Abstract

Advances in microelectronics allow the integration of more and more functionality on a single chip. Emerging system-on-a-chip architectures include a large amount of heterogeneous components and are of increasing complexity. Applications using these architectures require many low-level details in order to yield an efficient implementation. On the other hand constant time-to-market pressure on electronic systems demands a short design process that allows to model a system at a high abstraction level, not taking low-level implementation details into account. Clearly there is a significant abstraction gap between an ideal model for specification and another one for implementation. This abstraction gap has to be addressed by methodologies for electronic system design.

This thesis presents the ForSyDe (Formal System Design) methodology, which has been developed with the objective to move system design to a higher level of abstraction and to bridge the abstraction gap by transformational design refinement. ForSyDe is based on carefully selected formal foundations. The initial *specification model* uses a *synchronous model of computation*, which separates communication from computation and has an abstract notion of time. ForSyDe uses the concept of *process constructors* to implement the synchronous model, to allow for design transformation and the mapping of a refined model onto the target architecture. The specification model is refined into a detailed *implementation model* by the stepwise application of well-defined *design transformation rules*. These rules are either semantic preserving or they inflict a design decision modifying the semantics. These design decisions are used to introduce the low-level implementation details that are needed for an efficient implementation. The implementation model is mapped onto the components of the target architecture. At present ForSyDe models can be mapped onto VHDL or C/C++ in order to allow commercial tools to generate custom hardware or sequential software. The thesis uses a digital equalizer to illustrate the concepts and potential of ForSyDe.

Keywords: Electronic System Design, Hardware/Software Co-Design, Electrical Engineering