Super-Resolution Using Hierarchical Hidden Markov Models and Bayesian Estimation Framework

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Abstract

This paper presents a new method for super-resolution (SR) reconstruction of a high-resolution (HR) picture from several low-resolution (LR) pictures. It has been inspired and adapted from an image fusion model using the same framework [1,2]. The HR image is assumed to be composed of homogeneous regions. Thus, the a priori distribution of the pixels is modeled by a Finite Mixture Model (FMM) to let their classification in a finite number of classes, and a Potts Markov Model (PMM) for the labels. The whole a priori model is then a hierarchical Markov model. The LR images are assumed to be obtained from the HR image by low pass filtering, decimating, arbitrarily translation and corruption by a random noise. The problem is then put in a Bayesian detection and estimation framework, and appropriate algorithms are developed based on Markov Chain Monte-Carlo (MCMC) Gibbs sampling. At the end, we have not only an estimate of the HR image but also an estimate of the classification labels which leads to a segmentation result. The performances of the proposed method are compared with a registration, classical interpolation and a summation, and with another classical method based on popular Tikhonov regularized approach and a more recent SR method based on regularization approach [3,4].

Keywords.
Super-resolution, Bayesian detection and estimation, Image fusion, MCMC Gibbs sampling, Classification and Segmentation.

Refere;nces:
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