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Modified Mahalanobis-Taguchi system based on proper orthogonal decomposition for high-dimensional-small-sample-size data classification. (English) [Zbl 1472.62099]

Summary: Mahalanobis-Taguchi System (MTS) is an effective algorithm for dimensionality reduction, feature extraction and classification of data in a multidimensional system. However, when applied to the field of high-dimensional small sample data, MTS has challenges in calculating the Mahalanobis distance due to the singularity of the covariance matrix. To this end, we construct a modified Mahalanobis-Taguchi System (MMTS) by introducing the idea of proper orthogonal decomposition (POD). The constructed MMTS expands the application scope of MTS, taking into account correlations between variables and the influence of dimensionality. It can not only retain most of the original sample information features, but also achieve a substantial reduction in dimensionality, showing excellent classification performance. The results show that, compared with expert classification, individual classifiers such as NB, RF, k-NN, SVM and superimposed classifiers such as Wrapper + RF, MRMR + SVM, Chi-square + BP, SMOTE + Wrapper + RF and SMOTE + MRMR + SVM, MMTS has a better classification performance when extracting orthogonal decomposition vectors with eigenvalues greater than 0.001.

MSC:
62H30 Classification and discrimination; cluster analysis (statistical aspects)
62H12 Estimation in multivariate analysis
15A42 Inequalities involving eigenvalues and eigenvectors

Keywords:
Mahalanobis-Taguchi system; proper orthogonal decomposition; high-dimensional-small-sample-size data; classification

Full Text: DOI

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