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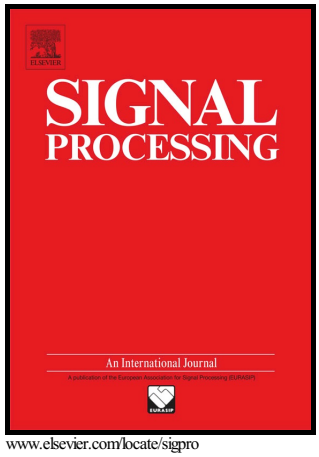

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Abstract

Super-resolution from a single image is a challenging task, more so, in presence of noise with unknown strength. We propose a robust super-resolution algorithm which adapts itself based on the noise-level in the image. We observe that dependency among the gradient values of relatively smoother patches diminishes with increasing strength of noise. Such a dependency is quantified using the ratio of first two singular values computed from local image gradients. The ratio is inversely proportional to the strength of noise. The number of patches with smaller ratio increases with increasing strength of noise. This behavior is used to formulate some parameters that are used in two ways in a sparse-representation based super-resolution approach: i) in computing an adaptive threshold, used in estimating the sparse coefficient vector via the iterative thresholding algorithm, ii) in choosing between the components representing image details and non-local means of similar patches. Furthermore, our approach constructs dictionaries by coarse-to-fine processing of the input image, and hence does not require any external training images. Additionally, an edge preserving constraint helps in better edge retention. As compared to state-of-the-art approaches, our method demonstrates better efficacy for optical and range images under different types and strengths of noise.

Keywords: Super-resolution, Sparse representation, Singular value decomposition, Additive noise, Non-local similarity, Edge preserving constraint.

1. Introduction

The swift development of technologies from surveillance to multimedia, makes high resolution (HR) image as an important requirement. Often, this requirement is not met by the restricted image capturing environment or low-cost imaging systems. Thus, some image processing techniques are required to increase the resolution of images, captured by low resolution (LR) cameras. Off-the-shelf interpolation techniques [1, 2] can up-sample LR images but fails to preserve image details. Hence, super-resolution (SR) techniques have been

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