Preface

One of the main difficulties that a user faces when applying an evolutionary algorithm (or, as a matter of fact, any heuristic method) to solve a given problem is to decide on an appropriate set of parameter values. Before running the algorithm, the user typically has to specify values for a number of parameters, such as population size, selection rate, and operator probabilities, not to mention the representation and the operators themselves. Over the years, there have been numerous research studies on different approaches to automate control of these parameters as well as understand their interactions.

At the 2005 Genetic and Evolutionary Computation Conference, held in Seattle, the first two editors of this book organized a workshop entitled *Parameter setting in evolutionary algorithms*. Shortly after we announced the workshop, we were approached by Janusz Kacprzyk to prepare a volume containing extended versions of some of the papers presented at the workshop, as well as contributions from other authors in the field.

We gladly accepted the invitation and Zbigniew Michalewicz joined us in the project.

The resulting work is in front of you, a book with 15 chapters covering the topic on various areas of evolutionary computation, including genetic algorithms, evolution strategies, genetic programming, estimation of distribution algorithms, and also discussing the issues of specific parameters used in parallel implementations, multi-objective EAs, and practical consideration used for real-world applications. Some of these chapters are overview oriented while others describe recent advances in the area.

In the first chapter, Ken De Jong gives us an historical overview on parameterized evolutionary algorithms, as well as his personal view on the issues related to parameter adaptation. De Jong was the first person to conduct a systematic study of the effect of parameters on the performance of genetic algorithms, and it is interesting to hear his view now that more than 30 years have passed since his 1975 PhD dissertation.

In the second chapter, Agoston Eiben et al. present a survey of the area giving special attention to on-the-fly parameter setting.

In chapter 3, Silja Meyer-Nieberg and Hans-Georg Beyer focus on self-adaptation, a technique that consists of encoding parameters into the individual's genome and evolving them together with the problem's decision variables, and that has been mainly used in the area of evolutionary programming and evolution strategies.

Chapter 4 by Dirk Thierens deals with adaptive operator allocation. These rules are often used for learning probability values of applying a given operator from a fixed set of variation operators. Thierens surveys the probability matching method, which has been incorporated in several adaptive operator allocation algorithms proposed in the literature, and proposes an alternative method called the *adaptive pursuit strategy*. The latter turns out to exhibit a better performance than the probability matching method, in a controlled, non-stationary environment.

In chapter 5, Mike Preuss and Thomas Bartz-Beielstein present the *sequential parameter optimization* (SPO), a technique based on statistical design of experiments. The authors motivate the technique and demonstrate its usefulness for experimental analysis. As a test case, the SPO procedure is applied to self-adaptive EA variants for binary coded problems.

In chapter 6, Bo Yuan and Marcus Gallagher bring a statistical technique called *Racing*, originally proposed in the *machine learning* field, to the context of choosing parameter settings in EAs. In addition, they also suggest an hybridization scheme for combining the technique with meta-EAs.

In chapter 7, Alan Piszcz and Terrence Soule discuss structure altering mutation techniques in genetic programming and observe that the parameter settings associated with the operators generally show a nonlinear response with respect to population fitness and computational effort.

In chapter 8, Michael Samples et al. present *Commander*, a software solution that assists the user in conducting parameter sweep experiments in a distributed computing environment.

In chapter 9, Fernando Lobo and Cláudio Lima provide a review of various adaptive population sizing methods that have been proposed for genetic algorithms. For each method, the major advantages and disadvantages are discussed. The chapter ends with some recommendations for those who design and compare self-adjusting population sizing mechanisms for genetic algorithms.

In chapter 10, Tian-Li Yu et al. suggest an adaptive population sizing scheme for genetic algorithms. The method has strong similarities with the work proposed by Smith and Smuda in 1993, but the components of the population sizing model are automatically estimated through the use of linkage-learning techniques.

In chapter 11, Martin Pelikan et al. present a parameter-less version of the hierarchical Bayesian optimization algorithm (hBOA). The resulting algorithm solves nearly decomposable and hierarchical problems in a quadratic or subquadratic number of function evaluations without the need of user inter-

vention for setting parameters. The chapter also discusses how the parameterless technique can be applied to other estimation of distribution algorithms.

In chapter 12, Kalyanmoy Deb presents a functional decomposition of an evolutionary multi-objective methodology and shows how a specific algorithm, the elitist non-dominated sorting GA (NSGA-II), was designed and implemented without the need of any additional parameter with respect to those existing in a traditional EA. Deb argues that this property of NSGA-II is one of the main reasons for its success and popularity.

In chapter 13, Erick Cantú-Paz presents theoretical models that predict the effects of the parameters in parallel genetic algorithms. The models explore the effect of communication topologies, migration rates, population sizing, and migration strategies. Although the models make assumptions about the class of problems being solved, they provide useful guidelines for practitioners who are looking for increased efficiency by means of parallelization.

In chapter 14, Zbigniew Michalewicz and Martin Schmidt summarize their experience of tuning and/or controlling various parameters of evolutionary algorithms from working on real word problems. A car distribution system is used as an example. The authors also discuss prediction and optimization issues present in dynamic environments, and explain the ideas behind *Adaptive Business Intelligence*.

The last chapter of the book, by Neal Wagner and Zbigniew Michalewicz, presents the results of recent studies investigating non-static parameter settings that are controlled by feedback from the genetic programming search process in the context of forecasting applications.

We hope you will find the volume enjoyable and inspiring; we also invite you to take part in future workshops on *Parameter setting in evolutionary algorithms*!

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