Multiframe Resolution-Enhancement using A Robust Iterative SRR based on Leclerc Stochastic Technique

Vorapoj Patanavijit
Department of Computer and Network Engineering, Faculty of Engineering, Assumption University, Bangkok, Thailand 10240
Email: patanavijit@yahoo.com

Abstract
This paper proposes a multiframe resolution-enhancement using a robust iterative SRR (Super-Resolution Reconstruction) for applying on images that is corrupted by several noise models. Typically, the success of SRR algorithms is highly dependent on the model accuracy regarding the imaging process. The real noise models corrupting the measure sequence are unknown hence SRR algorithms using l1 or l2 norm may degrade the image sequence rather than enhance it. The proposed enhancement algorithm is based on the stochastic regularization SRR technique of Bayesian MAP estimation by minimizing a cost function. The Leclerc norm is used for removing outliers in the data and for measuring the difference between the projected estimate of the HR image and each LR image. Due to the ill-posed problem, Tikhonov regularization is used to remove artifacts from the final answer and improve the rate of convergence. The experimental results show the effectiveness of our methods and demonstrate its superiority to other SRR algorithm based on L1 and L2 norm for several noise models such as Noiseless, AWGN, Poisson Noise, Salt&Pepper Noise and Speckle Noise.

Keywords: Image reconstruction, Image enhancement, Video signal processing

1. Introduction
In most imaging applications, high spatial resolution images are desired and often required. The classical resolution enhancement from a single observation using image interpolation techniques is of limited application because of the aliasing present in the low-resolution (LR) image. SRR [2, 10, 12, 16, 20] refers to the process of producing a high spatial resolution image than what is afforded by the physical sensor through postprocessing, making use of one or more low resolution observations. It includes upsampling the image, thereby increasing the maximum spatial frequency, and removing degradations that arise during the image capture, namely, aliasing and blurring. The basic ideal behind SRR is the fusion of a sequence of low-resolution noisy blurred images to produce a higher-resolution image or sequence.


For the data fidelity cost function, All the above SRR algorithms [1-22] are based on the simple estimation techniques such as L1 Norm or L2 Norm Minimization. For normally distributed data, the L1 norm produces estimates with higher variance than the optimal L2 (quadratic) norm but the L2 norm is very sensitive to outliers because the influence function increases linearly and without bound. From the robust statistical estimation [11], Leclerc Norm is more robust than L1 and L2. Leclerc Norm is designed to be robustness and reject outliers, the norm must be more forgiving about outliers; that is, it should increase less rapidly than L2. In this paper, we propose a robust iterative SRR algorithm using Leclerc Norm for the data fidelity cost function with Tikhonov Regularization. Whereas the former is responsible for robustness and edge preservation, the latter seeks