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Metaheuristic Optimization in Bioinformatics for Cancer Diagnosis Through Medical Image Processing

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Abstract:

Metaheuristic optimization techniques have emerged as powerful tools in bioinformatics, particularly for enhancing cancer diagnosis through medical image processing. By integrating algorithms such as Grey Wolf Optimizer, Cuckoo Search, and Particle Swarm Optimization with imaging modalities like MRI and ultrasound, researchers have developed advanced computer-aided diagnosis (CAD) systems. These systems effectively address challenges in feature selection, parameter tuning, and image segmentation, leading to improved classification accuracy and reduced computational costs. For instance, the combination of wavelet neural networks with Grey Wolf Optimization has demonstrated superior performance in breast cancer diagnosis by optimizing neural network parameters and enhancing image quality through preprocessing techniques. Similarly, the application of K-means clustering enhanced by Grey Wolf and Cuckoo Search optimizers has shown promise in automating MRI image clustering, facilitating more accurate tumor detection. Moreover, the integration of deep learning models with metaheuristic algorithms has further refined the segmentation and classification processes, contributing to more precise and reliable cancer diagnostics. These advancements underscore the significant role of metaheuristic optimization in improving the efficacy of bioinformatics applications in oncology.

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