
Preface

The idea for this book originated during the workshop “Model order reduction, coupled problems and optimization” held at the Lorentz Center in Leiden from September 19–23, 2005. During one of the discussion sessions, it became clear that a book describing the state of the art in model order reduction, starting from the very basics and containing an overview of all relevant techniques, would be of great use for students, young researchers starting in the field, and experienced researchers. The observation that most of the theory on model order reduction is scattered over many good papers, making it difficult to find a good starting point, was supported by most of the participants. Moreover, most of the speakers at the workshop were willing to contribute to the book that is now in front of you.

The goal of this book, as defined during the discussion sessions at the workshop, is three-fold: first, it should describe the basics of model order reduction. Second, both general and more specialized model order reduction techniques for linear and nonlinear systems should be covered, including the use of several related numerical techniques. Third, the use of model order reduction techniques in practical applications and current research aspects should be discussed.

We have organized the book according to these goals. In Part I, the rationale behind model order reduction is explained, and an overview of the most common methods is described. Furthermore, in the second chapter, an introduction is given to background material from numerical linear algebra needed to assess the theory and methods presented later in the book. This is very important and useful information, as advances in numerical linear algebra often lead to new results in the area of model order reduction. Thus, the first two chapters serve as an introduction to readers who are not familiar with the subject. In Part II, model order reduction techniques and related numerical problems are described from different points of view: both frameworks for structure-preserving techniques and more specialized techniques are presented, while numerical methods for (closely) related problems and approaches for nonlinear systems are considered as well. This part serves as the theoretical backbone of the book, containing an overview of techniques used and areas covered. In Part III the focus is on research aspects and applications of model order reduction. A variety of experiments with real-life examples shows that different problems require

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different techniques, while application of the techniques leads to new research topics that are described as well.

Despite the fact that the workshop was organized already in 2005, this book contains many recent advances in model order reduction. Moreover, it presents several open problems for which techniques are still in development, related to both linear systems, which become larger and more complex mainly due to industrial requirements, and nonlinear systems, which demand a completely new theory. The latter illustrates the final and most important goal of this book, namely to serve as a source of inspiration for its readers, who will discover that model order reduction is a very exciting and lively field.

At this point we would like to thank all authors of the chapters in this book. Without the contributions of these experts, it would not be possible to cover the wide and rapidly developing field of model order reduction in one book.

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