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EDITORIAL

Guest editorial: Memetic Computing in the presence of uncertainties

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The complexity of fitness landscapes, e.g., in terms of multi-modalities and presence of plateaus, typical of many real-world optimization problems coupled with the limitations imposed by the No Free Lunch Theorem, are strong mitigating factors for domain-specific Memetic Computing approaches. More specifically, since the No Free Lunch Theorem proves that the performance of each algorithm over all the possible problems is the same, there is no longer a reason to discuss which algorithm is universally better or worse. Thus, instead of trying to propose universally applicable algorithms, researchers in recent years have started to propose algorithms which are tailored specific to the problems in hand. In this context, the Memetic Computing paradigm offers the possibility of flexibly designing domain-specific optimization algorithms by integrating and coordinating algorithmic components capable of dealing with difficulties specifically related to the decision space and fitness landscape of a given problem.

This thematic issue deals with a set of problem difficulties which are of great interest in an industrial context, i.e., uncertainties in the fitness function, and gathers novel Memetic Computing approaches which attempt to solve this set of problems. It addresses those optimization problems characterized by a complex fitness landscape and uncertain environments. An optimization problem contains uncertainties when, for a given point, the fitness value varies over time. In other words, the same solution can score differently if its fitness value is calculated at different time periods of the evolution. Two macro-categories characterize uncertainties in optimization problems: (1) dynamic fitness environment; and (2) noisy fitness function. The first means that the fitness landscape varies its shape, with the position of the optima, during run-time. This situation is typical, for example, in telecommunications and control engineering. The second means that the fitness function is non-deterministic but, on the contrary, is affected by noise. This situation occurs when, for example, measurement devices and approximators are involved within the fitness calculation/measurement/construction framework.

This thematic issue includes three novel studies, two of them on dynamic fitness landscapes and one on noisy optimization problems. The paper titled "A predictive gradient strategy for multiobjective evolutionary algorithms in a fast changing environment" and authored by Wee Tat Koo, Chi Keong Goh, and Kay Chen Tan, proposes a memetic approach composed of an evolutionary framework and a gradient search method for handling multi-objective optimization problems in fast changing dynamic environments. The proposed algorithm makes use of a prediction logic, which attempts to foresee the dynamics of the landscape, and a memory structure which saves only the most promising solutions in order to reduce the computational overhead. In the paper "A memetic differential evolution approach in noisy optimization" by Ernesto Mininno and Ferrante Neri, a Differential Evolution framework is hybridized with a line search, attempting to locally optimize the scale factor and thus the offspring performance. The algorithm also integrates a noise analysis component for performing, on the basis of a theoretical background, only the necessary fitness evaluations which guarantee an efficient fitness averaging. In

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the paper "Dynamic function optimization with hybridized extremal dynamics" by Irene Moser and Raymond Chiong, three memetic approaches for moving peaks problems are presented. The three approaches differ from each other in the employed local search structure. In addition, this paper offers a valuable comparative analysis on the role and the performance of the three local search approaches for moving peaks problems.

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