Bilkent EEE Distinguished Seminar Series

Bilkent University
Department of Electrical and Electronics Engineering

Machine learning and brain imaging: contributions to diagnostics, prognostication, and treatment guidance

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Neuroimaging has significantly expanded our understanding of brain changes in neuropsychiatric disorders as well as in aging and neurodegenerative diseases. However, it wasn't until the advent of machine learning tools that imaging signatures that can be detected in individuals, rather than groups, were constructed. More importantly, imaging signatures derived via machine learning models have shown promise in prognostication, as well as in guiding personalized treatments. This talk will present work on deriving imaging signatures of diagnostic and predictive value. It will then focus on weakly-supervised machine learning methods for analysis of the heterogeneity of brain imaging phenotypes, arriving at a dimensional representation reflecting the heterogeneity of brain aging and of various brain diseases. Finally, international consortia pooling and harmonizing large numbers of brain MRIs from many studies are presented as means for creating sufficiently large datasets for robust machine learning training and heterogeneity analysis, but also pose new challenges, including that or harmonization and domain adaptation across studies. The talk will end with presentation of the NiChart software suite, which implements some of these ML models.

Bio: Dr. Davatzikos is the Wallace T. Miller Sr. Professor of Radiology at the University of Pennsylvania, and Director of the recently founded AI2D Center for AI and Data Science for Integrated Diagnostics. He has been the Founding Director of the Center for Biomedical Image Computing and Analytics since 2013, and the director of the AIBIL lab (AI in Biomedical Imaging). He holds a secondary appointment in Electrical and Systems Engineering and in the Division of Informatics at Penn, and he is member of the Bioengineering and Applied Mathematics and Computational Science graduate groups. He obtained his undergraduate degree by the National Technical University of Athens, Greece in 1989, and his Ph.D. degree from Johns Hopkins, in 1994, on a Fulbright scholarship. He then joined the faculty in Radiology and later in Computer Science, where he founded and directed the Neuroimaging Laboratory. In 2002 he moved to Penn, where he founded and directed the section of biomedical image analysis. Dr. Davatzikos' interests are in medical image analysis. He oversees a diverse research program ranging from basic problems of imaging pattern analysis and machine learning, to a variety of clinical studies of aging and Alzheimer's Disease, schizophrenia, and brain cancer. Dr. Davatzikos has served on a variety of scientific journal editorial boards and grant review committees. He is an IEEE fellow, a fellow of the American Institute for Medical and Biological Engineering, and member of the council of distinguished investigators of the US Academy of Radiology and Biomedical Imaging Research. His H-Index is 128.