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Summary and Outlook

This book is concerned with the problem of modelling and simulating mechatronic and micromechatronic systems on the basis of hardware description languages. To achieve this, it first describes the modelling of electronics, mechanics and electromechanics. This is followed by a comprehensive representation of the description methods and possibilities of hardware description languages. Then the latest methods for the modelling of multibody mechanics, continuum mechanics and software, plus their representation in hardware description languages, are presented. This compendium of basic methods is subsequently applied to six demonstrators from mechatronics and micromechatronics in the application chapters.

In the past, a hotchpotch of isolated individual solutions existed in the field of the modelling and simulation of (micro)mechatronics using hardware description languages. This work makes the transition to a unified approach for the whole problem class by highlighting the most important modelling strategies for the domains typically involved — i.e. multibody and continuum mechanics, digital and analogue electronics plus software — and describing their representation in digital and analogue hardware description languages. The problem of mixed simulation is thereby transformed into a problem of mixed modelling, which is significantly easier to get to grips with. In addition, elaborate, commercial simulators are available for all the main hardware description languages. Furthermore, due to the option of functional modelling, hardware description languages facilitate the introduction of a top-down design sequence. This has brought significant productivity gains in the design of digital electronics and increasingly also in the field of analogue electronics. Using the described methods, top-down design can now also be applied for mechatronic and micromechatronic systems.

In addition to the validation of executable specifications and the verification of designs by simulation — which are already possible using the methods presented in this book — in future, further options will open up, such as the synthesis and formal verification of mixed systems. This used to be the exclusive preserve of digital electronics and to some degree also analogue electronics. The use of the system models available in the form of hardware descriptions removes a significant obstacle.

However, there remain a few gaps that will have to be filled in the future. For example, the object-oriented modelling of three-dimensional multibody systems on the basis of hardware description languages is still in its infancy.

Furthermore, a significant problem of software modelling is the support not only of one controller, but of various families of controllers sometimes with some tens of variants. This calls for a set of building blocks that puts the peripheral blocks used together with the processor core to form a model. It will also be necessary to consider various abstractions in order to consider the pure function in one case, but to consider additional parasitic effects in another.