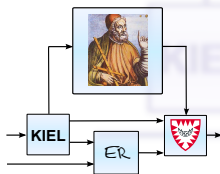


Executing SyncCharts with Ptolemy

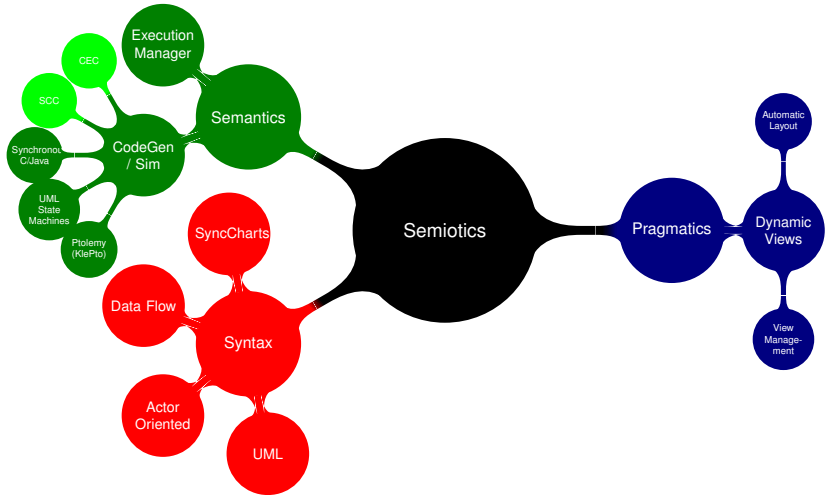
Christian Motika

Real-Time Systems and Embedded Systems Group
Department of Computer Science
Christian-Albrechts-Universität zu Kiel, Germany



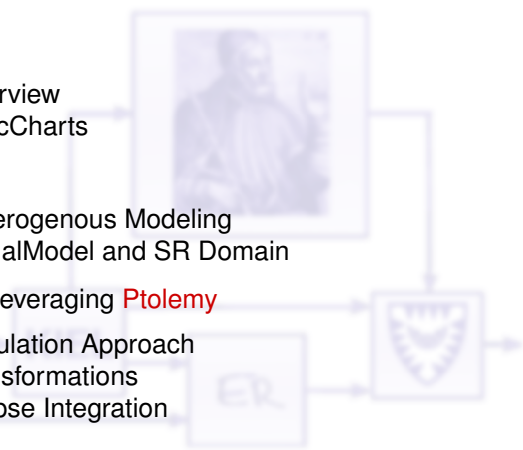
SYNCHRON Workshop 2010
Frejús, 29.11.2010

KIELER Semiotics



Overview

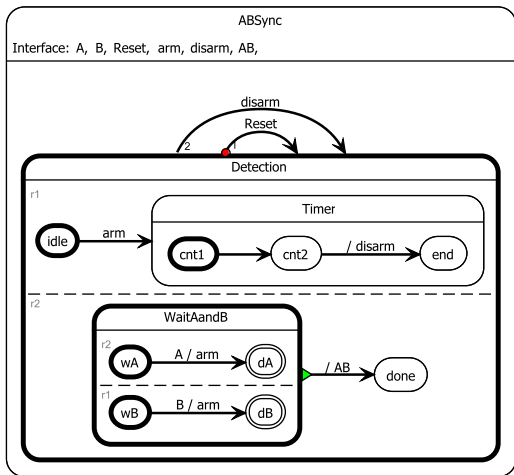
- ▶ KIELER
 - ▶ Overview
 - ▶ SyncCharts
- ▶ Ptolemy
 - ▶ Heterogenous Modeling
 - ▶ ModalModel and SR Domain
- ▶ KIELER leveraging Ptolemy
 - ▶ Simulation Approach
 - ▶ Transformations
 - ▶ Eclipse Integration
- ▶ Summary



What is KIELER?

- ▶ Kiel Integrated Environment for Layout Eclipse Rich Client
- ▶ Modeling platform and test bed
 - ▶ Improve pragmatics
- ▶ Open source and Eclipse based (plug-ins)
- ▶ General concepts:
 - ▶ Generic approaches
 - ▶ Symbiosis w/ Eclipse technologies (e.g., EMF, GMF, TMF, Xpand, Xtend)
 - ▶ Interfaces to other tools (Ptolemy, Papyrus)

