Organization(s): University of California at Berkeley

Title: Heterogeneous Modeling and Design

Duration of Effort: November 1996 - August 2000

MTO **Composite CAD**

Principal Investigator(s): Edward A. Lee
Phone: (510) 642-0455 / Email: eal@eecs.berkeley.edu
Web: http://ptolemy.eecs.berkeley.edu

Objective

This project is developing a methodology and associated modeling software for composite, heterogeneous systems. Such systems combine diverse implementation technologies, including MEMS, analog circuits, digital circuits, and embedded software. They also combine modeling and design paradigms, including physical modeling using differential equations, continuous-time signal processing, discrete-time signal processing, and discrete-event controllers. They are invariably concurrent, involving diverse modules that operate at the same time and interact through continuous signals or discrete messages. The focus of the project is on the theory and technology of heterogeneous modeling of heterogeneous concurrent systems. We are:

- developing theory and techniques for mixing diverse semantics, e.g. mixed signal, hybrid systems, discrete events and continuous signals;
- establishing software architecture for modular, distributed, and heterogeneous design, modeling and visualization tools;
- developing theory and software for domain-specific modeling of composite systems; and using programming language concepts (semantics, type theories, concurrency theories, reflection, ...) for modeling and design of composite systems.

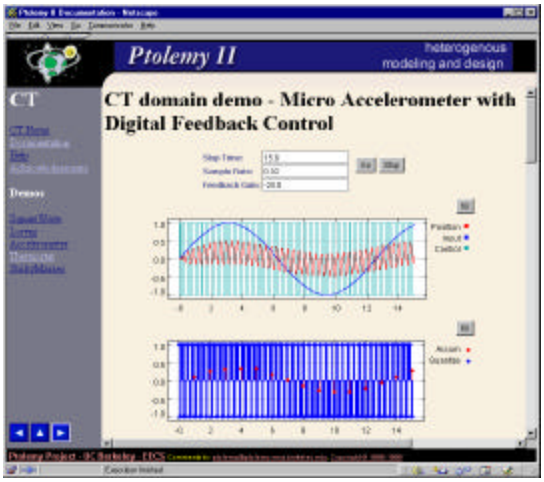
Progress/Results

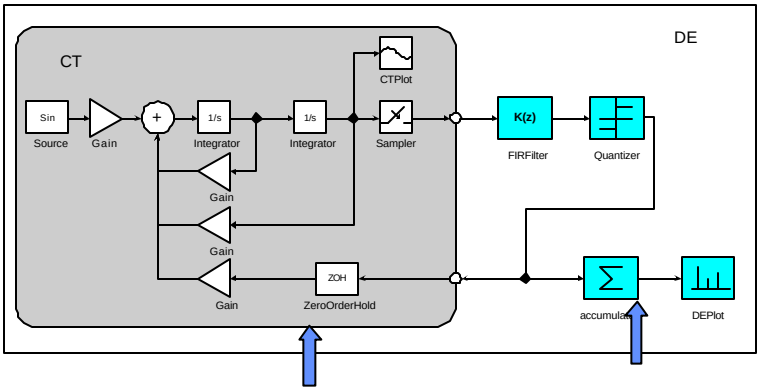
- Ptolemy II - Java based modeling software using multiple concurrent models of computation.
- Semantics and software supporting sequential control logic (FSMs) mixed with various modeling techniques, including continuous time, to get a general form of hybrid systems.
- Mixed-signal modeling supporting discrete control with continuous models.
- Integration of a modern type system with block-diagram-level design.
- Enhanced concurrent Java code design (safe threads, understandable, efficient scheduling).
- Polymorphic component libraries for system modeling.
- For publications, see the web page.
- Preliminary Java-based graphical user iterface for specifying designs.

Status

- Most recent software release is Ptolemy II version 0.4 beta, which includes a set of web-based demonstration applets, released March, 2000. Aiming to release Ptolemy II version 1.0 at the end of the project. This will include a graphical user interface, sophisticated and complete documentation, and all source code.

