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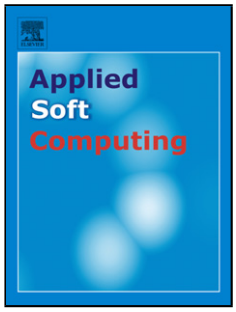

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A two-dimensional multilevel thresholding method for image segmentation

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Abstract

In this work, we develop a two-dimensional multilevel thresholding technique based on Rényi and Tsallis entropies. The formulation of the proposed method gives rise to an NP-hard combinatorial optimization problem. In order to solve efficiently this problem, two leading evolutionary algorithms, namely the Quantum Genetic Algorithm (QGA) and the Differential Evolution (DE) have been employed and compared. The effectiveness of both the proposed method and the optimizers was demonstrated on a sample of real-world and synthetic images showing different types of gray-level distributions. Moreover, the contribution of the two-dimensional histogram to the segmentation quality has been highlighted on some images corrupted by noise and containing shadow or reflection effects. Experimental results demonstrated, first, that DE is less time consuming than QGA which is slightly more efficient on complex problems. Second, the Rényi and Tsallis entropies leads to similar image segmentation quality. Finally, we have shown that the proposed method is more appropriate than bilevel thresholding for multimodal and noisy images segmentation.

Keywords: Multilevel image segmentation; two-dimensional histogram; Rényi entropy; Tsallis entropy; Quantum Genetic Algorithm; Differential Evolution.

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