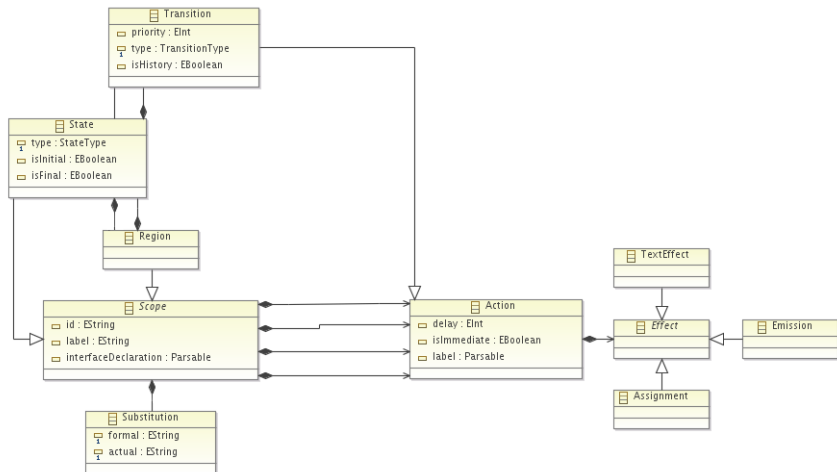
SyncCharts



Charles André, Computing SyncCharts Reactions, 2003

- ▶ Statechart dialect
- ▶ Mealy machine with
 - ▶ Parallelism, hierarchy, compound events, broadcast
- ▶ Graphical notation for the Esterel synchronous language
- ▶ Synchrony hypothesis
 - ▶ Discrete ticks
 - ▶ Computations take no time

Abstract Syntax (EMF)



KIELER Modeling - syncharts_quickstart/abro.kids - KIELER

File Edit Diagram Navigate Search Project Run KIELER Window Help

Project Explorer

- syncharts_quickstart
 - abro.kids
 - abro.kixs

Outline

ABRO

Interface: A, B, R, O,

```

stateDiagram-v2
    state WaitAB {
        state wA
        state wB
        state dA
        state dB
        wA --> dA : A
        wB --> dB : B
    }
    state ABO
    state done

    WaitAB --> ABO : R
    ABO --> WaitAB : R
    WaitAB --> done : I/O
    ABO --> done : I/O
  
```

Palette

- State
- Transition
- TextualCode

Execution Manager

Properties

State

Property	Value
Core	
Appearance	
Id	WaitAB
Incoming Transitions	
Interface Declaration	
Is Final	false
Is Initial	true
Label	WaitAB
Type	NORMAL

Layout

State 'WaitAB'

Property	Value
Nodes	
Fixed Size	false
Parents	
Aspect Ratio	1.3
Border Spacing	1.0
Expand Nodes	true
Layout Provider or Type	Box Layout (KIELER)
Object Spacing	1.0

Overview

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Ptolemy

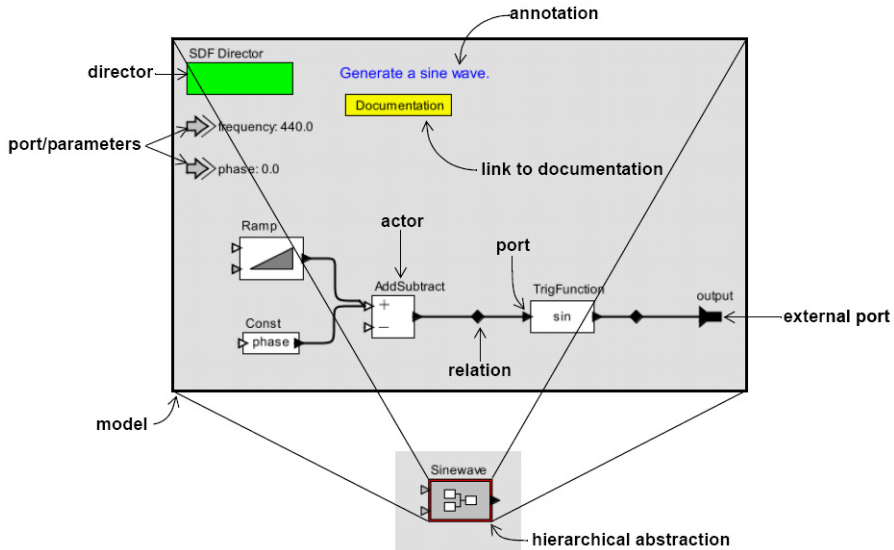


- ▶ „The Ptolemy project studies heterogeneous modeling, simulation, and design of concurrent systems.“

Introduction to Ptolemy II, UC Berkeley

- ▶ Executable Models to describe behavior of reactive systems
- ▶ Ptolemy models are a set of interacting components → **Actor-Oriented Design**
- ▶ Constructed under a **model of computation** (MoC)

