High-resolution remote sensing image classification using collaborative representation with a locally adaptive dictionary

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Abstract:

High-resolution remote sensing images (HRIs) have many practical applications, specially play an increasingly important role in land-use classification. Sparse representation is widely applied in the field of remote sensing image classification, but sparsity-based methods are time-consuming. Unlike sparse representation, collaborative representation could improve the efficiency, accuracy, and precision of image classification algorithms. Thus, we propose a high-resolution remote sensing image classification method using collaborative representation with a locally adaptive dictionary, the essence of which is the general CR model with corresponding regularizations, for reconstructing a test image with the global dictionary using a linear regression approach on all training image. The proposed method includes two steps. First, we use a similarity measurement technique to separately pick out the most similar images to each test image from the training sample images, instead of using the whole dictionary including the set of training sample images, to construct an one-step sub-dictionary. Second, we construct a locally adaptive dictionary for every class by extracting a two-step sub-dictionary from all one-step sub-dictionaries of that class. The test sample images of every class are individually represented over the locally adaptive dictionaries of that class instead of the whole dictionary or the corresponding one-step sub-dictionaries. The USA land-use dataset (includes 21 classes) is widely used for evaluating land-use classification algorithms. Using the dataset, we conduct many experiments comparing the SRC, CRC, NRS, and JCR algorithms. The compared indexes include average accuracy (OA) of all classes, Kappa coefficients and run-time. Extensive experiments show that our proposed method yields competitive classification results with greater efficiency than other tested methods. Sample images of each land-use class are shown in Fig.1. As shown in Fig.2, the average accuracies occur along a diagonal shown in red to yellow cells in the figure, mostly focusing on 82.62±0.71%.

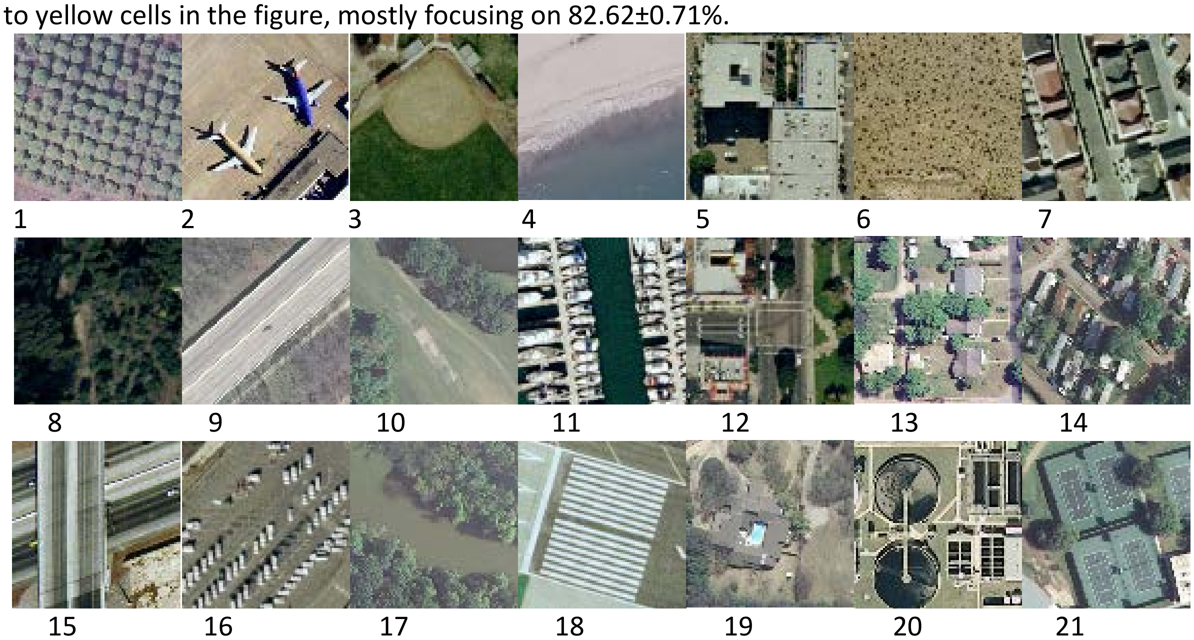

Fig.1 example images of USA land-use dataset

(1 agriculture; 2 airplane; 3 baseball diamond; 4 beach; 5 buildings; 6 chaparral; 7 dense residential; 8 forest; 9 freeway; 10 golf course; 11 harbor; 12 intersection; 13 medium residential; 14 mobile phone park; 15 overpass; 16 parking lot; 17 river; 18 runway; 19 sparse residential; 20 storage tanks; 21 tennis court)

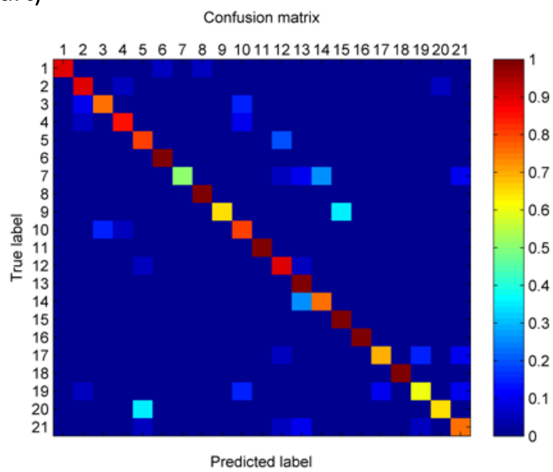

Fig.2 Confusion matrix for the land-use data set using the proposed method