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Image Processing

Josien P. W. Pluim
Benoit M. Dawant

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Session Chairs

1 Segmentation I
   Cristian Lorenz, Philips Research Laboratories (Germany)

2 Statistical Models
   Martin A. Styner, The University of North Carolina at Chapel Hill (United States)

3 Statistical Methods
   Mads Nielsen, University of Copenhagen (Denmark) and Nordic Bioscience A/S (Denmark)

4 Registration I
   Bernd Fischer, Universität zu Lübeck (Germany)

5 Registration II
   Daniel Rueckert, Imperial College London (United Kingdom)

6 Motion Analysis
   Bram van Ginneken, Universitair Medisch Centrum Utrecht (Netherlands)

7 Vascular Image Processing
   Kyongtae Ty Bae, University of Pittsburgh (United States)

8 Atlas-based Methods
   Sébastien Ourselin, Center for Medical Imaging Computing, University College London (United Kingdom)

9 Keynote and Diffusion Tensor Imaging
   Josien P. W. Pluim, Universitair Medisch Centrum Utrecht (Netherlands)
   Benoit M. Dawant, Vanderbilt University (United States)
   James C. Gee, University of Pennsylvania (United States)

10 Registration III
    Murray H. Loew, The George Washington University (United States)

11 Segmentation II
    Vincent A. Magnotta, The University of Iowa (United States)
Introduction

The 2009 SPIE Medical Imaging conference was held at “a magical place”: Disney’s Coronado Springs Resort in Florida. The symposium ran February 7–12, with the Image Processing conference spanning February 8–10. Despite the temptations of the Disney parks and the glorious Florida weather, the quality of the conference program lured the attendees indoors. A total of 274 abstracts were submitted to the Image Processing conference, a small increase over last year. Based on the reviews of our program committee, we selected 59 abstracts for oral presentation and 127 for poster presentation. This puts the acceptance rate this year at 68%.

The conference program contained several special highlights. Sunday evening saw the traditional workshop. This year’s topic was “Image Processing Challenges in Small Animal Imaging.” The workshop organization was in the hands of Dr. Boudewijn Lelieveldt of Leiden University Medical Center (The Netherlands). Together with Drs. David Wilson of Case Western Reserve University and Baowei Fei of Emory University School of Medicine, Dr. Lelieveldt facilitated a broad and informative workshop on the many image processing tasks required for small animal imaging and the corresponding specific difficulties in comparison to human imaging.

The Monday program ended with the poster session. The spacious poster hall offered ample opportunity for discussion of results with the authors, all while enjoying a drink and empanadas. A tie was presented to the two Cum Laude Student Poster Award winners. Their two papers, as well as the Honorable Mention award papers, are marked in these proceedings. The Michael B. Merickel Best Student Paper Award went to an author from the Image Processing conference: Robert J. Toth of Rutgers University.

Tuesday saw the excellent keynote speech by Dr. Peter Basser of the National Institute of Child Health and Human Development, NIH. His presentation, entitled “Frontiers in Diffusion Imaging,” covered the topic of diffusion imaging from the basic principles of imaging to the most recent advances and future expectations in the field.

Before concluding, we would like to express our gratitude to the people we have relied on to put together the Image Processing 2009 conference. We are grateful to our program committee members, who reviewed the submissions, chaired the sessions, judged the posters, and advise us on how to improve and innovate for future conferences. We would also like to thank the staff at SPIE for their efforts throughout the year in organizing the Medical Imaging symposium.

Josien P. W. Pluim
Benoit M. Dawant
In Memoriam

Robert F. Wagner
1938–2008

A founding scientist and prolific contributor
to modern medical imaging science and SPIE

Robert F. “Bob” Wagner was a tremendous innovator in the field of medical imaging and image assessment methodologies. He was a key figure in the creation of the SPIE Medical Imaging symposium. An SPIE Fellow since 1988, Bob was active on the program committee of the Physics of Medical Imaging conference at the Medical Imaging symposium, and author of numerous technical papers published by SPIE.

"The medical imaging community has lost one of its founding fathers and most highly regarded members," said Kyle Myers, director of the Division of Imaging and Applied Mathematics at the Center for Devices and Radiological Health (CDRH), U.S. Food and Drug Administration (FDA). “Bob’s career was dedicated to the development of consensus measurement methods for the assessment of medical imaging systems, quantitative medical imaging and tissue characterization, and computer-aided diagnosis. He earned an international reputation in these areas and applied his expertise to a wide range of regulatory issues central to the FDA’s mission. He enlightened the scientific community within the agency as well as the international scientific community through the many invited presentations and tutorials he gave in and outside of the FDA, his numerous publications, his many professional society activities, and his assistance in regulatory decision making.”

At this 2009 Medical Imaging symposium, a joint keynote session hosted by the CAD and Image Perception conferences honored Bob’s many contributions from the early 1970s to the present through a series of presentations by some of his closest collaborators.
David Brown (CDRH/FDA) recalled Bob’s early years in the field, relating that after graduate and post-graduate work on the physics of nuclear interactions with radiation, Bob was hired by the Bureau of Radiological Health [a precursor to CDRH] to assess the dose reduction potential of radiographic intensifying screens made with phosphors developed in the color TV industry. Within three months he published a review of the relevant imaging literature from the medical, defense, consumer, and scientific communities, together with a charter for a laboratory program. Soon after, Bob introduced digital noise analysis to radiography, and showed that the new technology offered a 1.6- to 2.5-fold exposure reduction without compromising imaging performance. He then launched a program of inter-laboratory comparison of measurements on radiographic film samples that were circulated among fifteen commercial, government, and academic laboratories worldwide. In the process he became the prime mover for work toward consensus methodology for quantitative imaging performance measurements.

Mike Insana (Univ. of Illinois at Urbana-Champaign) shared memories of his years as Bob’s post-doctoral student, working with Bob on the statistical characterization of ultrasound images. He described Bob as an exemplary mentor who shared his passion and joy for science.

Myers agreed, "Bob’s greatest legacy may be the many young scientists he nurtured, who either worked directly under his tutelage at the FDA or otherwise benefitted from his unfailing patience and unselfish ease of availability."

Harry Barrett (Univ. of Arizona) began his presentation by relating noise-equivalent quanta (NEQ)—a concept central to Bob’s unified approach to objective image performance assessment—to historical information-theoretic methods for evaluation of imaging systems. Barrett went on to describe the many ways in which NEQ was extended to address problems beyond the simple signal-known-exactly, background-known-exactly (SEK/BKE) task.

Ken Hanson (Los Alamos National Lab.) described his years of collaboration with Bob. He said they worked together, first in the area of noise characterization of radiographic and CT images and later on the evaluation of images confounded by artifacts. In this latter work, Bob and Ken pioneered the application of a decision theoretic approach to the assessment of image reconstruction algorithms, demonstrating that the common mean-square-error metric did not predict visual task performance as measured by detectability.

Bob’s contemporary work, as described by Myers, “involved the consideration of the random effects associated with multiple readers of medical images and the logical extension of this work to the problem of the evaluation of multiple competing classifiers in statistical pattern recognition. Bob tackled problems of increasing complexity over the course of his career, relying throughout on the application of a unified, decision theoretic framework. In the process he brought about consensus on the importance of a task-based approach to the objective assessment of imaging systems.”

During more than forty years of professional life, Bob Wagner made numerous contributions to the field of medical imaging that significantly impacted academia, industry, and the FDA. His brilliant mind, incredible intuition, passion for science, sense of humor, charm, and warm friendship will be greatly missed.