Taking average of feature vectors from the center and neighboring blocks to a block being coded is proposed as a method of considering context information in block classification. This is shown in Fig. 1. The algorithm has the advantage of low complexity. Gauss mixture models (GMM) are adopted to extract features from image blocks, including an algorithm to handle singular covariance matrices. Instead of discarding cells that have singular covariance matrices, we reduce their dimension to make them non-singular. Two different distortion measures are used: namely log-likelihood quadratic discrimination analysis (QDA) and a dimension-compensated distortion measure defined by dividing the QDA distortion by the corresponding cell’s dimension. We use DCT coefficients and prune higher frequency components until the cell is non-singular. In Fig. 2, our dimension reduction algorithm is compared with the discarding cell algorithm. For both cases, we start with the same initial codebook of size \( L \) and dimension \( k \) for every cell. When we discard cells, we end up with a smaller number of cells, but the dimensions for the remaining cells are the same. When we reduce the dimension, however, we have the same number of cells, but the dimension for each cell can be less than the original dimension \( k \). We fit GMM to data by the Lloyd algorithm using a model-based distortion measure and generate initial codebooks with the splitting algorithm. Aerial images were used to train and test. Experimental results show that the proposed algorithm not only improves the classification performance, but also provides a solution to the singular covariance problem.

The full paper can be found at http://www.stanford.edu/~holyoon/publications.html