

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
- 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

+ several industrial partners  
at national levels.

## 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).

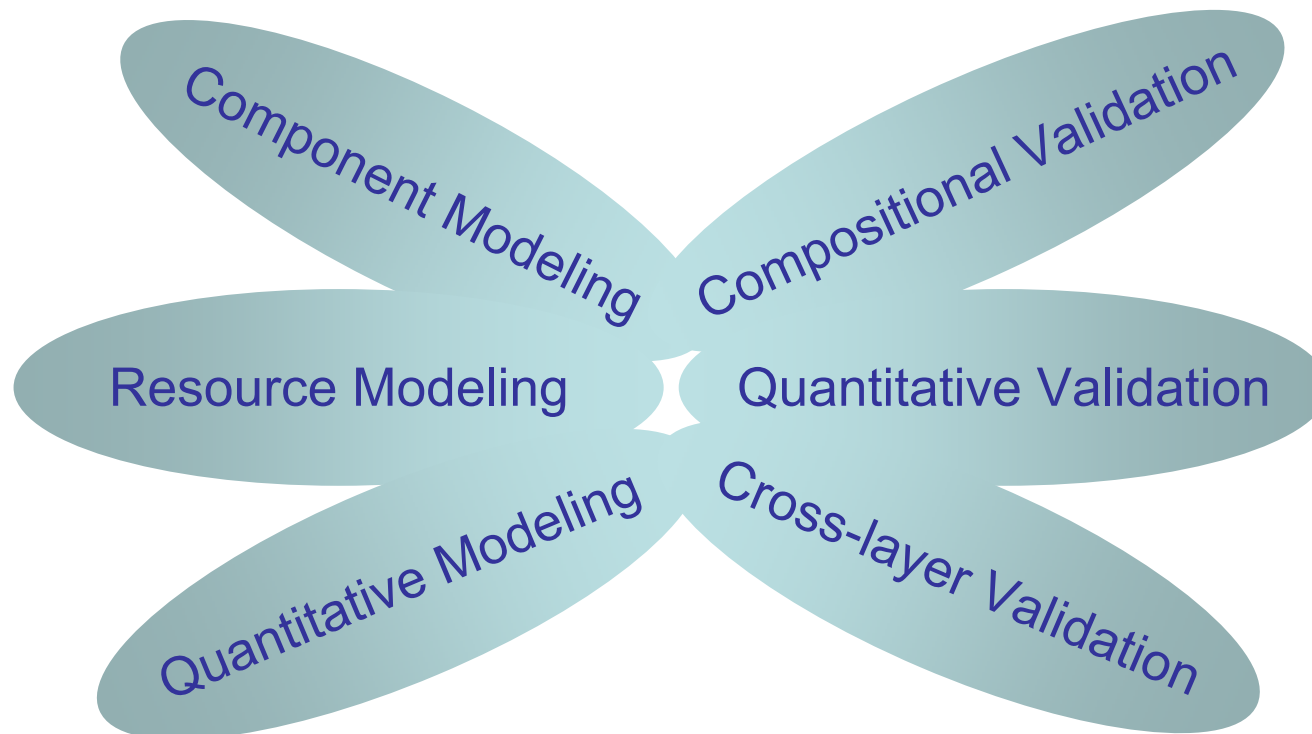
# Overview of Cluster Activities

## MODELING

Tom Henzinger (EPFL)  
Susanne Graf (VERIMAG)

## VALIDATION

Kim G. Larsen (Aalborg)



