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MODIS image super-resolution via learned topic dictionaries and regression matrices

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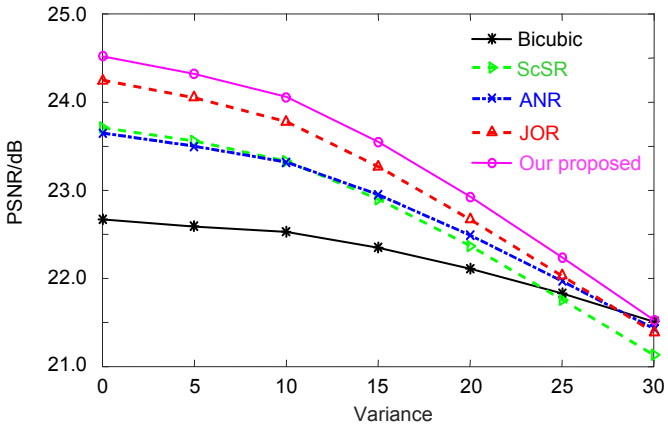

The noise robustness of different methods.

Abstract: Spatial resolution is an important property of remote sensing image. As an important branch of remote sensing, the moderate resolution imaging spectroradiometer (MODIS), mounted on Terra and Aqua satellites, is an important instrument for observing global biological and physical processes in the Earth observation system (EOS) program. It is widely used in the fields of ground detection, cloud classification and climate research because it contains rich information. However, due to sensor limitations and external interference, MODIS image resolution is still limited to a certain level. Therefore, using super-resolution technology to improve resolution of the MODIS image has a great practical significance.

Recently, although the method based on sparse representation has tackled the ill-posed problem effectively, two fatal issues have been ignored. First, many methods ignore the relationships among patches, which will result in some unfaithful output. Second, the high computational complexity of sparse coding using l_1 norm is needed in reconstruction stage. We proposed a single image super-resolution (SISR) method to predict a high-resolution (HR) MODIS image from a single low-resolution (LR) input. As is known to us, infinitely many HR patches will result in the same LR patch when blurred and down-sampled. This is an extremely ill-pose problem. Therefore, we group the LR patches with the similar semantic and the corresponding HR patches into topics in the training stage and find the HR patch with the most similar semantic from all possible HR patches for a given LR patches in the reconstruct stage by pLSA.

In the training stage, we discover the semantic relationships among LR patches and the corresponding HR patches and group the documents with the similar semantic into topics. Then, we can learn dual dictionaries for each topic in the low-resolution (LR) patch space and high-resolution (HR) patch space and also pre-compute corresponding regression matrices for dictionary pairs. In the reconstruction stage, for the test image we infer locally which topic it corresponds to and adaptive to select the regression matrix to reconstruct HR image by semantic relationships. With above processing, we can get the optimal reconstruction for the HR image.

Our method discovered the relationships among patches and pre-computed the regression matrices for topics. Therefore, our method can greatly reduce the artifacts and get some speed-up in the reconstruction phase. Experiment manifests that our method performs MODIS image super-resolution effectively, results in higher PSNR, reconstructs faster, and gets better visual quality than some current state-of-art methods.

Keywords: MODIS; super-resolution; sparse representation; sparse coding; regression matrix

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