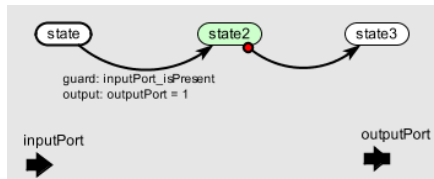
Ptolemy Actor Example



Model of Computation

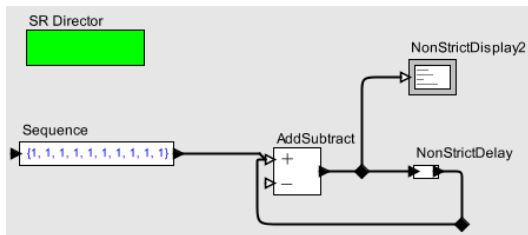
- ▶ Defines interaction of system components
 - ▶ Semantics of a model
- ▶ Ptolemy Model can have more than one MoC
- ▶ MoC domains/directors:
 - ▶ Process Networks (PN)
 - ▶ Continuous Time (CT)
 - ▶ Finite State Machines (FSM)
 - ▶ Synchronous Reactive (SR)
 - ▶ ...

ModalModel Domain



- ▶ Entities not actors but states
- ▶ Execution: Strictly ordered sequence of state transitions
- ▶ Build-in expression language to evaluate guards
- ▶ Refinements (multiple)
- ▶ Reset and preemptive transitions

Synchronous Reactive Domain



- ▶ Zero-Delay blocks
- ▶ Instantaneous communication
- ▶ Feedback
- ▶ Fixed point \Leftrightarrow Stable state
- ▶ Values from flat lattice
- ▶ Determinism \Leftrightarrow Unique solution

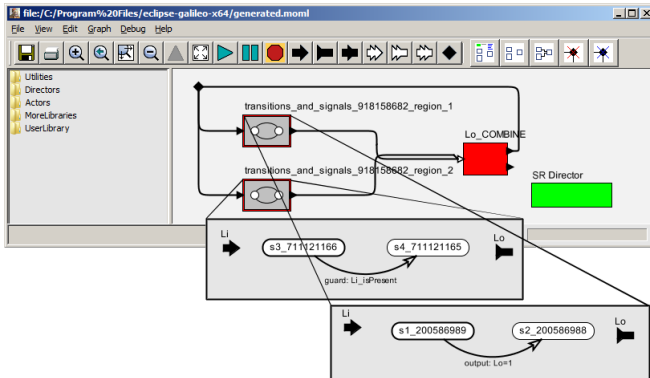
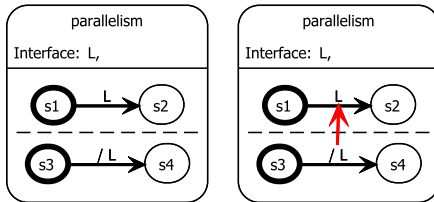
Overview

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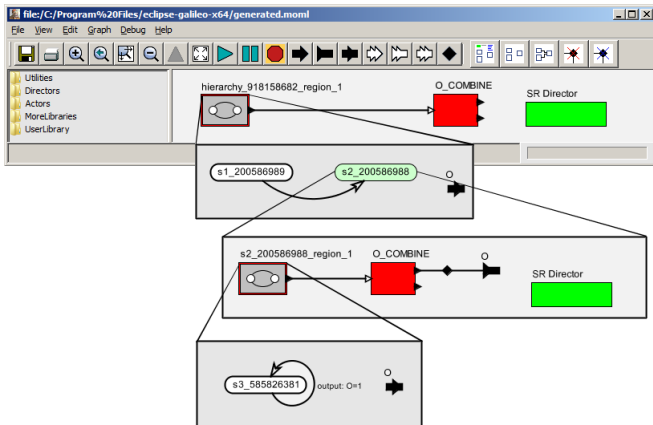
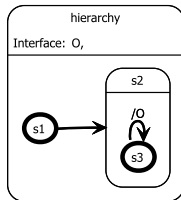
Ptolemy Simulation Engine

- ▶ Mapping SyncCharts to Ptolemy:
 - Mealy machine ↔ ModalModel
 - Orthogonality ↔ Concurrent Actors (inherent)
 - Hierarchy ↔ Compound Actors, state refinements
 - Compound events ↔ Expression language
- ▶ Interesting:
 - ▶ Implicit broadcast vs. explicit signal representation
 - ▶ Signal coherence (must/cannot analysis)
 - ▶ Transition priorities
 - ▶ Normal termination