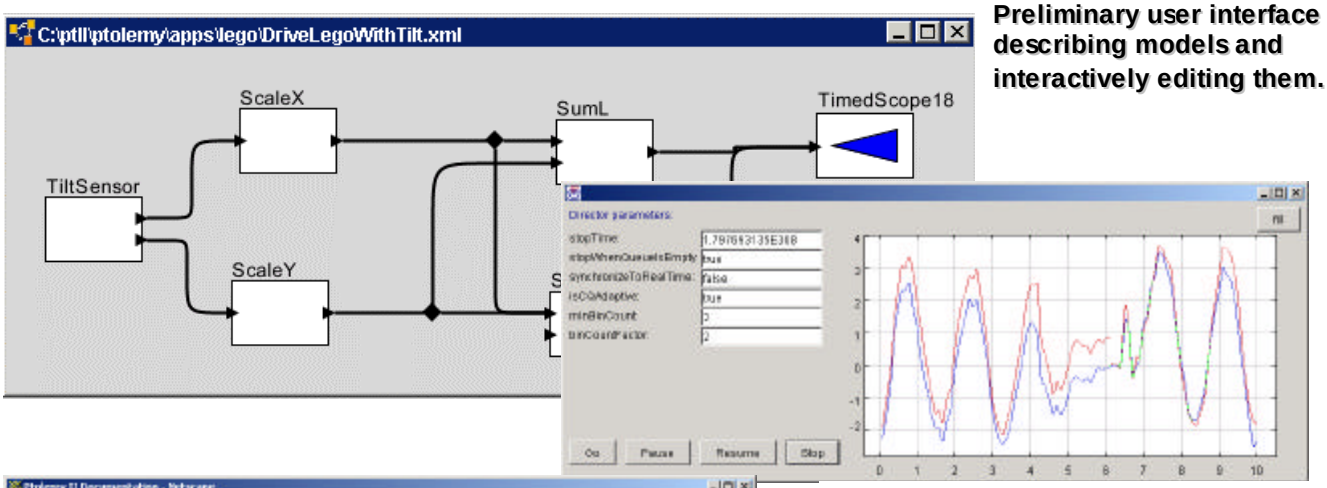
Applet showing a mixed-signal model of MEMS microaccelerometer

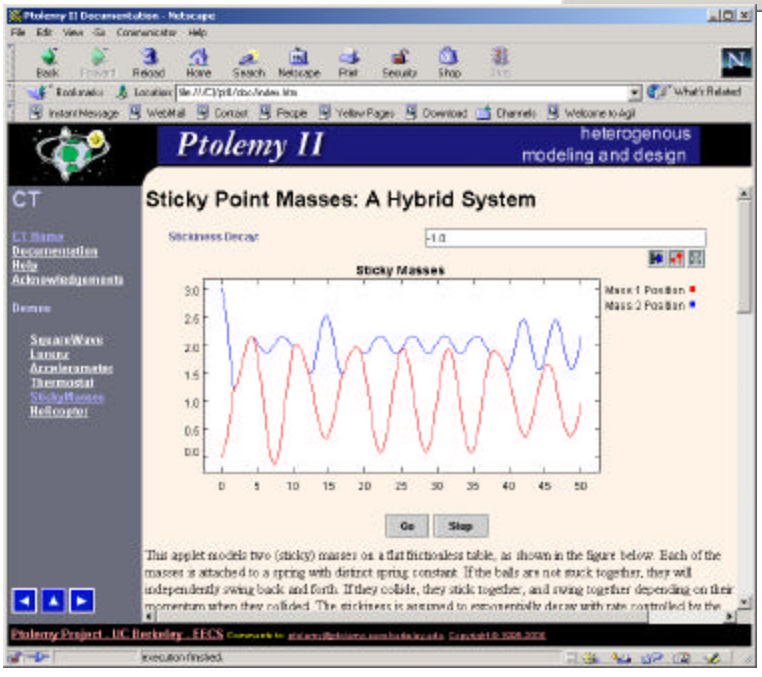




Continuous-time model **Discrete-event**

Preliminary user interface for describing models and interactively editing them.





Applet showing a hybrid system, which is a continuous-time model with modal behavior given by a finite-state machine. This model shows two point masses attached to springs that slide on a frictionless table. When they collide, they stick together for some time, until the stickiness decays.