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Efficient image segmentation using partial differential equations and morphology. (English)

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Summary: The goal of this paper is to investigate segmentation methods that combine fast preprocessing algorithms using Partial Differential Equations (PDEs) with a watershed transformation with region merging. We consider two well-founded PDE methods: a nonlinear isotropic diffusion filter that permits edge enhancement, and a convex nonquadratic variational image restoration method which gives good denoising. For the diffusion filter, an efficient algorithm is applied using an Additive Operator Splitting (AOS) that leads to recursive and separable filters. For the variational restoration method, a novel algorithm is developed that uses AOS schemes within a Gaussian pyramid decomposition. Examples demonstrate that preprocessing by these PDE techniques significantly improves the watershed segmentation, and that the resulting segmentation method gives better results than some traditional techniques. The algorithm has linear complexity and it can be used for arbitrary dimensional data sets. The typical CPU time for segmenting a 256^2 image on a modern PC is far below 1 s.

MSC:

68U99 Computing methodologies and applications
68U10 Computing methodologies for image processing
68T10 Pattern recognition, speech recognition

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