An Operational Semantics for Hybrid Systems involving Behavioral Abstraction

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Abstract

We discuss the challenges of building a simulation framework for hybrid systems, in particular the well-known Zeno effect and correct composition of models idealised by abstracting irrelevant behavioural details (e.g. the bounce dynamics of a bouncing ball or the process of fuse melting in an electrical circuit). We argue that the cornerstone of addressing these challenges is the definition of a semantic framework with an appropriate underlying model of time.

Using two simple examples, we illustrate the properties of such a model and explain why existing models are not sufficient. Finally, we propose a new Zeno-free semantic model that allows mixing discrete and continuous behaviour in a rigorous way and provides for the compositional behavioural abstraction.

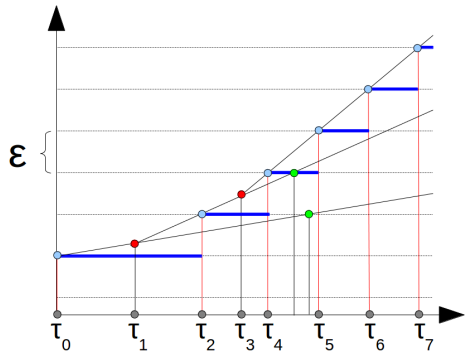

Figure 1: Semantics of a differential equation.

Although it is based on non-standard analysis, we explain how our semantic model can be used to develop hybrid system simulators.

Keywords: Hybrid Modeling Languages; Non-Standard Analysis; Models of Signals; Behavioral Abstraction; Operational Semantics

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