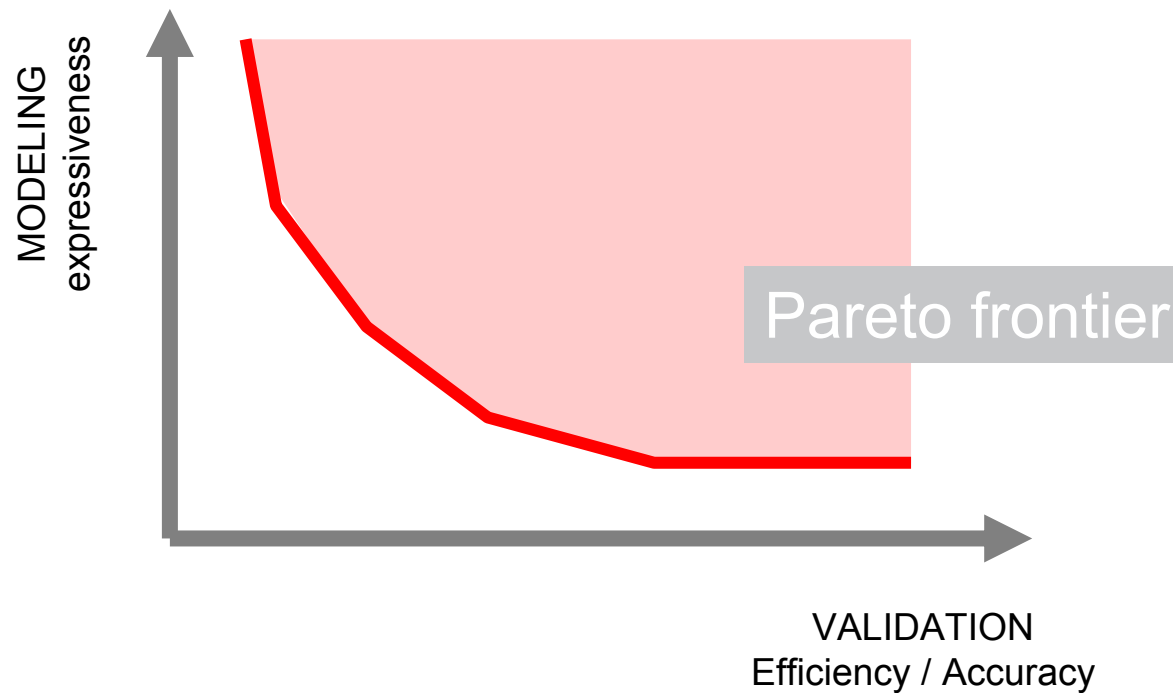
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# State of the Integration in Europe

**Extensive collaboration** between partners of the cluster

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

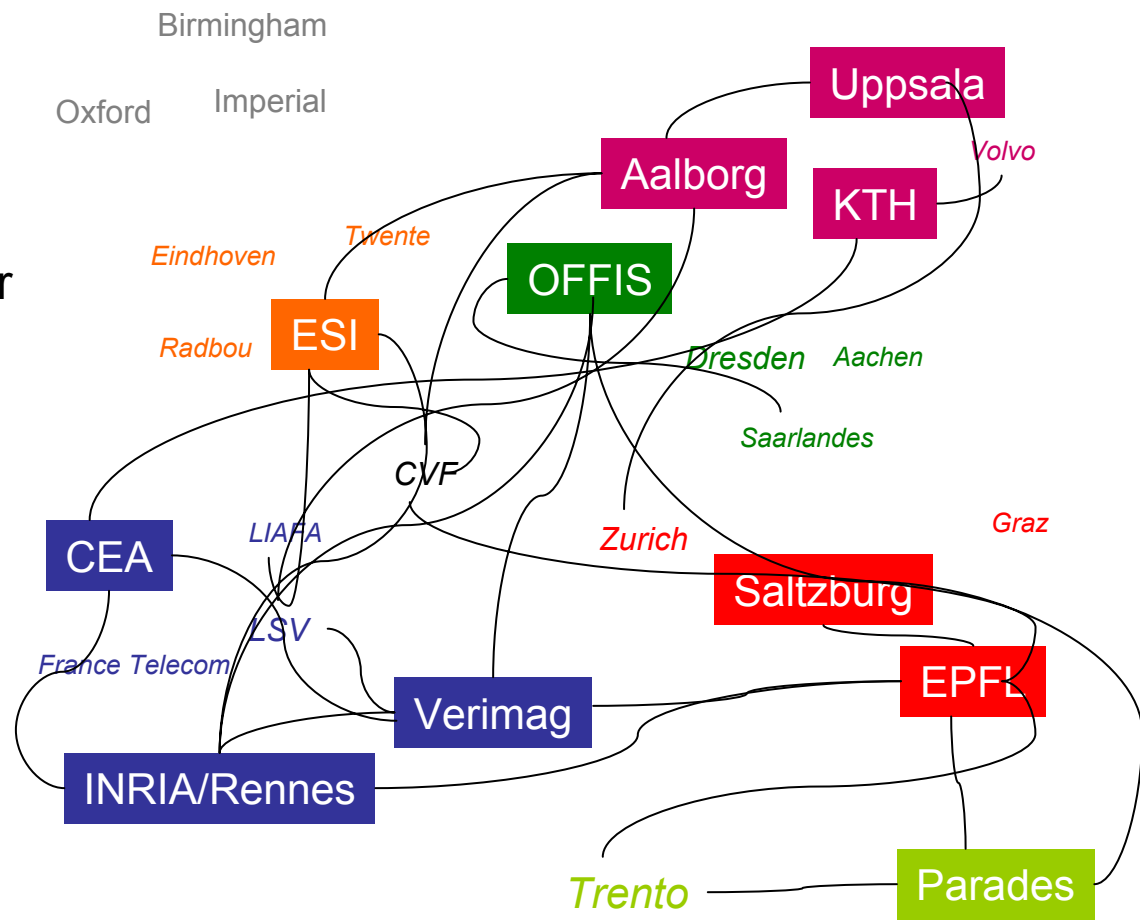
**Extensive interaction** with other communities

