Isometric Sliced Inverse Regression for Nonlinear Manifold Learning

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Abstract

Sliced inverse regression (SIR) was developed to find effective linear dimension-reduction directions for exploring the intrinsic structure of the high-dimensional data. In this study, we present isometric SIR for nonlinear dimension reduction, which is a hybrid of the SIR method using the geodesic distance approximation. First, the proposed method computes the isometric distance between data points; the resulting distance matrix is then sliced according to K-means clustering results, and the classical SIR algorithm is applied. We show that the isometric SIR (ISOSIR) can reveal the geometric structure of a nonlinear manifold dataset (e.g., the Swiss roll). We report and discuss this novel method in comparison to several existing dimension-reduction techniques for data visualization and classification problems. The results show that ISOSIR is a promising nonlinear feature extractor for classification applications.