Least Squares and ML Estimation Approaches of the Sufficient Reduction for Matrix Valued Predictors

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In some regression and classification settings, as in longitudinal data analysis, predictors are matrix valued. In earlier work, we proposed first-moment-based sufficient dimension reduction (SDR) methods, such as Longitudinal Sliced Inverse Regression (LSIR), for combining several longitudinally measured markers into a composite marker score for prediction or regression modeling, under a mild distributional assumption and by exploiting their matrix structure. In this paper, we project the dimension reduction subspace onto the tensor product of the column and row vector space of the conditional predictor mean. We propose least squares and maximum likelihood based approaches to estimate optimal combinations of matrix valued predictors that comprise sufficient reductions in regression and classification problems and obtain a score with improved predictive accuracy as well as computational efficiency. We establish the connection with 2D-LDA (2-dimensional Linear Discriminant Analysis), a machine learning method for the statistical analysis of images and face recognition, for which we offer estimation algorithms with optimal statistical properties.