



Bilkent EEE



Bilkent EEE Distinguished Seminar Series

Bilkent University - Department of Electrical and Electronics Engineering



Machine Learning in Computed Tomography: From Dictionary Learning to Deep Learning

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Over the past decade, machine learning has become a cornerstone of innovation in medical imaging. Our lab has been at the forefront of introducing machine learning techniques to the field of X-ray tomographic image reconstruction, as demonstrated through a series of pioneering publications. In 2011, we developed the first dictionary learning-based method for low-dose CT reconstruction, which laid the groundwork for leveraging sparsity-driven approaches in this domain. Building on this foundation, we expanded our techniques by introducing tensorized dictionaries for dynamic and spectral CT reconstruction, addressing challenges in temporal and spectral dimensions. More recently, we have developed and applied the deep learning-based methods for image reconstruction, leading a new field named "deep reconstruction." Unlike compressed sensing (CS)-based methods that rely entirely on precise physical models, deep reconstruction employs the power of big data to train deep neural networks, enabling superior image quality. In this talk, I will present our journey in applying machine learning to CT reconstruction, highlighting key milestones from dictionary learning to deep learning. We welcome your feedback and collaboration as we continue to push the boundaries of medical imaging.

Bio: Hengyong Yu is a Full Professor and Director of the Imaging and Informatics Lab in the Department of Electrical and Computer Engineering at the University of Massachusetts Lowell, Lowell, MA, 01854. He received dual Bachelor's degrees in information science & technology and computational mathematics in 1998, and a PhD degree in information & communication engineering in 2003, all from Xi'an Jiaotong University. Dr. Yu's research interests include tomographic image reconstruction, medical image processing, and bioinformatics. He has authored or coauthored over 350 peer-reviewed journal papers and conference proceedings, with a Google Scholar H-index of 50. He was the founding Editor-in-Chief of JSM Biomedical Imaging Data Papers, and currently serves as an Editorial Board member or associate editor for prestigious journals, including IEEE Transactions on Medical Imaging, Medical Physics, IEEE Access, and Signal Processing. Dr. Yu is a Fellow of the IEEE, American Association of Physicists in Medicine (AAPM), American Institute of Medical and Biological Engineering (AIMBE), Asia-Pacific Artificial Intelligence Association (AAIA), and International Artificial Intelligence Industry Alliance (AIIA). He is also a member of the Biomedical Engineering Society (BMES), American Association for the Advancement of Science (AAAS), and the international society for optics and photonics (SPIE). Throughout his career, Dr. Yu has received numerous awards. In 2005, he was awarded the first prize for the Best Natural Science Paper by the Association of Science & Technology of Zhejiang Province. In January 2012, he received an NSF CAREER award for development of CS-based interior tomography. More recently, in September 2022, he was honored with the IEEE Region One Technological Innovation Award (Academic) for "pioneering contributions and international leadership in tomographic imaging, especially interior tomography and machine learning-based tomographic imaging".