

# Preface

The trend towards large-scale deployments of cyber-physical systems (CPSs) makes analysis of computing and physical world interactions of paramount importance. During the development of the software, designers model the physical world that the future CPS will interact with. Some of these models represent the external physical world that the CPS will monitor and control, and others represent a physical part of the CPS itself: its computing platform, sensors and actuators.

Models are built with various techniques and granularity. Several of these models are used at various stages of the CPS lifecycle, from the early stages of specification to development and all the way to production time when a CPS is actually deployed. Furthermore, they are involved not only in the development of the software but also in the assessment of functional and non-functional properties of the full CPS.

As a consequence, CPS software development raises several questions on the *fidelity of models*:

- What is the fidelity of a model with regard to the part of the physical world it represents?
- To what extent is a model's fidelity adequate, i.e. accurate enough but not too complex or costly, with regard to the way the model will be used by the CPS software?
- What is the impact of a model's fidelity on key properties of the full CPS, like dependability, performance or energy consumption?

These three questions lay beneath the authors' contributions. The chapters address several crucial CPS design aspects such as cross-application interference, parsimonious modelling and trustful code production. The book describes a wide range of solutions from simulation for extra-functional properties, extension of programming techniques, model-driven development (MDD), resource-driven modelling and quantitative and qualitative verification based on statistics and formal proofs. These solutions are applied to several CPS design techniques: mixed criticality, communication protocols and computing platform simulation. Tentative answers are presented from very different communities, such as compiler construction,

power/temperature modelling of digital devices, high-level performance analysis, code/device certification, etc.

The target audience is researchers and engineers in the field of CPS development and validation. They will have the opportunity to learn what is the common practice in these fields and, more importantly, to make the links between them. Trends and open research issues presented in this book can be an inspiration for future research.

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