International Workshop on Computer Vision, April 26-30, 2004, IPM, Tehran

Bayesian Data and Image Fusion (I)

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This presentation is a tutorial on the Bayesian inference approach to multi-sensor data and image fusion. First a few examples of simple image fusion problems are presented. Then, the simple case of registered image fusion problem is considered to show the basics of the Bayesian estimation approach and its link to classical data fusion methods such as Principal Component Analysis (PCA), Factor Analysis (FA) and Independent Component Analysis (ICA). Then, the case of simultaneous registration and fusion of images is considered. Finally, the problem of fusion of really heterogeneous data such as X-ray radiographic and ultrasound echo-graphic data for computed tomography image reconstruction of 2D or 3D objects are considered. For each of the mentioned data fusion problems, a basic method is presented and illustrated through some simulation results.

Bayesian Data and Image Fusion (II)

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This presentation is a tutorial on the Bayesian inference approach to Blind Source Separation (BSS). First a review of classical methods of BSS (PCA, ICA, HOS, InfoMax, FA) is presented and their main limitations are high lighted. Then, we will see how the Bayesian approach can push farther these limits. Then, we focus on the case of BSS for 2D signals (images) and show how Hierarchical Markov modeling of images can be used to develop new BSS methods. Finally, we present some details of two classes of these methods, i.e., those mho work directly on the pixel space and those who work in dual spaces (splines, Fourier or wavelets).

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Bayesian Data and Image Fusion (III)

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In this work we consider time series with discrete point changes which may contain a finite number of changes of probability density functions (pdf). We focus on the case where the data in all segments are modeled by Gaussian probability density functions with different means, variances and correlation lengths. The problem as we stated can also be considered as an unsupervised classification and/or segmentation of the time serie. We put a prior law on the change point occurances (Poisson process) as well as on these different parameters (conjugate priors) and give the expression of the posterior probality distributions of these change points as well as those of the unknown parameters. The computations are done by using an appropriate Markov Chain Monte Carlo (MCMC) technique.