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Effective, Fast and Adaptive Strategies for Evolutionary Computation

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Abstract:

During recent years, the exploitation of new intelligent systems in engineering, technology, modelling, computing and simulations has attracted the attention of researchers worldwide. Currently used methods are mostly based on soft computing, which is a discipline tightly linked with computers, representing a set of special algorithm methods, and belonging to the artificial intelligence paradigm. The most popular methods are neural networks and machine learning, evolutionary computation techniques (ECTs), and fuzzy logic [1]. Currently, ECTs are known as a powerful set of tools for almost any difficult and complex optimization problem. Furthermore, in today's area of ECTs, specialized methods exist which allow the synthesis of complex structures (e.g. mathematical formulas etc.). Well-known techniques include for example, genetic programming, grammatical evolution or analytic programming.

These soft computing based techniques are used for global optimization problems [2], [3], [4], process control, diagnosis, pattern recognition and image-processing, cybersecurity, operation research, industrial informatics, planning, scheduling and assignment problems, power and smart systems and financial & stock-market monitoring and prediction purposes. Moreover, the rapid development in information technologies has facilitated the development of high-performance computing, hybrid and parallel evolutionary techniques, and mainly, the self-adaptive strategies. Despite the fact, that the ongoing research has brought many powerful and robust metaheuristic algorithms, the researchers have to deal with a well-known phenomenon so-called no free lunch theorem [5] forcing them to test various methods, techniques, adaptations and parameter settings leading to the acceptable results

This thesis will be focused on the study and development of fast, effective and self-adaptive strategies of either evolutionary algorithms or swarm-based algorithms for a wide class of optimization problems. Emphasis will be laid either on the combination and hybridization of various known adaptive approaches, or the development and synthesis of novel adaptive strategies. Moreover, due to the popularity of Machine Learning, the focus will be also to development of robust evolutionary techniques for evolutionary machine learning, i.e. algorithms for highly constrained and higher-dimensional optimization problems The evolutionary techniques of interest will be (but not limited to) Differential Evolution (DE) [6], Particle Swarm Optimizer (PSO) [7], Evolutionary Strategies (ES/CMAES) [1] and more.

Literature:

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