Landmark isometric fuzzy sliced inverse regression with application to medical image segmentation

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Abstract

Image segmentation is an essential and crucial step in the pattern recognition processes. It has been applied to many fields such as the medical image segmentation for tumor diag- nosis and the satellite image positioning. The approaches to improve the accuracy of image segmentation has been an active research topic. When conducting the image segmentation, the features extracted from images usually consist of a large amount of high-dimensional data. Dimensional reduction (DR) is one of the solutions to such data and is employed to improve the efficiency and the accuracy of segmentation. Isometric sliced inverse regression (ISOSIR) is an effective non-linear DR method that can be used to discover the embedded features of the high-dimensional data and presents their geometric structure in the low-dimensional sub- space. ISOSIR uses K-means (KMS) to cluster the isometric distance matrix of the input data and then applies SIR to the classification problems. ISOSIR has been proved to perform better than some traditional DR methods such as ISOMAP or PCA. Although KMS can achieve good performance, it tends to be biased for clustering the image features. Consequently, we use the fuzzy C-means clustering (FCM) as an alternative for SIR in this study. For the large amount of features generated from the images, we are motivated to propose the landmark isometric fuzzy sliced inverse regression (L-ISOFSIR) to improve the computational efficiency of the image segmentation. Two sets of simulated images and one real medical image are used to evaluate the proposed method based on three feature domains. Comparisons with results obtained via FCM and the fuzzy sliced inverse regression (FSIR) are also reported. The experimental results show that L-ISOFSIR improves the accuracy of image segmentation significantly which is an efficient computer-aided automatic image segmentation tool.

Keywords: Fuzzy C-means clustering, isometric fuzzy sliced inverse regression, nonlinear dimen- sionality reduction, image segmentation.