Overview of Ptolemy II

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Status Update

- Ptolemy II version 1.0 available
  - A platform for experimentation, collaboration
  - Open source, open architecture
  - Rated code (red, yellow, green)
  - Core code is very high quality (green)
  - Code is written to be read
  - Extensible GUI (all red, currently)

- Commercial support organization
  - recently formed: Agile Design
Components and their Relationships

The Ptolemy II kernel provides an abstract syntax - clustered graphs - that is well suited to a wide variety of component-based modeling strategies, ranging from state machines to process networks.

Hierarchy - Construct components from finer grain components.
Basic Kernel Classes

Actor Package – Infrastructure for Producer/Consumer Components

Basic Transport:

Services in the Infrastructure:
- broadcast
- multicast
- busses
- mutations
- clustering
- parameterization
- typing
- polymorphism
Domains – Provide semantic models for component interactions

- CSP – concurrent threads with rendezvous
- CT – continuous-time modeling
- DE – discrete-event systems
- DDE – distributed discrete events
- FSM – finite state machines
- DT – discrete time (cycle driven) *
- Giotto – synchronous periodic *
- GR – 3-D graphics *
- PN – process networks
- RTOS – priority-driven reactive models *
- SDF – synchronous dataflow
- SR – synchronous/reactive **

* New domains in Ptolemy II
** Not yet realized in Ptolemy II

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SDF domain author: Steve Neuendorffer

Synchronous Dataflow

The SDF domain does static dataflow analysis to construct compile-time schedules, and analyze for deadlock and bounded memory.
Discrete Event Models

The DE domain uses an event queue to process events in chronological order, as in VHDL, Verilog, and a number of network simulation languages.

Continuous Time Models

CT uses an ODE solver to model continuous-time systems.

CT domain author: Jie Liu
Finite State Machines

The FSM domain combined hierarchically with other domains gives modal models, as in this hybrid system example.

Hierarchical Heterogeneity

Directors are domain-specific. A composite actor with a director becomes opaque. The Manager is domain-independent.
Basic Object Model for Executable Components

- Interface: Executable
  - ComponentEntity
    - AtomicActor
      - Director
      - CompositeActor
    - CompositeEntity
      - ComponentEntity

- Interface: Actor
  - +getDirector(): Director
  - +getExecutiveDirector(): Director
  - +getManager(): Manager
  - +inputPortList(): List
  - +newReceiver(): Receiver
  - +outputPortList(): List

- Interface: Executable
  - +fire()
  - +initialize()
  - +postfire(): boolean
  - +prefire(): boolean
  - +preinitialize()
  - +stopFire()
  - +terminate()
  - +wrapup()

Code Generator:
“Shallow” and “Deep”

Code generator produces Java code from block diagrams.

Code gen author:
Jeff Tsay
Infrastructure Support

- Vergil – visual editor (Steve Neuendorffer)
- MoML – XML schema (Edward Lee, Steve Neuendorffer)
- Expression language (Neil Smyth, Xiaojun Liu)
- Type system (Yuhong Xiong)
- Math package (Jeff Tsay, Bart Kienhuis, William Wu)
- Graph package (Yuhong Xiong)
- Plot package (Edward Lee, Christopher Hylands)
- 3-D graphics (Chamberlain Fong)
- Actor library (all)

Type System

Output of type general - pure event with no value

Input of general type - anything will do

Polymorphic output - type depends on the parameters

Opaque port - types propagated from inside

Lossless runtime type conversion

Polymorphic actor uses late binding in Java to determine implementation of addition.

Type system author: Yuhong Xiong
Software Practice

- Object models in UML
- Design patterns
- Layered software architecture
- Design and code reviews
- Design document
- Nightly build
- Regression tests
- Sandbox experimentation
- Code rating

Code rating

- A simple framework for
  - quality improvement by peer review
  - change control by improved visibility

- Four confidence levels
  - Red. No confidence at all.
  - Yellow. Passed design review.
  - Green. Passed code review.
  - Blue. Passed final review.
  - Backwards-compatibility assurance.