

ArtistDesign Kickoff Meeting

Paris, January 29-30, 2008

Cluster presentation

Modeling and Validation

Cluster Leaders:

Kim G. Larsen, CISS, Aalborg

Tom Henzinger, EPFL

Main Research Trends in the Area

- Underlying hardware and networking trends
 - system/network-on-chip, multicore, sensor nets, wireless, etc.
- Trend towards model-based design
 - interaction of different models of computation and communication
 - automation of property-preserving model transformations
- Trend towards standardization and componentization
 - interfaces critical for component reuse
 - beyond functional characteristics of components: timing, memory, power, reliability, security, etc.
- Gap between best-effort and critical systems engineering
 - optimization/average case vs. constraint satisfaction/worst-case

High-Level Objectives

- Develop model- and component-based theories, methods, and tools that establish a coherent family of design flows spanning the areas of computer science, control, and hardware.
 - model-based, to achieve portability
 - component-based, to achieve scalability
 - **deterministic**, to achieve predictability
- Requires a new scientific foundation
 - new abstractions for computing as a physical, imperfect act
 - from boolean correctness to quantitative robustness measures: failure rate, life time, input tolerance, etc.
 - deterministic systems from nondeterministic components
- Impact on safety critical industries (aerospace, automotive) as well as high volume systems (professional systems, consumer electronics).

Core Teams (**Modeling** & Validation)

- **Tom Henzinger (EPFL - Switzerland);**
- Kim Larsen (Aalborg - Denmark),
- **Alain Girault (INRIA - France);**
Thierry Jéron (INRIA - France);
- Martin Törngren (KTH - Sweden) ;
- Werner Damm (OFFIS - Germany);
- Christoph Kirsch (Salzburg - Austria);
- Bengt Jonsson (Uppsala - Sweden);
Wang Yi (Uppsala - Sweden);
- Joseph Sifakis(VERIMAG - France)
- **Sébastien Gérard (CEA LIST - France);**
- Ed Brinksma (ESI -Netherlands);
- Alberto Sangiovanni-Vincentelli (PARADES - Italy)

Affiliated Teams (Modeling)

- Pierre Wolper (CFV - Belgium);
- Yiannis Papadopolous (Hull - UK);
- Simin Nadjm-Tehrani (Linkoping - Sweden);
- Marta Kwiatkowska (Oxford - UK);
- Henrik Lönn (Volvo Technology -Sweden);
- Johan Lilius (Turku Centre for Computer Science, and Department of Information Technologies, Åbo Academi – Finland);
- Jan-Friso Groote, Jos Baeten, Henk Corporaal (Eindhoven University of Technology);
- Mariëlle Stoelinga, Boudewijn Haverkort, Pieter Hartel (University of Twente);
- Arie van Deursen, Arjan van Gemund, Henk Sips (Delft University of Technology);
- Joost-Pieter Katoen (Aachen - Germany);
- Christel Baier (Dresden - Germany);
- Francois Laroussinie (LSV Cachan - France);
- Roberto Passerone (University of Trento -Italy); Tiziano Villa (Verona - Italy)

Affiliated Teams (Validation)

- Marius Minea (Institute e-Austria Timisoara, Romania);
- Christophe Gaston (CEA LIST);
- Roberto Passerone (Trento – Italy);
- Jean-Francois Raskin (CVF – Belgium);
- Joost-Pieter Katoen (Aachen – Germany);
- Holger Hermanns (Saarlandes U – Germany);
- Christel Baier (Dresden – Germany);
- Francois Laroussinie (LSV Cachan – France),
- Peter Eriksson (ABB Robotics - Sweden).

