Speeded-up and Compact Visual Codebook for Object Recognition

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Abstract

The well known framework in the object recognition literature uses local information extracted at several patches in images which are then clustered by a suitable clustering technique. A visual codebook maps the patch-based descriptors into a fixed-length vector in histogram space to which standard classifiers can be directly applied. Thus, the construction of a codebook is an important step which is usually done by cluster analysis. However, it is still difficult to construct a compact codebook with reduced computational cost. This paper evaluates the effectiveness and generalisation performance of the Resource-Allocating Codebook (RAC) approach that overcomes the problem of constructing fixed size codebooks that can be used at any time in the learning process and the learning patterns do not have to be repeated. It either allocates a new codeword based on the novelty of a newly seen pattern, or adapts the codebook to fit that observation. Furthermore, we improve RAC to yield codebooks that are more compact. We compare and contrast the recognition performance of RAC evaluated with two distinctive feature descriptors: SIFT and SURF and two clustering techniques: K-means and Fast Reciprocal Nearest Neighbours (fast-RNN) algorithms. SVM is used in classifying the image signatures. The entire visual object recognition pipeline has been tested on three benchmark datasets: PASCAL visual object classes challenge 2007, UIUC texture, and MPEG-7 Part-B silhouette image datasets. Experimental results show that RAC is suitable for constructing codebooks due to its wider span of the feature space. Moreover, RAC takes only one-pass through the entire data that slightly outperforms traditional approaches at drastically reduced computing times. The modified RAC performs slightly better than RAC and gives more compact codebook. Future research should focus on designing more discriminative and compact codebooks such as RAC rather than focusing on methods tuned to achieve high performance in classification.

Author Keywords

Object Recognition, Codebook, K-means, RAC, fast-RNN, SIFT, SURF