

Preface

This book is about the Augmented Lagrangian method, a popular technique for solving constrained optimization problems. It is mainly dedicated to engineers, chemists, physicists, economists, and general users of constrained optimization for solving real-life problems. Nevertheless, it describes in rigorous mathematical terms the convergence theory that applies to the algorithms analyzed. Users often need to understand with precision the properties of the solutions that a practical algorithm finds and the way in which these properties are reflected in practice. Many theorems concerning the behavior of practical algorithms will be found in this book. The geometrical and computational meaning of each theoretical result will be highlighted to make the relevant theory accessible to practitioners. Often, the assumptions under which we prove that algorithms work will not be the most general ones but will be those whose interpretation helps one to understand the computational behavior in real-life problems. Moreover, the plausibility of most assumptions will be discussed, presenting simple sufficient conditions under which assumptions hold. This helps one foresee what can be expected from a practical algorithm and which properties are not expected at all.

Modest mathematical background is required to understand the proofs and less is required for understanding and interpreting statements and definitions. Elementary calculus in \mathbb{R}^n with the basic topological properties concerning convergence of sequences and compact sets are enough. In fact, we have deliberately included only results for which the comprehension of such background is sufficient. The optimality conditions for nonlinear programming, for example, are presented in a concise though rigorous way that demands only resources acquired in good undergraduate engineering courses. In particular, although familiarity is always welcome, no previous knowledge of optimization is required.

Readers are introduced in this book to the employment of a specific constrained optimization package of Augmented Lagrangian type, called Algencan. The software is introduced after the statement and interpretation of all the relevant theory. The book finishes with practical examples. Codes and supplementary materials can be found at www.siam.org/books/fa10.

Acknowledgments Many students, colleagues, and friends have contributed to this book and to the development of Algencan. To all of them we are extremely thankful. In particular, we would like to thank Ana Friedlander, Francisco Magalhães Gomes, Francisco Sobral, Gabriel Haeser, Jair Silva, Jan Gentil, John Gardenghi, Juliano Francisco, Maria Aparecida Diniz Ehrhardt, Márcia Gomes Ruggiero, Margarida Pinheiro Mello, Marina Andretta, Laura Schuverdt, Leandro Prudente, Lucas Pedroso, Lúcio Tunes dos Santos, Luis Felipe Bueno, Luiz Antonio Medeiros, Nataša Krejić, Rafael Lobato, Ricardo Andrade, Roberto Andreani, Rodrigo Lima, Sandra Santos, Sergio Ventura, Vera Lucia da Rocha Lopes, Viviana Ramírez, and Yalcin Kaya. We are especially thankful to Rafael

Lobato for the dedicated and careful reading of the manuscript. We are also thankful to all the Algenca users who have contributed with suggestions over the years. We also would like to thank Marcos Raydan and the other members of the editorial board of the SIAM Fundamentals of Algorithms book series, who encouraged us to write this book. To the anonymous referees of our proposal, whose comments contributed to assembling and giving shape to our initial ideas, many thanks for invigorating and stimulating suggestions and kind words. We also express our gratitude to the Institute of Mathematics and Statistics of the University of São Paulo and to the Institute of Mathematics, Statistics, and Scientific Computing of the State University of Campinas for their support of our research and to the National Council for Scientific and Technological Development (CNPq) and the São Paulo Research Foundation (FAPESP, grants 2013/03447-6, 2013/05475-7, and CEPID/Industrial Mathematics 2013/07375-0) for their financial support. Finally, we wish to thank the SIAM publishing staff, including Bruce Bailey, Gina Rinelli, and Lois Sellers for their hard work. In particular, our thanks to Ann Manning Allen and Elizabeth Greenspan for their patience, understanding, and support.

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