

Preface

Nowadays, engineering systems are of ever-increasing complexity and must be considered as *multidisciplinary* systems composed of interacting subsystems or system components from different engineering disciplines. Thus, an integration of various engineering disciplines, e.g. mechanical, electrical and control engineering in a *concurrent* design approach is required. With regard to the systematic development and analysis of system models, *interdisciplinary* computer aided methodologies are becoming more and more important.

A graphical description formalism particularly suited for multidisciplinary systems are *bond graphs* devised by Professor Henry Paynter in as early as 1959 at the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, USA and in use since then all over the world.

This monograph is devoted exclusively to the bond graph methodology. It gives a comprehensive, in-depth, state-of-the-art presentation including recent results scattered over research articles and dissertations and research contributions by the author to a number of topics.

The book systematically covers the fundamentals of developing bond graphs and deriving mathematical models from them, the recent developments in methodology, symbolic and numerical processing of mathematical models derived from bond graphs. Additionally it discusses modern modelling languages, the paradigm of object-oriented modelling, modern software that can be used for building and for processing of bond graph models, and provides a chapter with small case studies illustrating various applications of the methodology.

In favour of presenting topics in some reasonable depth and to keep the size of the book manageable, the book refrains from scratching the surface of too many topics. For this reason, some topics, e.g., chemical reactions or links to qualitative reasoning, are not addressed. The compilation of the material in this book and its presentation has been motivated by the author's individual experiences in research and teaching for more than two decades and has been inspired by his personal interaction with many leading personalities in this area.

This monograph addresses students, lecturers, researchers, and practicing engineers in industry who want to learn more about the potential and the state-of-the-art

design of this powerful interdisciplinary graphical modelling methodology and who want to see how it can help them better understand physical processes in multi-energy domain engineering systems in order to develop proper models in their respective engineering field. As bond graph modelling is based on the intuitive consideration of energy exchange between system components from various energy domains, the methodology is particularly suited for modelling and design tasks in mechatronics.

Bond Graph Methodology – Development and Analysis of Multidisciplinary Models addresses the fundamentals as well as advanced topics. It has been designed to serve readers interested in what bond graph modelling is about, readers with expertise in related areas who want to see how bond graph modelling can help them in their projects as well as members of the international community of bond graph modellers. The book can be used as a supplementary text in master's programme courses on modelling, simulation and control, as well as a guide for self-study and as a reference.

The progress made in bond graph modelling is due to many people around the world. Without their research, this monograph would not have been possible.

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