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Introduction

Following the success of previous years, the CAD Conference at the SPIE Medical Imaging Symposium 2015 again invited original papers on all aspects related to CAD, including: theory, overall system development, database construction, segmentation, feature extraction, classifier design, workstation design, and evaluation.

In 2015, the CAD Conference received 149 abstracts and offered acceptance to approximately 88%. Abstract submissions came from various countries including: United States, Japan, Germany, the Netherlands, South Korea, Brazil, India, United Kingdom, Australia, Canada, France, Israel, Singapore, Spain, Portugal, China, and Mexico. The presentations spanned three-and-a-half days and included 64 oral presentations, 62 posters, a keynote address, a panel discussion, and a live demonstration workshop.

Keynote

On Monday morning, Dr. Tanveer Syeda-Mahmood from IBM Research - Almaden (United States) gave the CAD conference keynote on "Role of machine learning in clinical decision support". She was introduced by Dr. Larry Clarke from the National Cancer Institute (NCI), who discussed the importance of joint efforts among NCI, academia, and industry for big data collection, storage, and analysis, machine learning, publicly available datasets, and Grand Challenges.

In the very inspiring keynote, Dr. Syeda-Mahmood presented the new IBM research avenues and initiatives related to clinical decision support. She discussed the role of advanced machine learning techniques and presented examples from practical multimodal decision support systems such as the IBM AALIM (Advanced Analytics for Information Management) system. The IBM AALIM system pioneered a new direction in evidence-based medicine using the concept of patient similarity and exploiting consensus opinions of other physicians who have seen similar patients. The fusion of healthcare data with inference algorithms from artificial intelligence, machine learning techniques, and patient similarity is driving a multimodal approach for clinical decision support.

In addition, Dr. Syeda-Mahmood discussed the IBM Medical Sieve Radiology Grand Challenge: a worldwide collaborative research effort across IBM research labs that is expanding patient data and knowledge-driven learning methods to define new clinical decision support systems for radiologists. The next generation for clinical decision support, she said, will involve cognitive assistants using multimodal reasoning and machine learning in all stages of disease detection.

LUNGx: the CAD Grand Challenge

As part of the CAD Conference, SPIE, along with additional support from the American Association of Physicists in Medicine (AAPM) and the National Cancer Institute (NCI), conducted a "Grand Challenge" on developing quantitative image analysis methods for the diagnostic classification of malignant and benign lung nodules. This LUNGx Challenge provided a unique opportunity for participants to compare their algorithms to those of others from academia, industry, and government in a structured, direct way using the same data set.

The results of 13 algorithms from 11 groups were compared. An algorithm presented by Lyndsey Pickup, Mirada Medical UK (United Kingdom), was identified as the winner, and an algorithm presented by Yoganand Balagurunathan, Moffitt Cancer Center and University of Arizona (United States) was named runner-up. During the conference, participants presented posters about their LUNGx methods and results. The Challenge winner and runner-up were invited to join the special panel discussion. Additional information, including updates and lessons learned from the LUNGx Challenge, will be published soon in the SPIE Journal of Medical Imaging.

Panel Discussion

The special panel discussion on Tuesday afternoon focused on the topic of "CAD Grand Challenges-Present and Future." The moderators of the panel were Georgia D. Tourassi, Oak Ridge National Laboratory (United States) and Lubomir M. Hadjiiski, University of Michigan Health System (United States). The Panelists were: Samuel G. Armato, The University of Chicago (United States); Karen Drukker, The University of Chicago (United States); Laurence P. Clarke, National Cancer Institute (United States); George Redmond, National Cancer Institute (United States); Stephen Aylward, Kitware, Inc. (United States); Nicholas A. Petrick, U.S. Food and Drug Administration (United States); Lyndsey Pickup, Mirada Medical UK (United Kingdom), Yoganand Balagurunathan, Moffitt Cancer Center and University of Arizona (United States).

The panel provided a forum for discussion of the current experience with the LUNGx Challenge, other CAD grand challenges, and the future potential of these avenues for evaluation and testing of decision support systems. The panel included experts from academia, the National Cancer Institute (NCI) (United States), the Food and Drug Administration (FDA) (United States), industry, and the winners of the LUNGx Challenge. The panel members and audience discussed current and future opportunities for CAD Grand Challenges to become important testbeds and to enable cross platforms for decision support system evaluation. The panel agreed that by efficient planning and coordination among key organizing institutions, CAD Grand Challenges can play a vital role in the selection of promising classes of algorithms and systems for further clinical translational efforts and prompting advances in computer-aided diagnosis and ultimately precision medicine.

Live demonstration workshop

In our annual Tuesday evening live demonstration workshop, 13 research groups interactively presented their real-time demonstrations of CAD workstations. The workshop was organized by Stephen Aylward, Kitware, Inc. (United States), and Heang-Ping Chan, University of Michigan Health System (United States). The applications ranged from detection, characterization, treatment monitoring, surgery, segmentation, and visualization aids in breast, lung, brain, abdomen, bladder, and spine imaging.

Awards

Ibrahim Sadek, Université de Bourgogne, (France) from our CAD Conference was named the Robert F. Wagner Best Student Paper First-Place Winner for the entire 2015 Medical Imaging Symposium, for his paper, "Automatic discrimination of color retinal images using the bag of words approach," [9414-54].

The high level of participation in all venues of the CAD conference gave a clear indication of the substantial active research work in the CAD field and the importance of the SPIE Medical Imaging CAD Conference as a major meeting place to present and discuss ongoing research and future directions.

Lubomir M. Hadjiiski
Georgia D. Tourassi

2015 Medical Imaging Award Recipients

Robert F. Wagner Award

Robert F. Wagner was an active scientist in the SPIE Medical Imaging meeting, starting with the first meeting in 1972 and continuing throughout his career. He ensured that the BRH, and subsequently the CDRH, was a sponsor for the early and subsequent Medical Imaging meetings, helping to launch and ensure the historical success of the meeting. The Robert F. Wagner All-Conference Best Student Paper Award (established 2014) is acknowledgment of his many important contributions to the Medical Imaging meeting and his many important advances to the field of medical imaging.

This award is cosponsored by:

The Medical Image Perception Society

SPIE

2015 Recipients:

First Place: **Automatic discrimination of color retinal images using the bag of words approach** (9414-54)
I. Sadek, D. Sidibé, F. Meriaudeau, Univ. of Burgundy (France)

Second Place: **Automated pulmonary lobar ventilation measurements using volume-matched thoracic CT and MRI** (9417-42)
F. Guo, S. Svenningsen, E. Bluemke, M. Rajchl, J. Yuan, A. Fenster, G. Parraga, The Univ. of Western Ontario (Canada)

Conference Awards

2015 Recipients:

Cum Laude Poster Award: **A new CAD approach for improving efficacy of cancer screening** [9414-74]
B. Zheng, M. Tan, Y. Qiu, The Univ. of Oklahoma (United States); W. Qian, F. Lure, The Univ. of Texas at El Paso (United States); L. Li, Hangzhou Dianzi Univ. (China); J. Pu, Univ. of Pittsburgh (United States); Y. Kang, Northeastern Univ. (China)