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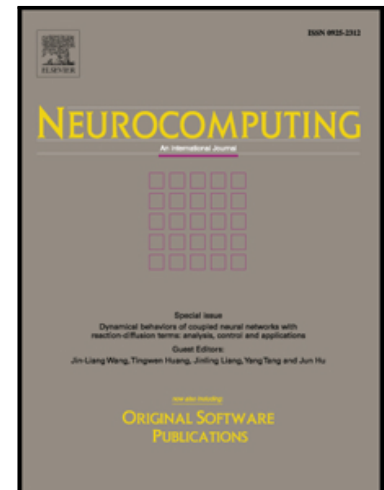
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Classification of Small Structures in Piecewise-Constant Mumford-Shah Model

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Abstract. Mumford-Shah model is a very popular variational model in image restoration and image classification. As a simplification, piecewise constant Mumford-Shah model is very useful and has been extensively studied in recent two decades. An interesting topic on Mumford-Shah model is how to choose the weight parameters for implementation. This paper aims at discussing and analyzing the relation between choosing weight parameters and removing/preserving small structures, including noise, for piecewise-constant Mumford-Shah model. The main contributions are: (1) provided a necessary condition on the weight parameter of regularity term for removing a small structure from background. It is proved that whether or not a small structure could be removed from the background in the piecewise-constant Mumford-Shah model depends on two aspects: the ratio of the area to the perimeter for the smaller structure and the intensities of other classes; (2) provided a decision-making strategy on the class that a small structure will be classified to if it does not belong to the background; (3) developed a balanced Mumford-Shah model with which the scale measurements (weights for fidelity terms) can be chosen based on prior knowledge or users' purposes.

Keywords: Mumford-Shah Model; image classification; balanced segmentation; small structure

1 Introduction

Let $I(x)$ be an 2-D image defined on a bounded, smooth and open set $\Omega \subset \mathbf{R}^2$. Suppose there are K different objects existing in the domain. Together with the background, there are totally $K + 1$ classes in the image. The $K + 1$ -phase segmentation is to find a partition $\{\Omega_i\}_{i=0}^K$ of Ω so that the pixels in a same region Ω_i share same or similar features while pixels located in different regions have quite different features. In this paper, we always use Ω_0 to represent the

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