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Research Statement

My research interests are in design of formal models for concurrent communicating systems, with asynchronous behavior. In particular, I'm interested in formal models with rich visual notation for such systems, targeting Model Driven Design and Development of such systems. I'm also interested in high level programming models for asynchronous systems.

In my PhD thesis, I have developed a formal model for asynchronous concurrent communicating systems and a programming language extension - CLARITY[1] - for implementing asynchronous code. The formal model presents a natural visual notation using Finite State Machines (FSMs) and Message Sequence Charts (MSCs). The CLARITY language, developed as an extension to 'C' provides constructs that allows asynchronous actions to be coded in a single sequential block by introducing a new construct named 'waitfor'. CLARITY has been implemented as a prototype, and has been found have very little performance overhead. One of my personal research targets to to extend the formal model I have developed to be able to formally model and specify CLARITY programs (at a high-level).

While visiting University of Trento, in summer 2009, I have been working on a model for heterogeneous systems as part of the COMBEST project. In this I have been working on extending my earlier formal model developed in my PhD thesis to model heterogeneous systems in a single framework. To begin with, we are working on modelling Kahn Process Networks and (Synchronous) Finite State Machines in a single framework. This is currently ongoing collaboration with Prof. Roberto Passerone at DISI, Univ. of Trento.

Thus said, to summarize, my research goals in the next few years, is to fully address the problem of Model Based Design and Synthesis for a chosen domain. This will involve developing a visual modelling language, with automated verification and (semi-)automated synthesis. The formal modelling framework will allow for both the design of the system, and its specification. I have not yet locked down on a target domain to work on, and currently open to both working on the low-level targets like embedded/control systems and on high level targets like event-driven software (eg. device drivers, as targeted by CLARITY). Since, choosing a domain like embedded systems will require technical know-how on such systems, while the work on the event-driven software domain will require help in form of more programmers to implement the technology. This makes the choice of domain very much dependent on my future collaborators.

[1] This work was done during my internship at Microsoft Research India.

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