Year 1 Review
Brussels, January 23rd, 2008

Cluster

Achievements and Perspectives:
Modeling and Validation

Cluster Leaders:
Kim G. Larsen, Aalborg University
Tom Henzinger, EPFL
Core Teams (Modeling & Validation)

- **Tom Henzinger (EPFL - Switzerland)**;
  - Rich Interfaces. Quantitative properties and resources.

- **Kim Larsen (Aalborg – Denmark)**
  - Timed automata based models. Performance analysis and synthesis.

- **Thierry Jéron (INRIA - France)**;
  - Model-based testing, control and diagnosis.

- **Martin Törngren (KTH - Sweden)**;
  - Integrated models and validation.

- **Werner Damm (OFFIS - Germany)**;
  - Component-based design and semantic foundation.

- **Christoph Kirsch (Salzburg - Austria)**;
  - Timing and reliability modeling.

- **Bengt Jonsson (Uppsala - Sweden)**;
  - Component-based mod. & ver.

- **Wang Yi (Uppsala - Sweden)**
  - Resource modeling and timing analysis.

- **Susanne Graf (VERIMAG – France)**
  - Component-based design. Extra-functional properties.

- **Joseph Sifakis (VERIMAG - France)**
  - Model Checking. Component-based design.

- **Sébastien Gérard (CEA LIST - France)**
  - Model-based engineering, standard modeling.

- **Ed Brinksma (ESI - Netherlands)**
  - Quantitative modeling and testing.

- **Alberto Sangiovanni-Vincentelli (PARADES - Italy)**
  - Platform-based design.
Affiliated Teams

- Henrik Lönn, Volvo Technology
- Jacques Pulou, France Telecom
- Albert Benveniste, INRIA Rennes
- Roderick Bloem, TU Graz
- Roberto Passerone, Uni Trento
- Koos Rooda, TU Eindhoven
- Paul van den Hof, TU Delft
- Tiziaqna Villa, Uni. Verona,
- Pierre Wolper, CFV, Belgium
- Yiannis Papadopolis, Uni. Of Hull
- Ahmed Bouajjani, LIAFA

+ several industrial partners at national levels.

- Stavros Tripakis, Cadence Research Lab.
- Jean-Francois Raskin, CVF, Belgium
- Joost-Pieter Kateon, Aachen
- Holger Hermanns, Saarlandes
- Christel Baier, Dresden
- Patricia Bouyer, Nicola Markey, Phillippe Schnoebelen, LSV Cachan
- Wil van der Aalst, TU Eindhoven
- Mehmet Aksit, Twente Uni
- Sandro Etalle, TU Eindhoven
- Arjen van Gemund, Delft Uni
- Frits Vaandrager, Radboud Uni
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

- Establish a coherent mathematically sound family of design flows spanning the areas of computer science, control, and hardware based on model- and component-based theories, methods, and tool:
  - model-based, to achieve portability
  - component-based, to achieve scalability
  - analyzable (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.

- Impact on safety critical industries (aerospace, automotive) as well as high volume systems (professional systems, consumer electronics).
Overview of Cluster Activities

MODELING

Tom Henzinger (EPFL)
Susanne Graf (VERIMAG)

VALIDATION

Kim G. Larsen (Aalborg)
Overview of Cluster Activities

**MODELING**
Tom Henzinger (EPFL)
Susanne Graf (VERIMAG)

**VALIDATION**
Kim G. Larsen (Aalborg)

![Graph showing Pareto frontier between modeling expressiveness and validation efficiency/accuracy.](image-url)
State of the Integration in Europe

**Extensive collaboration** between partners of the cluster

**Extensive collaboration** with leading research teams outside Europe.

**Extensive interaction** with other communities

**National Centers and projects**
- CISS, ESI, ..
- CREDO, DaNES, DOTS, Testec, ICES, .. ..

**New FP7/ARTEMIS/ESF Projects**
- QUASIMODO (STREP)
- MULTIFORM (STREP)
- COMBEST (STREP)
- GASICS
- CESAR
- GENESYS
- ADAMS
- ATTEST2, … …
Building Excellence

- **156 publications**  
  (ARTIST2 Y4 98)

- **47 joint publications**  
  (ARTIST2 Y4 19)

- High level of dissemination through PhD schools and industrial seminars (>40 keynote presentations).

- **Strong impact**  
  on a number of important international conferences  
  (CAV, TACAS, FORMATS, EMSOFT, CONCUR, ETAPS, HSCC,..)

- **Transfer to industry**  
  long-term collaboration performed by individual partners.  
  National centers and laboratories.
Building Excellence

Workshops organized

- INFINITY08
- TIME’08
- PDMC’08
- SafeCert 2008
- 1st International workshop on Model Based Architecting and Construction of ES
- SLA++P 2008
- UML & FM, 2008
- UML & AADL, 2008
- RTSS’08 Track on Design and Verification of ES
- FIT’08
- NWPT’08
- MOVEP’08
- Several national seminars

- EMSOFT’09
- CAV’09
Achievements Y1

Modeling

- Component Modeling
  - Heterogeneous models
  - Models w rich semantics
  - Interfaces / contracts

- Resource Modeling
  - Quantitative resources
  - Boolean resources
  - Applications

- Quantitative Modeling
  - Design frameworks for quantitative models
  - Quantitative generalizations of classical languages
  - Timed automata extensions.

Validation

- Compositional Validation
  - Timing, safety, failure and reliability
  - Abstraction / refinement

- Quantitative Validation
  - (Un)decidability results:
    - Markov chains,
    - priced timed automata,
    - stacks/queues,
    - hybrid systems
  - Efficient datastructures & algorithms.

- Cross-layer Validation
  - Controller synthesis from rich game models
  - Conformance testing of non-functional properties.
ARTIST Design Workshop on Tools & Platforms (CAV09)
Scientific Highlight: Controller Synthesis

Quasimodo & Multiform (HSCC09)

- Tool Chain
  - Synthesis: UPPAAL TIGA
  - Verification: PHAVer
  - Performance: SIMULINK

- 40% improvement of existing solutions..

ARTIST DESIGN Partners:
- Aalborg
- CFV
- INRIA/Rennes
- VERIMAG
Oil Pump Control Problem

- **R1**: stay within safe interval $[ 5 , 25 ]$

- **R2**: minimize average/overall oil volume

\[ \int_{t=0}^{t=T} v(t) \, dt / T \]
Tool Chain

- Synthesis TIGA
- Verification PHAVER
- Performance Evaluation

- Guaranteed Correctness and Robustness with 40% Improvement

- Collaboration between partners
- Tools connected
- Academic and commercial
- Tool chain identified

Initial volume (l)
Plans for Y2

- Develop and extend the results from Y1 along the 6 research directions.
- Implementations of results in tools-components.
- Increase industrial impact of cluster results (competences and tools).
  - Demonstrate maturity by applications.
  - Design flows and tool chains.
  - …
- Increased focus on
  - Sensor networks
  - Multicore & MPSoC
  - Low Power
Plans for Y2

- School on Model-based Engineering for RTES. Aussois, March 2009 (supported by ARTIST DESIGN).
- QUANTLOG 2009 - Workshop on Quantitative Logics. Rhodes, Greece, July 5-12, ICALP 2009
- GASICS, Workshop on Games for Design, Verification and Synthesis Satellite event at CAV 2009, Grenoble, June 26-July 2
- **Cluster Workshop on Platform & Tools**
  Satellite Event with CAV’09.
  (July 2009; Susanne Graf, Sebastien Gerard).
- **Cluster PhD School on Quantitative Model Checking**