Band-wise Adaptive Sparsity Regularization for Quantized Compressed Sensing Exploiting Nonlocal Similarity

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The theory of compressive sensing (CS) has the potential of significantly improving the energy efficiency of sensors by achieving perfect reconstruction of a sparse signal from a small number of random measurements. In practice, because of the considerations of data storage and transmission, scalar quantization is necessary to be implemented on the CS measurements.

In compressive sensing, the sparsity degree of a signal plays a significant role in recovery. And most CS recovery methods utilize sparsity prior models, such as the local sparsity prior model [1] and non-local similarity property of natural images [2,3]. However, most of the methods ignore the quantization of measurements which significantly reduces the recovery efficiency.

Considering the above problem, we propose an adaptive bandwise sparsity regularization to handle the recovery problem of quantized compressive sensing. The sparsity regularization constraints every patch by using bandwise distribution model in transform domain. Instead of using a global model, the scheme employs adaptive PCA model of each patch and treats different transform bands unequally according to their statistical characteristics. Then a novel strategy is developed for image compressive sensing recovery via this sparse representation. In addition, we take into account the particular nature of the scalar quantization model. This is achieved by defining an appropriate cost measuring deviation from quantization consistency. To make the proposed method tractable and robust, an iterative shrinkage/thresholding algorithm (ISTA) based technique is developed to solve the above severely under-determined inverse problem efficiently. Experimental results show that proposed method achieves higher PSNR than the state-of-the-art methods. Compared to [1] and [2], the proposed algorithm achieves about 3.97dB and 1.66dB improvement on average without quantization and 2.27dB and 2.05dB improvement on average with quantization. For visual quality assessment, the reconstructed images produced by the proposed algorithm reveal much more sharp edge structures and richer textures.

References

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