Overview of Clusters Activities

Modeling

Leader: Tom Henzinger (EPFL)

- Component Modeling
 - Heterogenous Models
 - Interfaces / Contracts
 - Code generation
- Resource Modeling
 - Implementation
 - Architecture modeling
- Quantitative Modeling
 - Real-time, stochastic, hybrid
 - Robustness

Modeling

Component Modeling

- Heterogeneous Models**
 - KTH
UML, Simulink, AADL
FoSYDA - transf-oper.
 - PARADES
Conservative appr.
 - Uppsala
Timed Aut. & Streams
 - ESI
Industri driven
 - CEA
MoCC design using Marte

Interfaces/contracts

- EPFL
Rich Interfaces
- Aalborg
Timed Modal TS
- INRIA
Algebra of contracts - viewpoint
Polychrony
- OFFIS
Rich Components
- Verimag
BIP subclasses

Codegeneration

- Salzburg
Giotto
- Aalborg
UPPAAL TIGA

Quantitive Modeling

- Aalborg
Ext of UPPAAL with multiple Cost
Ext of UPPAAL with Probabilities
- EPFL
Metrics for relating systems
Model checking
- INRIA
Combination of boolean and numerical control
- KTH
Metrics of architectural design
NoC / SoC netw-calculus
- PARADES
Estimation of quantities
- Uppsala
Long-term resources
- CEA
Model transformations (Marte)
- ESI
Industrial-scale modelling of performance and dependability

Resource Modeling

Implementation

- Uppsala
Relationships between detailed operational level and abstract level resources & timing
- VERIMAG
Codegeneration from BIP

Architecture

- Aalborg
MPSoC in UPPAAL+Stpwatches
Design space expl
- INRIA
SynDEX tool,
Optimal Scheduling
- KTH
Network & communication resources
- OFFIS
Hierarchical abstractions
- PARADES
Design space expl.
- Salzburg
Reliability Giotto/HTL
- CEA
HW/SW modelling + simulation

Compositional Techniques

- EPFL
Compositional proof rules/
Interfaces
- ESI
Budget-based design techniques

Overview of Clusters Activities

Validation

Leader: Kim G. Larsen (Aalborg)

- Compositional Validation (scalability, interfaces, quantities)
 - Dealing w heterogeneous models.
- Quantitative Validation
 - real-time
 - energy / resources
 - stochastic
 - hybrid
- Cross-layer Validation
 - validation of model transformation
 - code-generation
 - controller synthesis
 - software verification

Aalborg, Uppsala
Robust codegeneration from UPPAAL

EPFL, Salzburg
Compositional generation of reliable code

EPFL, Aalborg, CFV
Controller Synthesis from timed, stochastic models

OFFIS
Deployment architecture synthesis

ESI
Multilayer performance analysis

PARADES
Automatic mapping of functional requirements

Aalborg
Eff. algorithms for Priced TA
Priced Prob AT

EPFL
Reliability & Stochastic Analysis

Salzburgh
Reliability Constraints

Uppsala
Tradeoff between accuracy and efficiency
TIMES & UPPAAL

ESI
On-line real time testing coverage, TorX

INRIA
Model-based test selection
Data-intensive models

PARADES
Reliability and performances

Cross-Layer Validation

Validation

Compositional Validation

EPFL
Assume/Guarantee checking of compatibility

Aalborg
MTS refinement and consistency using Games (TIGA)