## National Centers and projects

- CISS, ESI, ..
- CREDO, DaNES, DOTS, Testec, ICES, ...

## New FP7/ARTEMIS/ESF Projects

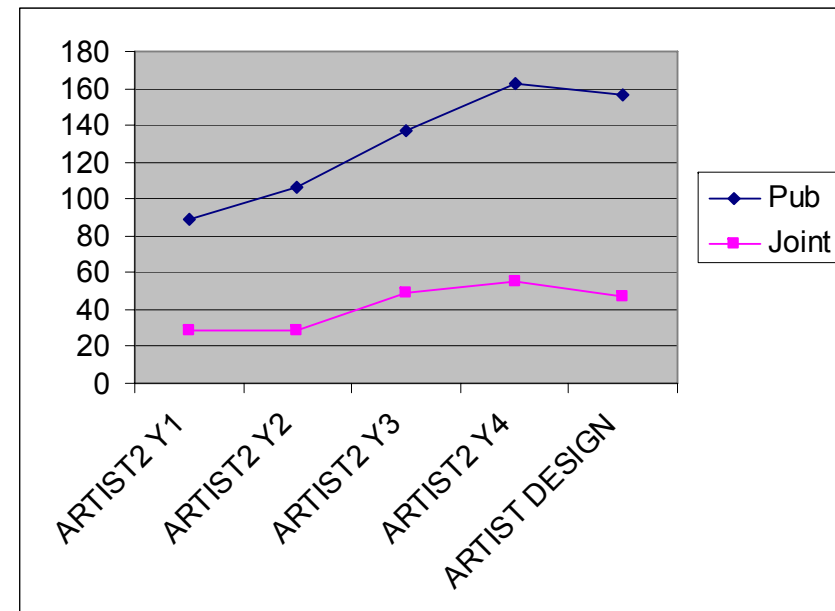
- QUASIMODO (STREP)
- MULTIFORM (STREP)
- COMBEST (STREP)
- GASICS
- CESAR
- GENESYS
- ADAMS
- ATTEST2, ... ..





