Preface

Evolutionary Computation has become an important problem solving methodology among many researchers working in the area of computational intelligence. The population based collective learning process, self adaptation and robustness are some of the key features of evolutionary algorithms when compared to other global optimization techniques. Evolutionary computation has been widely accepted for solving several important practical applications in engineering, business, commerce etc. As we all know, the problems of the future will be more complicated in terms of complexity and data volume.

Hybridization of evolutionary algorithms is getting popular due to their capabilities in handling several real world problems involving complexity, noisy environment, imprecision, uncertainty and vagueness. This edited volume is targeted to present the latest state-of-the-art methodologies in '*Hybrid Evolutionary Algorithms*'. This book deals with the theoretical and methodological aspects, as well as various applications to many real world problems from science, technology, business or commerce. This volume comprises of *14* chapters including an introductory chapter giving the fundamental definitions and some important research challenges. Chapters were selected on the basis of fundamental ideas/concepts rather than the thoroughness of techniques deployed. The thirteen chapters are organized as follows.

In Chapter 1, *Grosan and Abraham* emphasize the need for hybrid evolutionary algorithms and illustrate the various possibilities for hybridization of an evolutionary algorithm. Further, some of the generic hybrid evolutionary architectures are presented with a detailed review of some of the interesting hybrid frameworks reported in the literature.

Abs da Cruz et al. in Chapter 2 propose a novel evolutionary algorithm for numerical optimization inspired by the multiple universes principle of quantum computing that presents faster convergence time for the benchmark problems. Empirical results reveal that the proposed algorithm can find better solutions, with less evaluations, when compared with similar algorithms, which greatly reduces the convergence time.

In Chapter 3, *Dellino et al.* deal with the application of hybrid evolutionary methods to design optimization issues in which approximation techniques and model management strategies are used to guide the decision making process in a multidisciplinary context. A multi-objective optimization formulation of the problem is proposed. The adopted optimization strategy pursues the Pareto-optimality on the basis of fitness functions that capture domain specific design aspects as well as static and dynamic objectives. The computational experiments illustrate the efficiency of the proposed method for finding a satisfactory set of good solutions.

Oliveira and Lorena in the fourth chapter propose a clustering search as a generic way of combining search metaheuristics with clustering to detect promising search areas before applying local search procedures. The clustering process aims to gather similar information about the search space into groups, maintaining a representative solution associated with this information. Two applications are examined for combinatorial and continuous optimization problems clearly illustrating how to develop hybrid evolutionary algorithms based on clustering search.

In the fifth chapter, *Mo et al.* present Particle swarm assisted Incremental Evolution Strategy (PIES), which is designed for enhancing the performance of evolutionary computation techniques by evolving the input variables incrementally. The whole evolution consists of several phases and one more variable is focused in each phase. The number of phases is equal to the maximum number of variables. Evolution strategies is applied to search optima in the cutting planes / hyper-planes, while particle swarm optimization algorithm is applied to adjust the cutting planes / hyper-planes. The experiment results illustrate that PIES generally outperforms some other optimization algorithms, in terms of quality of solutions which are closer to the true optima both in the variable and in the objective space.

Frederic and Serge in the sixth chapter attempts to build an efficient nearest neighbor classifier that could achieve a high accuracy rate and also minimizes the set of prototypes to make the classifier tractable and by reducing the set of features used to describe the prototypes. Authors propose a method based on a hybrid genetic algorithm combined with a local optimization procedure. Some concepts are introduced to promote both diversity and elitism in the genetic population. The proposed method is validated using synthetic and real chemometric data, involving a large number of features.

In the seventh chapter, *Kim et al.* propose a hybrid approach by combining a euclidian data distance based genetic algorithm and particle swarm optimization method for tuning the proportional integral derivative controller of an automatic voltage regulator. Using the hybrid Euclidean data distance based genetic algorithm - particle swarm optimization approach, global and local solutions could be simultaneously found for optimal tuning of the controller parameters.

Kim and Abraham in the eighth chapter propose an hybrid approach involving genetic algorithms and bacterial foraging algorithms for function opti-

mization problems. The proposed method is illustrated using some test functions and the performance is studied with an emphasis on mutation, crossover, variation of step sizes, chemotactic steps, and the lifetime of the bacteria. The proposed algorithm is then used to tune a Proportional Integral Derivative (PID) controller of an automatic voltage regulator. To design disturbance rejection tuning, disturbance rejection conditions based on H_∞ are illustrated and the performance of response is computed for the designed controller as the integral of time weighted squared error. Simulation results clearly illustrate that the proposed approach is very efficient and could easily be extended for other global optimization problems.

Dürr et al. in the ninth chapter present a hybrid algorithm employing a genetic algorithm and the sequential quadratic programming algorithm. Authors illustrate that the proposed memetic algorithm for the calibration of photoresist parameters is adequate to improve both the convergence behavior and the reproducibility of the results.

Hoque et al. in the tenth chapter explore hybrid evolutionary computing techniques for protein folding prediction (PFP). By using the well known Hydrophobic-Hydrophilic model, the performance of a number of contemporary non-deterministic search techniques are examined with particular emphasis to the new hybrid genetic algorithm approach.

In the eleventh chapter, *Xhafa* presents a hybrid evolutionary metaheuristic based on memetic algorithms with several local search algorithms. The memetic algorithm is used as the principal heuristic that guides the search and can use any of 16 local search algorithms during the search process. The local search algorithms used in combination with the memetic algorithm are obtained by fixing either the type of the neighborhood or the type of the move. They include swap/move based search, hill climbing, variable neighborhood search and Tabu search. Author also discusses some issues related to the fine tuning and experimenting of meta-heuristics in a dynamic environment.

Hruschka et al. in the twelveth chapter elaborate on an evolutionary algorithm specially designed to solve clustering problems and shows how it can be used to optimize the k-means algorithm. The performance of the hybrid approach is illustrated by experiments using several bioinformatics datasets with multiple measurements, which are expected to yield more accurate and more stable clusters. Euclidean and Pearson measures are employed for computing the dissimilarity between genes. A review of the use of evolutionary algorithms for gene-expression data processing is also included.

In the thirteenth chapter, *Calderon et al.* present a hybrid method to find the best set of parameters to match a transformed image (possible with noise) to a target image. Hybridization occurs when genetic algorithms are able to determine rough areas of the parameter optimization space, but fail to fine tune the parameters. In that case, the Newton Levenberg Marquardt method is used to refine the results.

Kumar and Singh in the last chapter highlight the issues and challenges in solving single and multiobjective Traveling Salesman Problem (TSP) in-

stances. Authors present a Pareto-rank based evolutionary algorithm hybridized with local search heuristics. Since the problem is hard and Pareto-front is unknown, the main issue in such problem instances is how to assess convergence. Authors used a simple selection process to maintain diversity and rank-histograms to assess convergence. The proposed method is evaluated using TSP instances taken from well known benchmark datasets and the results are analyzed in terms of obtained solution fronts, diversity and convergence.

We are very much grateful to the authors of this volume and to the reviewers for their tremendous service by critically reviewing the chapters. The editors would like to thank Dr. Thomas Ditzinger (Springer Engineering In-house Editor, Studies in Computational Intelligence Series), Professor Janusz Kacprzyk (Editor-in-Chief, Springer Studies in Computational Intelligence Series) and Ms. Heather King (Editorial Assistant, Springer Verlag, Heidelberg) for the editorial assistance and excellent cooperative collaboration to produce this important scientific work.

We hope that the reader will share our excitement to present this volume on '*Hybrid Evolutionary Algorithms*' and will find it useful.

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