OFFIS
Compositional Safety Analysis

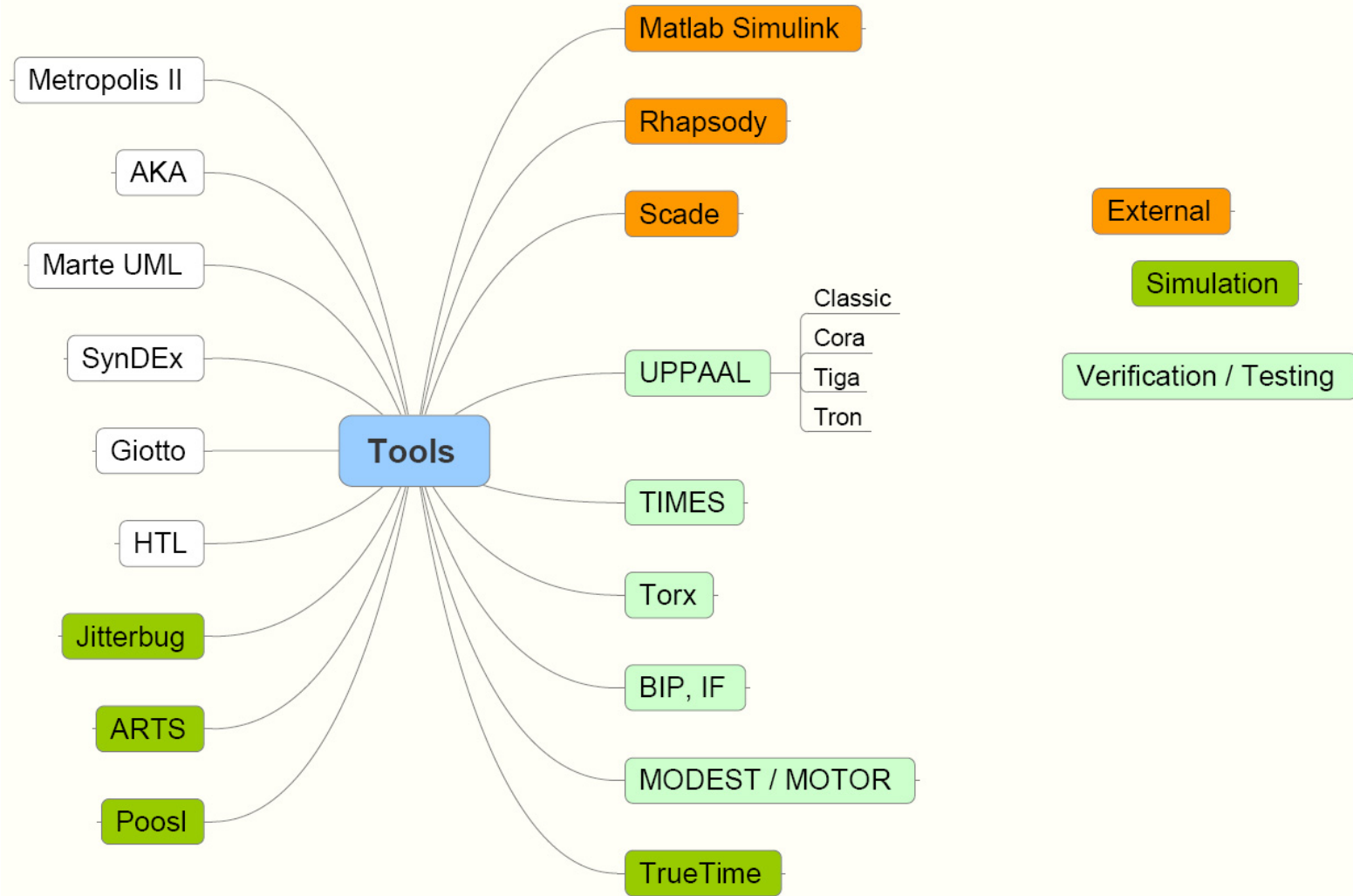
ESI
Combined Analysis technique

CEA
Symbolic execution of heterogeneous systems

PARADES
component verification in Metropolis II

Quantitative Validation

Tools



Projects

- National
 - DaNES
 - ..
- EU STREP / IP / Support Action
 - Quasimodo (AAU, ESI,..)
 - Multiform (AAU, ESI, VERIMAG, ..)
 - SPEEDS (OFFIS, VERIMAG, INRIA, PARADES,..)
 - COMBEST (OFFIS, ...)
 - ATESSST1, ATESSST2 (CEA, KTH, ..)
 - GENESYS (ESI, VERIMAG, ..)
 - ADAMS (CEA, ..)
 - ..

Indicators for Interaction

- Connections to SPEEDS; UPPAAL & RAPTURE & MODEST; Metropolis and HDL
- (Giotto); UPPAAL & IF; ARTS & UPPAAL (from simulation to verification); TrueTime.
- 10 Joint publications between partners/year
- 2 open workshops / year
- connections between tools of partners; joint meetings.
- Mobility, i.e. of PhD students and faculty staff.
- Impact on industrial practice (take-up of validation techniques and tools)

Indicators for Interaction

- International collaboration
 - Nancy Lynch
 - Rance Cleaveland
 - Cy berphysics.
- **FIT**: Foundations for Interface Theory, ETAPS 2008, March 29-April 6, Budapest, Hungary. Invited speakers: Albert Benveniste, Mariëlle Stoelinga.
- **ARTIST2 Summer School**, September 8-13, Autrans, France.
- **ES Week**: Workshop on Components.

