Viewpoints, Formalisms, Languages, and Tools for Cyber-Physical Systems

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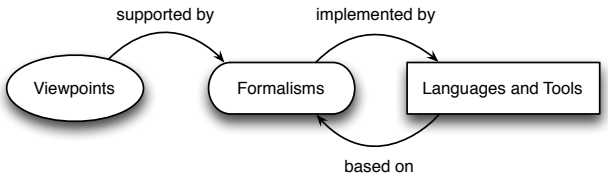
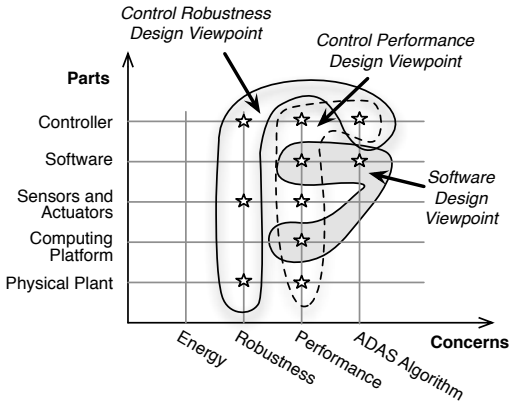
Abstract

Cyber-physical systems (CPS) are becoming indispensable in our modern way of life. As an application domain CPS is not new. As an intellectual discipline, however, it is. This paper focuses on CPS modeling, which is an essential activity in CPS design, with multiple challenges. In particular, stakeholders lack a systematic framework and guidelines to help them choose among the many available modeling languages and tools. We propose such a framework in this paper. Our framework consists of three elements: viewpoints, which capture the stakeholders' interests and concerns; concrete languages and tools, among which the stakeholders must make a selection when defining their CPS design environments; and abstract, mathematical formalisms, which are the "semantic glue" linking the two worlds. As part of the framework, we survey various formalisms, languages, and tools and explain how they are related. We also provide examples of viewpoints and discuss how they are related to formalisms.

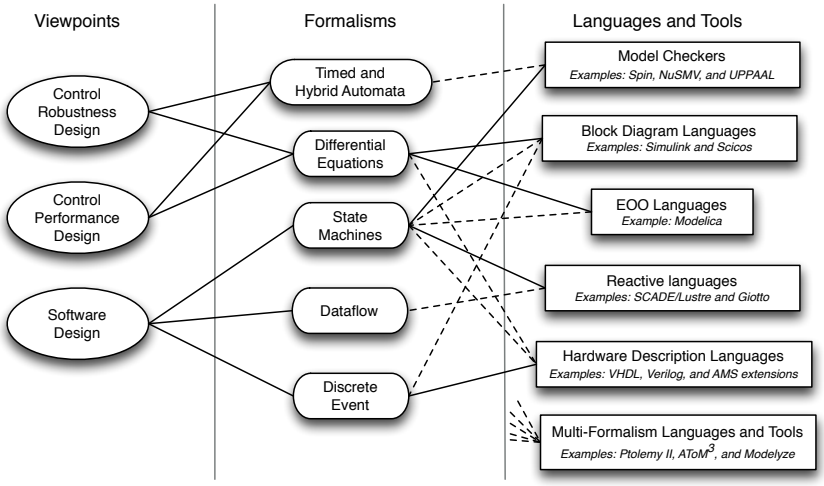
Framework Overview



Viewpoints Matrix



Relationships between Viewpoints, Formalisms, Languages, and Tools



Challenges

- Categorization of and mapping between viewpoints, formalisms, languages, and tool
- Combining and using formalisms together
- Using the framework's categories and relations as guidelines when selecting languages and tools

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