THE DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING SPEAKER SERIES

PRESENTS

Transport and Other Lagrangian Transforms for Signal Processing and Machine Learning

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LECTURE ABSTRACT

Favorable data representation methods can dramatically simplify the solution of numerical problems at the core of signal processing, computer vision, and machine learning. Fourier transforms, for example, can be very useful when solving linear filtering problems while Wavelet transformation methods can elucidate transient properties buried in signals and images. In the machine learning field, kernel methods are also known to simplify certain regression tasks such as clustering and classification. We describe an emerging set of Lagrangian signal/image transform methods, with well-defined forward and inverse operations, that can simplify certain nonlinear signal processing and machine learning problems. While most mathematical representation methods used in signal processing and image analysis compare signal/image intensities at fixed coordinates, the new set of mathematical transformation methods we propose can compare intensities across signal locations/pixel coordinates and are thus naturally related to optimal transportation methods. The new framework also has interesting mathematical properties including the ability to convert coordinate shifts in signal domain into amplitude modulations in transform domain. The new signal transforms can also be shown to convexify signal classes and render certain nonlinear problems linearly separable and thus can offer a simpler, more efficient, and robust solution to optimization-based data analysis problems. Examples related to signal detection and estimation, image reconstruction, machine learning, and transport-based image morphometry are discussed to show the advantages and disadvantages of the approach.

SPEAKER BIOSKETCH

Gustavo K. Rohde earned B.S. degrees in physics and mathematics in 1999, and the M.S. degree in Electrical Engineering in 2001 from Vanderbilt University. He received a doctorate in applied mathematics and scientific computation in 2005 from the University of Maryland. He is currently an associate professor of Biomedical Engineering, and Electrical and Computer Engineering at the University of Virginia.

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