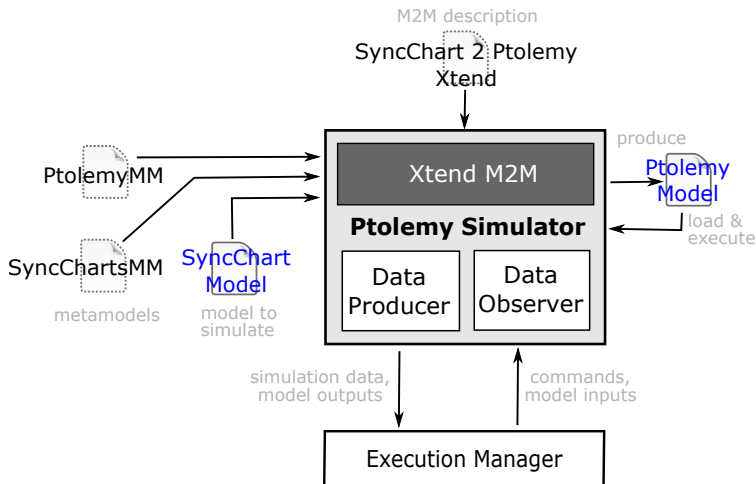
Transformation Example: Parallelism and Signals



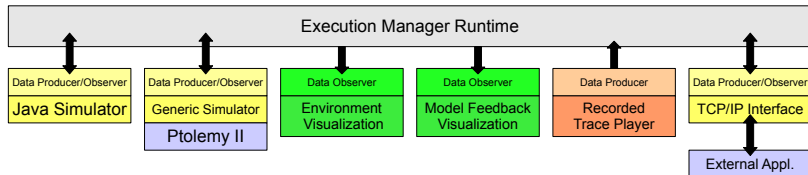
Transformation Example: Hierarchy



Schematic Overview



Architecture and User Interface



Component Name / Key	Value	Type	Master
<input checked="" type="checkbox"/> Synchronous Signal Resetter		<input checked="" type="checkbox"/> Observer/Producer	
<input checked="" type="checkbox"/> Data Table		<input checked="" type="checkbox"/> Producer	
<input checked="" type="checkbox"/> ABRO in Java		<input type="checkbox"/> Observer/Producer	
<input checked="" type="checkbox"/> Synccharts Ptolemy Simulator		<input checked="" type="checkbox"/> Observer/Producer	
<input checked="" type="checkbox"/> SyncChart Editor			
<input checked="" type="checkbox"/> State Name	state		
<input checked="" type="checkbox"/> SimpleRailCtrl Ptolemy Simulator		<input type="checkbox"/> Observer/Producer	
<input checked="" type="checkbox"/> Viewmanagement SyncCharts Visualizer		<input checked="" type="checkbox"/> Observer	
<input checked="" type="checkbox"/> Data Table		<input checked="" type="checkbox"/> Observer	

KIELER KlePto Simulation Demo

LIVE DEMO

Summary

- ▶ KIELER
- ▶ Ptolemy
- ▶ KIELER leveraging Ptolemy
 - ▶ KlePto concept
 - ▶ Construct runnable Ptolemy models for EMF based models (Xtend)
 - ▶ Ptolemy integration in Eclipse
 - ▶ Infrastructure for interactive model execution
 - ▶ Also: Visualization, stepwise transformation, model checking, online debugging, regression tests, validation, ...

To Go Further



ANDRÉ, C.

Computing SyncCharts reactions.

In *SLAP 2003: Synchronous Languages, Applications and Programming, A Satellite Workshop of ECRST 2003* (2004), vol. 88, pp. 3 – 19.



MOTIKA, C., FUHRMANN, H., AND VON HANXLEDEN, R.

Semantics and execution of domain specific models.

In *2nd Workshop Methodische Entwicklung von Modellierungswerkzeugen (MEMWe 2010) at conference INFORMATIK 2010* (Leipzig, Germany, Sept. 2010), GI-Edition – Lecture Notes in Informatics (LNI), Bonner Köllen Verlag.



UC BERKELEY, EECS DEPT.

Ptolemy webpage.

<http://ptolemy.eecs.berkeley.edu/>.



UNI KIEL, REAL-TIME AND EMBEDDED SYSTEMS GROUP.

KIELER webpage.

<http://www.informatik.uni-kiel.de/en/rtsys/kieler/>.



Thank you for your attention and participation!

Any questions or suggestions?

