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基于广义反向粒子群与引力搜索混合算法的多阈值图像分割

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Image segmentation of multilevel threshold using hybrid PSOGSA with generalized opposition-based learning

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摘要 提出了基于粒子群优化(PSO)与引力搜索(GSA)混合算法(PSOGSA)的多阈值图像分割方法来解决图像阈值搜寻过程中单一优化算法局部搜索能力不强的问题。提出了图像阈值分割领域中的广义反向学习策略,在阈值寻优过程中提高群体多样性,增强了全局搜索能力;采用了全局最优解的正态变异策略,扩展了全局最优的搜索区域,避免了算法的早熟收敛。在此基础上,实现了基于广义反向粒子群与引力搜索混合算法的多阈值图像分割方法。最后,使用本方法对复杂多目标图像进行了多阈值分割实验,并与引力搜索算法和萤火虫算法进行了比较。实验结果表明,本文方法的分割精度优于引力搜索算法与萤火虫算法,其分割目标函数值在连续运行时的标准差降低了90%以上,是一种精度高、稳定性强的多阈值图像分割方法。

关键词 : 图像分割, 多阈值分割, 粒子群优化, 引力搜索算法, 广义反向学习, 正态变异

Abstract : A multilevel threshold image segmentation method based on hybrid Particle Swarm Optimization (PSO) and Gravitation Search Algorithm (GSA) was proposed to solve the weakness that a single algorithm in image segmentation has a lower local searching ability. A strategy of generalized opposition-based learning in image segmentation was proposed to improve the population diversity and to strengthen the global searching ability in optimizing processing. The normal mutation strategy on the best particle was conducted to extend the searching space and to avoid the premature convergence of the algorithm. Then, the multilevel threshold image segmentation method of hybrid PSOGSA with generalized opposition-based learning was implemented. Finally, complex image segmentation experiments were processed by proposed method and the results were compared with those of multilevel threshold segmentation methods of GSA and Firefly Algorithm (FA). Experimental results show the proposed method possesses a higher accuracy in multilevel threshold segmentation and the standard deviation of best objective values in continuous operation has decreased by up to 90%. Therefore, the image segmentation method of multilevel threshold using the hybrid PSOGSA with generalized opposition-based learning can be accurately and stably used in multilevel threshold image segmentation.

Key words : image segmentation multilevel threshold segmentation particle swarm optimization gravitational search algorithm generalized opposition-based learning normal mutation

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