Book Review

C. A. Floudas and P. M. Pardalos, *A Collection of Test Problems for Constrained Global Optimization Problems*, Lecture Notes in Computer Science 455 (Eds. G. Goos and J. Hartmanis), Springer-Verlag, Berlin, Heidelberg, New York (1990), xii + 180 pp.

This monograph by Floudas and Pardalos should be a very useful contribution to researchers in the area of global optimization. Several collections of test problems for nonlinear programming problems have been available, but these have been aimed primarily at testing local optimization algorithms. The few test problems that have been reported specifically for global optimization problems have been restricted to unconstrained problems (e.g., Dixon and Szegö, 1978). Given the increased interest in the development of algorithms for the global optimization of nonconvex constrained problems, this monograph provides a timely service to researchers in this area.

The test problems are presented in 11 chapters in which the model equations, data, problem size and solutions are given. For most of the problems the best known solution rather than the global optimum are reported. Chapters 2 and 3 include standard and randomly generated test problems for quadratic programming and quadratically constrained problems. Chapter 4 includes a number of well known nonconvex nonlinear programming test problems. Chapters 5 to 10 present nonlinear and mixed integer nolinear programming problems in chemical engineering that arise in applications such as distillation, pooling and blending, heat exchanger networks, phase equilibria and chemical reactors. Chapters 11 and 12 deal with applications in mechanical and VLSI design. The size of the problems ranges from two to about one hundred variables and constraints, respectively.

A unique feature of this monograph is that it presents a large number of optmization problems in engineering showing that nonconvexities tend to be the rule rather than the exception in these problems. The reader, should be warned that numerical difficulties will be encountered in the solution of some of these problems. For instance, several of the constraint functions of Test Problems 8 and 9 in chapter 4 are given in terms of logarithmic mean temperature differences for heat exchangers. This function is undefined when the two temperature differences are the same. Chapter 7 avoids this difficulty by replacing the logarithmic mean with the continuous approximation proposed by Patterson (1984). Also, some of the problems in Chapter 8 on phase equilibrium are likely to cause numerical difficulties when the concentrations take very small values (Test problem 3). There are also few omissions in this monograph. For instance, data and/or solutions are not reported for several test problems (e.g. Test Problem 5 in Chapter 5, Test Problem 1 and 3 in Chapter 12).

There is no doubt, however, that anyone interested in testing global optimization algorithms should acquire this monograph. The reader will find many of the test problems to be quite challenging. It should be interesting to see for how many of the problems the reported best known solutions do indeed correspond to the global optimum. In addition, the many practical applications may motivate the study and identification of new classes of structured problems in global optimization.

References

1. Dixon, L. C. W. and G. P. Szegö (1978), *Towards Global Optimization 2*, North Holland.
2. Patterson, W. R. (1984), A Replacement for the Logarithmic Mean, *Chem. Eng. Sci.* **39**, 1635.

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