Industrial Applications of Inverse Problems

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Abstract

An inverse problem is a mathematical framework that is used to obtain unknown information about a physical problem or system from observed measurements. The solution of this problem is useful for various industrial problems. There are many different applications including, medical imaging, geophysics, computer vision, astronomy, nondestructive testing and so on. In this workshop, several industrial applications of inverse problems will be introduced. Such as visualization of pressure distribution on disk-brake of automobile, identification of cathodic protection currents of seaside structures and joint estimation of tissue Types and linear attenuation coefficients for photon counting CT.

Especially, we are focus on the topic of joint estimation of tissue Types and linear attenuation coefficients for photon counting CT which implements new approach of regularization concept. We propose a new framework to jointly perform image reconstruction, material decomposition, and tissue type identification for photon counting detector computed tomography by applying maximum a posteriori (MAP) estimation with voxel-based latent variables for the tissue types. The latent variables are treated using a voxel-based coupled Markov random field to describe the continuity and discontinuity of human organs and a Gaussian mixture model to incorporate the statistical relation between the tissue types and their attenuation characteristics. A hierarchical Bayesian model is adopted to describe hyper prior distribution over a patient-based expected pixel value so that the proposed method can adjust them during the estimation. The performance of the proposed method is quantitatively compared to that of filtered backprojection and a quadratic penalized likelihood method. The proposed method makes it possible not only to identify tissue types more accurately but also to reconstruct CT images with decreased noise and enhanced sharpness owing to the information about the tissue types.

Keywords Inverse Problems, Industrial Application, Regularization, Joint Estimation

References
