TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

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Wavelets and Tensor Decompositions in High-Order Data Mining

by Michael D Barnathan
Temple University

Abstract. Though traditionally fit to a matrix structure, many spatiotemporal datasets exhibit "high-order" structure, in which many independent variables exist (e.g. space and time) or in which features are not scalar at all (e.g. diffusion tensor imaging). Rather than using a matrix model, which may lose vital information about these datasets, we propose to model such complex data using tensors, which are high-rank generalizations of matrices. We then create a framework for common data mining operations, such as classification, clustering, compression, and latent analysis, using the Tucker and PARAFAC tensor factorizations. To address the efficiency challenge that these techniques present, we preprocess the dataset using wavelets and create a high-order clustering algorithm based on WaveCluster, significantly increasing accuracy while reducing both time and memory requirements by two orders of magnitude. We apply our framework to a large motor task fMRI dataset, where it automatically discovered discriminative concepts on subject handedness.