Preface

Combinatorial optimization problems, although largely overlooked in the early development of optimization techniques, are rather common in the operational research and management science applications. In just these domains there arose different problems in location, transport, scheduling, network design, timetabling, partitioning, path planning, assignment, cutting, and elsewhere, with common characteristics of being NP-complete, that is, hard (or rather impossible at present) to solve in a reasonable time for problems in real dimensions. Recent developments like e.g. those in communication technology, management of world-scale enterprises or artificial intelligence techniques introduce new combinatorial problems and often new scales, far exceeding the dimensions considered before.

It became evident already in the 1970s that optimization of such problems for practical purposes requires special types of algorithms which do not necessarily attempt to find the optimal solution but possibly terminate with a solution close to the optimal, computed, though, in much shorter time. As these algorithms use some rules coming from common sense and practical experience, they were called *heuristics*. Although some general advise on how to construct heuristics could be given, see e.g. Silver et al. (1980), the heuristics were generally closely related to the problem at hand and might even change with some of its characteristics, like e.g. problem dimension.

The 1980s spotted the development of general heuristic methods, potentially applicable to any hard optimization problem after some adaptation. These type of currently known heuristics include simulated annealing, taboo search, genetic algorithms, target analysis and (so far rather marginally applied to optimization problems) neural networks. To distinguish them from other methods, more tailor-made heuristics, the term *metaheuristics* has been coined.

The main idea of most metaheuristic methods is evident if we consider two opposite approaches to optimization of combinatorial problems: local search (in an appropriately defined neighbourhood) and global search (like full enumeration or stochastic Monte Carlo type techniques). The former easily ends in the first (of usually many) local optimum while the latter is computationally prohibitive for real-life problems. Metaheuristics provide ways of going out of a local optimum while keeping the necessary amount of computation on a reasonable level. Some of them, like simulated annealing, genetic algorithms or neural networks, are analogies of natural (physical or biological) processes. To keep this preface within in a reasonable dimension we will not be presenting each heuristic method in more details. The reader is referred in this respect to an excellent tutorial paper by Pirlot (1993).

So far, there is rather little theoretical justification for the success of the metaheuristics in solving hard problems. Before it will be achieved, the practical verification of metaheuristics on different test problems helps in better understanding of their role and the extent of applications. This volume presents a compact collection (after an earlier one edited by Vidal, 1993) of such contributions connected with the simulated annealing approach.

Following experience gained up to now, the volume starts with a tutorial paper on simulated annealing and a survey paper, both not only presenting the approaches but also focusing on important factors of applying them to practical problems. The rest of the papers present applications of the simulated annealing algorithm to solve different real life combinatorial optimization problems. They range from problems of clustering, assortment, power network design, scheduling (total tardiness problem), vehicle routing (dial-a-ride) shape detection, down to location problems. All the authors carefully analyze the properties of the algorithms, discuss the choice of parameters and often compare the performance of the simulated annealing approach to other metaheuristics, like taboo search (Borges & Ferreira) or genetic algorithms (di Ianni at al.), as well as other heuristic methods. Czyżak & Jaszkiewicz propose also a method which incorporates some concepts of genetic algorithms and simulated annealing to deal with a multiobjective investment problem.

We feel that this volume will be of help in further identification of application possibilities offered by the simulated annealing methodology. Moreover, new results, both concerning new problem formulation and new algorithm specification, are presented. Last but not least, the volume is intended to acquaint new groups of researchers with the power of this particular representative member of the family of metaheuristic algorithms.

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