Principal Component, Independent Component and Parallel Factor Analysis

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This talk is an introduction to Independent Component Analysis (ICA) and Parallel Factor Analysis (PARAFAC), the way they are related and their links with Principal Component Analysis (PCA). PCA is now a standard technique for the analysis of two-way multivariate data, i.e., data available in matrix format. However, principal components are subject to rotational invariance. By imposing statistical independence rather than uncorrelatedness, the solution becomes unique. This is ICA. On the other hand, PARAFAC is a technique for multiway data analysis, based on the decomposition of the data tensor in rank-1 terms. PARAFAC is unique under mild conditions on the factors. ICA decomposes a higher-order cumulant tensor in rank-1 terms. Hence, ICA uniqueness stems from PARAFAC uniqueness. PCA is often used as preprocessing, leading to PARAFAC with orthogonality constraints.