework.*

1993 (Flagstaff, AZ, USA): **Jeffrey A. Fessler**, University of Michigan, Ann Arbor, MI, USA.

*J.A. Fessler: Tomographic reconstruction using information-weighted spline smoothing.*

1995 (Brest, France): **Maurits K. Konings**, University Hospital, Utrecht, The Netherlands.

*M.K. Konings, W.P.T.M. Mali, M.A. Viergever: Design of a robust strategy to measure intravascular electrical impedance.*

1997 (Poultney, VT, USA): **David Atkinson**, Guys Hospital, London, UK.

*D. Atkinson, D.L.G. Hill, P.N.R. Stoye, P.E. Summers, S.F. Keevil: An autofocus algorithm for the automatic correction of motion artifacts in MR images.*

1999 (Visegrad, Hungary): **Liana M. Lorigo**, Massachusetts Institute of Technology, Cambridge, MA, USA.

*L.M. Lorigo, O. Faugeras, W.E.L. Grimson, R. Keriven, R. Kikinis, C.-F. Westin: Co-dimension 2 geodesic active contours for MRA segmentation.*

2001 (Davis, CA, USA): **Viktor K. Jirsa**, Florida Atlantic University, FL, USA.

*V.K. Jirsa, K.J. Jantzen, A. Fuchs, J.A. Scott Kelso: Neural field dynamics on the folded three-dimensional cortical sheet and its forward EEG and MEG.*



2003 (Ambleside, UK): **Guillaume Marrelec**, INSERM, France.

*G. Marrelec, P. Ciuciu, M. Péligrini-Issac, H. Benali: Estimation of the hemodynamic response function in event-related functional MRI: Directed acyclic graphs for a general Bayesian inference framework.*

2005 (Glenwood Springs, Colorado, USA) **Duygu Tosun**, Johns Hopkins University, Baltimore, USA.

*D. Tosun, J.L. Prince: Cortical surface alignment using geometry driven multi-spectral optical flow.*

2007 (Kerkrade, The Netherlands) **Ben Glocker**, Technische Universität München, Garching, Germany.

*B. Glocker, N. Komodakis, N. Paragios, G. Tziritas, N. Navab: Inter- and intra-modal deformable registration: Continuous deformations meet efficient optimal linear programming.*

2009 (Williamsburg, Virginia, USA): **Maxime Descoteaux**, NeuroSpin, IFR 49 CEA Saclay, France.

*M. Descoteaux, R. Deriche, D. Le Bihan, J.-F. Mangin, C. Poupon: Diffusion propagator imaging: Using Laplace's equation and multiple shell acquisitions to reconstruct the diffusion propagator.*

2011 (Kloster Irsee, Germany): **Hubert Fonteijn**, University College London, UK.

*H. Fonteijn, M. Clarkson, M. Modat, J. Barnes, M. Lehmann, S. Ourselin, N. Fox, D. Alexander: An event-based disease progression model and its application to familial Alzheimer's disease.*

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