A TWO-STAGE IMAGE SEGMENTATION METHOD USING A CONVEX VARIANT OF THE MUMFORD-SHAH MODEL AND THRESHOLDING

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Abstract. The Mumford-Shah model is one of the most important image segmentation models, and has been studied extensively in the last twenty years. In this talk, we propose a two-stage segmentation method based on the Mumford-Shah model. The first stage of our method is to find a smooth solution g to a convex variant of the Mumford-Shah model. Once g is obtained, then in the second stage, the segmentation is done by thresholding g into different phases. The thresholds can be given by the users or can be obtained automatically using any clustering methods. Because of the convexity of the model, g can be solved efficiently by techniques like the split-Bregman algorithm or the Chambolle-Pock method. We prove that our method is convergent and the solution g is always unique. In our method, there is no need to specify the number of segments K ($K \geq 2$) before finding g. We can obtain any K-phase segmentations by choosing $(K-1)$ thresholds after g is found in the first stage; and in the second stage there is no need to recompute g if the thresholds are changed to reveal different segmentation features in the image. Experimental results show that our two-stage method performs better than many standard two-phase or multi-phase segmentation methods for very general images, including anti-mass, tubular, MRI, noisy, and blurry images; and for very general noise models such as Gaussian, Poisson and multiplicative Gamma noise.

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