NICHING METHODS FOR MULTI-MODAL OPTIMIZATION

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Population or single solution search-based optimization algorithms (i.e. {meta,hyper}-heuristics) in their original forms are usually designed for locating a single global solution. Representative examples include among others evolutionary and swarm intelligence algorithms. These search algorithms typically converge to a single solution because of the global selection scheme used. Nevertheless, many real-world problems are "multimodal" by nature, i.e., multiple satisfactory solutions exist. It may be desirable to locate many such satisfactory solutions, or even all of them, so that a decision maker can choose one that is most proper in his/her problem domain. Numerous techniques have been developed in the past for locating multiple optima (global and/or local). These techniques are commonly referred to as "niching" methods. A niching method can be incorporated into a standard search-based optimization algorithm, in a sequential or parallel way, with an aim to locate multiple globally optimal or suboptimal solutions. Sequential approaches locate optimal solutions progressively over time, while parallel approaches promote and maintain formation of multiple stable subpopulations within a single population. Many niching methods have been developed in the past, including crowding, fitness sharing, derating, restricted tournament selection, clearing, speciation, etc. In more recent times, niching methods have also been developed for meta-heuristic algorithms such as Particle Swarm Optimization, Differential Evolution and Evolution Strategies.

Most of existing niching methods, however, have difficulties that need to be overcome before they can be applied successfully to real-world multimodal problems. Some identified issues include: difficulties to pre-specify some niching parameters; difficulties in maintaining found solutions in a run; extra computational overhead; poor scalability when dimensionality and modality are high. This special session aims to highlight the latest developments in niching methods, bringing together researchers from academia and industries, and exploring future research directions on this topic. We invite authors to submit original and unpublished work on niching methods.

Topics

- Theoretical developments in multimodal optimization

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- Niching methods that incurs lower computational costs
- Handling the issue of niching parameters in niching methods
- Handling the scalability issue in niching methods
- Handling problems characterized by massive multi-modality
- Adaptive or parameter-less niching methods
- Multiobjective approaches to niching
- Multimodal optimization in dynamic environments
- Niching methods applied to discrete multimodal optimization problems
- Niching methods applied to constrained multimodal optimization problems
- Niching methods using parallel or distributed computing techniques
- Benchmarking niching methods, including test problem design and performance metrics
- Comparative studies of various niching methods
- Niching methods applied to engineering and other real-world multimodal optimization problems