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One-Class Classification Approach Using Fukunaga-Koontz Transform and Selective Multiple Kernel Learning

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Abstract : This paper presents a one-class classification (OCC) technique based on Fukunaga-Koontz Transform (FKT) for binary classification problems. The FKT is originally a powerful tool to feature selection and ordering for two-class problems. To utilize the standard FKT for data domain description problem (i.e., one-class classification), in this paper, a set of non-class samples which exist outside of positive class (target class) describing boundary formed with limited training data has been constructed synthetically. The tunnel-like decision boundary around upper and lower border of target class samples has been designed using statistical properties of feature vectors belonging to the training data. To capture higher order of statistics of data and increase discrimination ability, the proposed method, termed one-class FKT (OC-FKT), has been extended to its nonlinear version via kernel machines and referred as OC-KFKT for short. Multiple kernel learning (MKL) is a favorable family of machine learning such that tries to find an optimal combination of a set of sub-kernels to achieve a better result. However, the discriminative ability of some of the base kernels may be low and the OC-KFKT designed by this type of kernels leads to unsatisfactory classification performance. To address this problem, the quality of sub-kernels should be evaluated, and the weak kernels must be discarded before the final decision making process. MKL/OC-FKT and selective MKL/OC-FKT frameworks have been designed stimulated by ensemble learning (EL) to weight and then select the sub-classifiers using the discriminability and diversities measured by eigenvalue ratios. The eigenvalue ratios have been assessed based on their regions on the FKT subspaces. The comparative experiments, performed on various low and high dimensional data, against state-of-the-art algorithms confirm the effectiveness of our techniques, especially in case of small sample size (SSS) conditions.

Keywords : ensemble methods, fukunaga-koontz transform, kernel-based methods, multiple kernel learning, one-class classification
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