

# Preface

This book can be considered as the result of a ten-year cooperation (starting in 2000) of the four authors within the so-called Stochastic Optimization Working Group (SOWG), a research team of the CERMICS (Applied Mathematics Laboratory) of École Nationale des Ponts et Chaussées (ENPC-ParisTech). Among the topics addressed in this working group, a major concern was to devise numerical methods to effectively solve stochastic optimization problems, particularly in a dynamic context, as this was the context of most real-life applications also tackled by the group.

The background of the four authors is system theory and control but the 2000s have seen the emergence of the Stochastic Programming stream, a stochastic expansion of Mathematical Programming, so the group was interested in bridging the gap between these two communities.

Of course, several Ph.D. students took part in the activities of this group, and among them were Kengy Barty, Laetitia Andrieu, Babacar Seck, Cyrille Strugarek, Anes Dallagi, Pierre Girardeau. Their contributions are gratefully acknowledged. We hope this book can help future students to get familiar with the field.

The book comprises five parts and two appendices. The first part provides an introduction to the main issues discussed later in the book, plus a chapter on the stochastic gradient algorithm which addresses the so-called open-loop optimization problems in which on-line information is absent. Part Two introduces the theoretical tools and notions needed to mathematically formalize and handle the topic of information which plays a major part in stochastic dynamic problems. It also discusses optimality conditions for such problems, such as the dynamic programming equation, and a variational approach which will lead to numerical methods in the next part. Part Three is precisely about discretization and numerical approaches. A simple benchmark illustrates the contribution of the particle method proposed in Chap. 7. Convergence issues of all those techniques are discussed in Part Four. Part Five is devoted to more advanced topics that are more or less out of reach of the numerical methods previously discussed, namely multi-agent problems and the presence of the so-called dual effect. Appendix A recalls some basic facts on

Optimization, while Appendix B provides a brief description of essential tools of Probability theory.

Although the four authors share the responsibility of the whole book contents, the reader may be interested in knowing who was the primary writer of each chapter. Here is the list:

**Pierre Carpentier:** Chapter 2, Appendix A;

**Jean-Philippe Chancelier:** Chapter 8, Appendix B;

**Guy Cohen:** Notation (in preliminary pages), Chapters 1, 5, 6, 7;

**Michel De Lara:** Chapters 3, 4, 9, 10.

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Control and Stochastic Programming

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