# 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

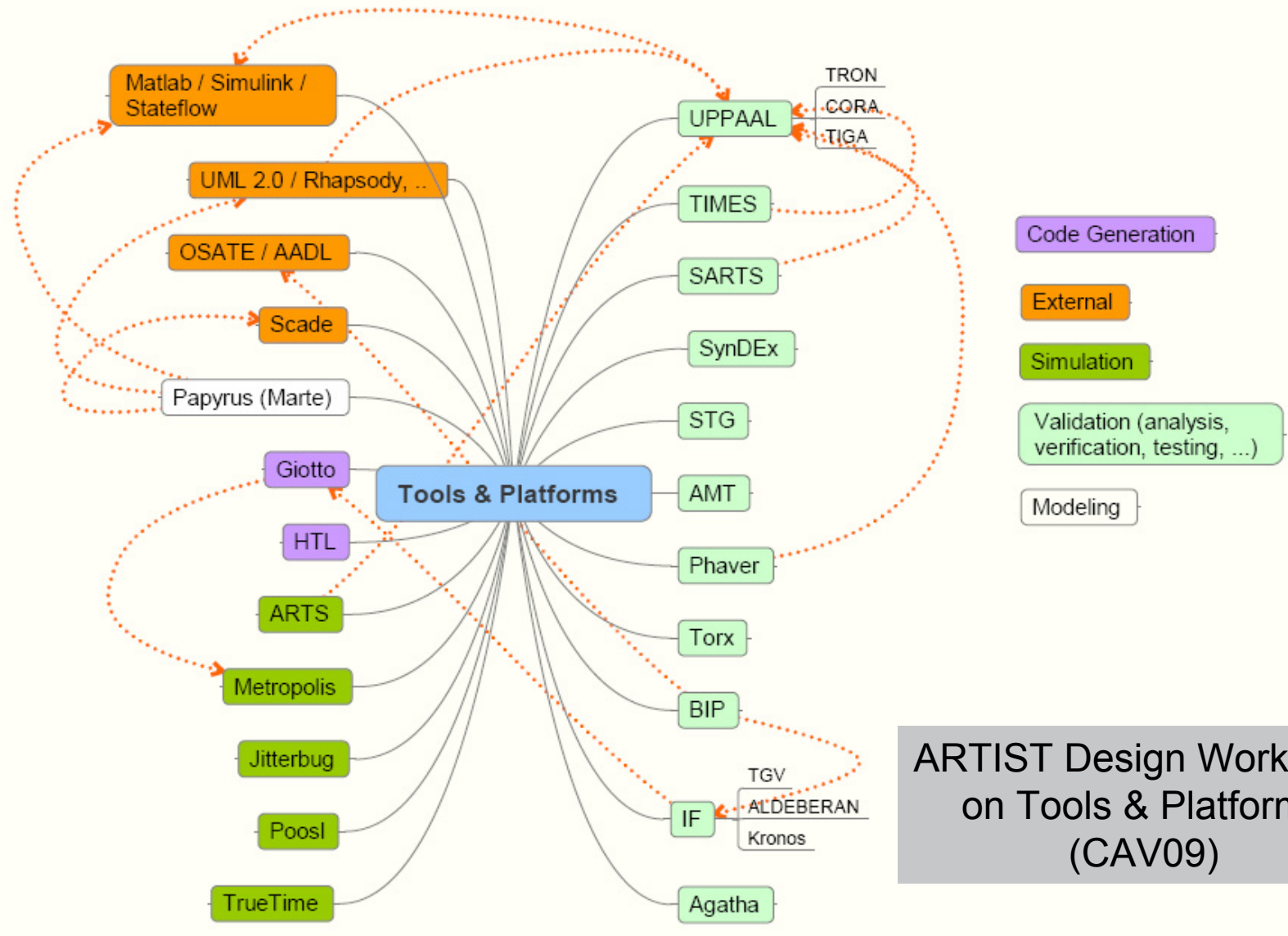
## Modeling

- 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.

