Healing Intelligence: A Bio-Inspired Metaheuristic optimization method Using Recovery Dynamics

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Abstract

BioHealing Optimization (BHO) is a bio-inspired metaheuristic optimization algorithm that emulates the biological process of injury and recovery. Its operation follows a cyclical mechanism comprising three main stages: an optional recombination phase, an injury phase, and a healing phase. During recombination, elements from the best-known solution are combined with differences drawn from other population members, producing candidate solutions that inherit beneficial traits while maintaining diversity. The injury phase applies stochastic perturbations to selected dimensions of solutions, using either Gaussian-like distributions or heavy-tailed variations, thereby promoting exploration of new regions in the search space. In the healing phase, the altered dimensions are guided gradually toward the current best solution, mimicking the progressive restoration of function observed in biological tissues. These core mechanisms are enhanced through adaptive strategies, including dynamic adjustment of injury intensity and probability, a "scar mapping" system that stores directional trends, focus on dimensions of higher relevance, and the introduction of high-intensity disturbance phases to overcome stagnation. The combination of these elements results in a self-regulating search process that maintains a balance between exploration and exploitation, enabling effective performance on challenging continuous optimization problems.