DOCTORAL THESIS

Variational image segmentation, inpainting and denoising

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Date of Award:
2016

Abstract

Variational methods have attracted much attention in the past decade. With rigorous mathematical analysis and computational methods, variational minimization models can handle many practical problems arising in image processing, such as image segmentation and image restoration. We propose a two-stage image segmentation approach for color images, in the first stage, the primal-dual algorithm is applied to efficiently solve the proposed minimization problem for a smoothed image solution without irrelevant and trivial information, then in the second stage, we adopt the hill-climbing procedure to segment the smoothed image. For multiplicative noise removal, we employ a difference of convex algorithm to solve the non-convex AA model. And we also improve the non-local total variation model. More precisely, we add an extra term to impose regularity to the graph formed by the weights between pixels. Thin structures can benefit from this regularization term, because it allows to adapt the weights value from the global point of view, thus thin features will not be overlooked like in the conventional non-local models. Since now the non-local total variation term has two variables, the image u and weights v, and it is concave with respect to v, the proximal alternating linearized minimization algorithm is naturally applied with variable metrics to solve the non-convex model efficiently. In the meantime, the efficiency of the proposed approaches is demonstrated on problems including image segmentation, image inpainting and image denoising.

Keywords: Alternating minimization; Image restoration; Minimal surface; Nonconvex minimization; Total variation.

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