



# International Journal of Biomedical Imaging

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## A Stochastic-Variational Model for Soft Mumford-Shah Segmentation

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### Abstract

In contemporary image and vision analysis, stochastic approaches demonstrate great flexibility in representing and modeling complex phenomena, while variational-PDE methods gain enormous computational advantages over Monte Carlo or other stochastic algorithms. In combination, the two can lead to much more powerful novel models and efficient algorithms. In the current work, we propose a stochastic-variational model for *soft* (or fuzzy) Mumford-Shah segmentation of mixture image patterns. Unlike the classical *hard* Mumford-Shah segmentation, the new model allows each pixel to belong to each image pattern with some probability. Soft segmentation could lead to hard segmentation, and hence is more general. The modeling procedure, mathematical analysis on the existence of optimal solutions, and computational implementation of the new model are explored in detail, and numerical examples of both synthetic and natural images are presented.

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