

## PREFACE

In Chemical Engineering, optimization plays a key role in the design, scheduling and operation of industrial reactors, separation processes, heat exchangers and complete plants. It is also being used on a larger scale in managing supply chains and production plants across the world. Furthermore, optimization is useful for understanding and modeling physical phenomena and processes. Without the use of optimization techniques, chemical processes would not be as efficient as they are now. Optimization has, in short, proven to be essential for achieving sustainable processes and manufacturing.

In many applications, the key is to find the global optimum and not just a local optimum. This is desirable as the former is obviously better than the latter in terms of the desired objective function. In some applications such as phase equilibrium, only the global optimum is the correct solution. Finding the global optimum is more challenging than finding a local optimum. Methods for finding the global optimum can be divided into two main groups: deterministic and stochastic (or probabilistic) techniques. Stochastic global optimization (SGO) techniques involve probabilistic elements and consequently use random numbers in the search for the global optimum. They include simulated annealing, genetic algorithms, taboo/taboo search and differential evolution. SGO techniques have a number of attractive features including being simple to understand and program, requiring no assumptions on the optimization problem, the wide range of problems they can solve, their ability to provide robust results for highly nonlinear problems even with many decision variables, and faster convergence towards global optimal solution.

Significant progress has been made in SGO techniques and their applications in the last two decades. However, there is no book devoted to SGO techniques and their applications in Chemical Engineering, which motivated the preparation of this book. The broad objective of this book is to provide an overview of a number of SGO techniques and their applications to Chemical Engineering. Accordingly, there are two parts in the book. The first part, Chapters 2 to 11, includes description of the SGO techniques and reviews of their recent modifications and Chemical Engineering applications. The second part, Chapters 12 to 19, focuses on Chemical Engineering applications of SGO techniques.

Each chapter in the book is contributed by well-known and active researcher(s) in the area. A brief resume and photo of each of the contributors to the book, are given on the enclosed CD-ROM. Each chapter in the book was reviewed anonymously by at least two experts and/or other contributors. Of the submissions received, only those considered to be useful for education and/or research were revised by the respective contributor(s), and the revised submission was finally reviewed for presentation style by the editor or one of the other contributors. I am grateful to my long-time mentor, Dr. R. Luus, who coordinated the anonymous review of chapters co-authored by me.

The book will be useful to researchers in academia and research institutions, to engineers and managers in process industries, and to graduates and senior-level undergraduates. Researchers and engineers can use it for applying SGO techniques to their processes whereas students can utilize it as a supplementary text in optimization courses. Each of the chapters in the book can be read and understood with little reference to other chapters. However, readers are encouraged to go through the Introduction chapter first. Many chapters contain several exercises at the end, which can be used for assignments and projects. Some of these and the applications discussed within the chapters can be used as projects in optimization courses at both undergraduate and postgraduate levels. The book comes with a CD-ROM containing many programs and files, which will be helpful to readers in solving the exercises and/or doing the projects.

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Gade Pandu Rangaiah