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基于监督正交局部保持映射的植物叶片图像分类方法

Plant leaf image classification based on supervised orthogonal locality preserving projections

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中文摘要:

针对传统的线性分类方法不能有效处理复杂、多变和非线性的植物叶片图像，在局部保持映射算法的基础上，提出了一种监督正交局部保持映射算法，并应用于基于物叶片图像分类中。该算法首先利用Warshall算法计算样本的类别矩阵，在此基础上充分利用样本的局部信息和类别信息构造类间散度矩阵和类内散度矩阵，使得维数后，在低维子空间同类样本之间的距离变小，而不同类样本之间的距离增大，由此提高了该算法的分类能力。最后，利用K-最近邻分类器进行植物分类。与经典的监督空间维数约简方法相比，该方法在构建类内和类间散度矩阵时不需要判别数据的类别信息，能够提高算法的分类性能。在公开植物叶片图像数据库上进行了一系列植物片分类试验，平均正确识别率高达95.92%。试验结果表明了该算法在植物分类中的可行性。

英文摘要:

Plants play a critical role on human life. This role includes food, medicine, industry and environment. Plant species classification based on plant leaf has been carried out by botanists, plant specialist and many scholars for many years. Leaf shape provides rich information for classification and most of the computer-aided plant classification methods a based on plant leaf images. Dimensionality reduction and feature extraction are two critical steps in the plant leaf image classification. Traditional statistical and linear methods to extract the classifying features and reduce the dimensionalities cannot obtain the intrinsic manifold structure of the nonlinear data. Manifold learning is a new dimensionality redu method for nonlinear data and it has been commonly employed in the recognition of face, palmprint and handwriting. One common problem with supersized manifold learning algorithms is that any pair sample points need to check whether or not they are in the same class and the problem degrades the recognition performance of these algorithms. To overcome the problem, a supervised orthogonal LPP (SOLPP) algorithm is presented and applied to the plant classification by using leaf images, based on locality preserving projections (LPP). LPP can be trained and applied as a linear projection and can model feature vectors that are assumed to lie on a nonlinear embedding subspace by preserving lo relations among input features, so it has an advantage over conventional linear dimensionality reduction algorithms like principal components analysis (PCA) and linear discrimina analysis (LDA). First, the class information matrix is computed by the Warshall algorithm, which is an efficient method for computing the transitive closure of a relationship. It tak matrix as input to represent the relationship of the observed data, and outputs a matrix of the transitive closure of the original data relationship. Based on the matrix, the within-cla and between-class matrices are obtained by making full use of the local information and class information of the data. After dimensionality reduction, in subspace space, the dista between the same-class samples become smaller, while the distances between the different-class samples become larger. This characteristic can improve the classifying performan the proposed algorithm. Compared with the classical subspace supervised dimensional reduction algorithms, in the proposed method, it is not necessary to judge whether any tw samples belong to the same class or not when constructing the within-class and between-class scatter matrices, which can improve the classifying performance of the proposed algorithm. Finally, the K-nearest neighborhood classifier is applied to classifying plants. Comparison experiments with other existing algorithms, such as neighborhood rough set (NRS), support vector machine(SVM), efficient moving center hypersphere(MCH), modified locally linear discriminant embedding(MLLDE) and orthogonal global and local discriminant projection(OGLDP) are implemented on the public plant leaf image database, Swedish leaf dataset, which contains isolated leaves from 15 different Swedish tree speci with 75 leaves per species. The average correct recognition rate of SOLPP reaches more than 95.92%. The experimental results verify that the proposed method is effective and fea for plant classification. The future work of the paper can extend the experiments to the larger public plant leaf databases to verify the effectiveness and robustness of the propose algorithm and take full use of the non-label samples to make the algorithm semi-supervised one.

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