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Tensor Factorizations and Decompositions for Modern Massive Data Sets and their Potential Applications

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Abstract—Nonnegative and sparse multi-way array (tensor) factorizations and decompositions have emerged as new tools with a wide range of important potential applications, including bioinformatics, neuroinformatics, brain computer interface (BCI), text mining, image understanding, air pollution research, chemometrics, and spectral data analysis. Tensor factorizations and decompositions have many other applications, such as multi-way clustering, image classification, neural learning process, sound recognition, remote sensing, and object characterization. For example, we applied tensor decompositions for early diagnosis (detection) of Alzheimer Disease before any clinical symptom and also for Brain Computer Interface. We believe that a potential impact of the tensor decompositions on scientific advancements in biomedical signal processing and machine learning might be greater than Independent Component Analysis (ICA), or even the Singular Value Decomposition (SVD). In contrast to ICA or SVD/PCA approaches, sparse and nonnegative tensor decomposition techniques if successively implemented, may improve dramatically physical interpretation and 3D visualization of large-scale noisy data while maintaining the physical feasibility more closely. Multi-modality and high-dimensionality massive datasets are rapidly becoming more commonplace in many applications because they provide useful information that cannot be obtained from 2D data sets. Our goals is to explore novel techniques for modeling and analyzing massive, high-dimensional, and nonlinearly-structured scientific data sets. Analysis of such multidimensional data using traditional 2D processing is insufficient because of the interleaving and superimposed structures that often occlude the target regions of interest. Visual representation and understanding of such data is also an emerging area of research interest. In this talk main emphasize will be given to multi-linear models, nonlinear iterative algorithms for large-scale tensor factorizations and decompositions and their various applications.

References

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