

Preface

Differential-algebraic equations (DAEs) are mixed systems of differential and algebraic equations. They form one of the most elegant and simple ways to model a physical system because they allow for the creation of separate models for subcomponents that can then be pasted together via a network. Based on this feature, the analytical and numerical work on DAEs was originally driven by the simulation community, where the desire was to simulate the behavior of a complex system which could be a combination of electrical, mechanical, chemical, or other physical components.

Once a system can be modeled and simulated, this DAE model provides an ideal tool to control or optimize the performance of the underlying physical system. Tremendous advances in the theory and numerical methods have led to applications of model-based control and optimization in almost all areas of science and technology, including many industrial research departments. In this way, model-based optimization and control of DAE modeled processes has become an important driver of innovation.

In spite of the large importance of the interconnected areas of DAE-based simulation, optimization, and control, there had never been a workshop dedicated to this topic.

To meet this need, a week-long workshop, *Control and Optimization with Differential-Algebraic Constraints*, was held at the Banff International Research Station (BIRS) in Banff, Canada, from Oct. 24 to Oct. 29, 2010. Participants came from academia and industry. Their backgrounds included mathematics, scientific computing, chemical engineering, aerospace engineering, mechanical engineering, and computer science. They represented seven countries and three continents.

That highly successful workshop and its accompanying energy and enthusiasm were the genesis for this volume, whose editors organized the original workshop. All of the chapters in this book were written by attendees, and in most cases an earlier version of the paper was presented at the workshop. The first chapter is written by the workshop organizers and is both a survey of the area and an introduction to the papers that follow.

The editors would like to thank the staff at Banff for their help in planning and running the workshop. We would also like to thank SIAM for making this volume a reality and providing needed assistance and guidance. A special thanks from one of us goes to John Rogosich of Techsetters, who was able to get all of the contributions smoothly working together within the special style being used in spite of the contributions altering hidden commands inside AMSTeX and the style file having undocumented restrictions.

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