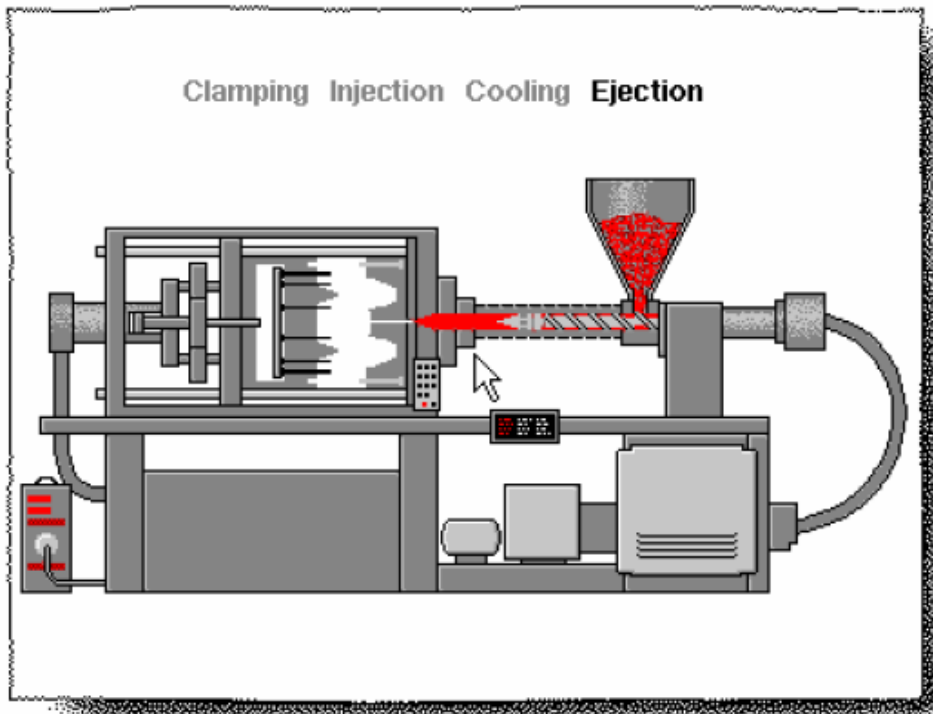
# Tools & Platforms



ARTIST Design Workshop  
on Tools & Platforms  
(CAV09)

# Scientific Highlight: Controller Synthesis

Quasimodo & Multiform (HSCC09)

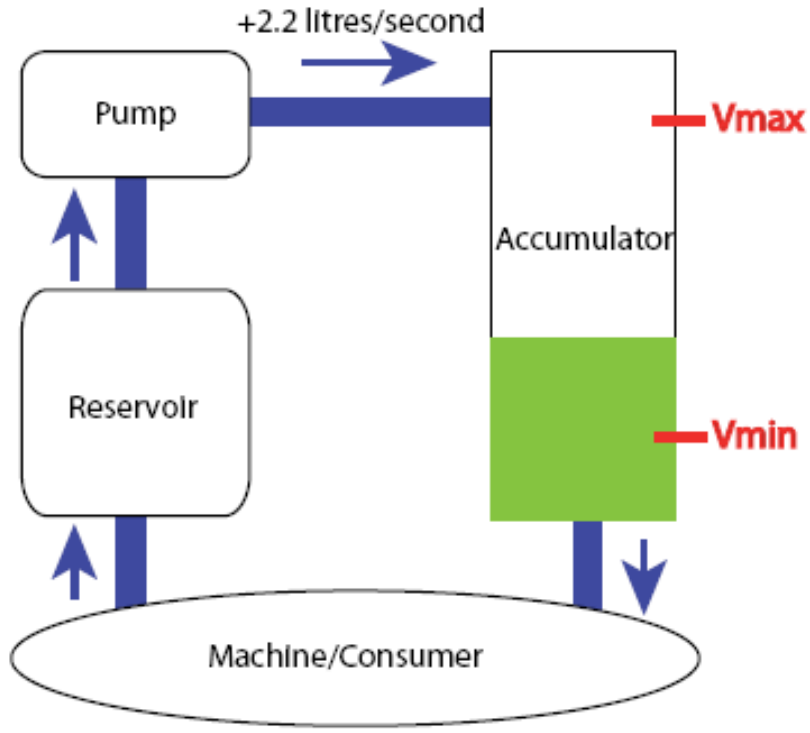


- Tool Chain
  - Synthesis: **UPPAAL TIGA**
  - Verification: **PHAVer**
  - Performance: **SIMULINK**
  
- 40% improvement of existing solutions..

## ARTIST DESIGN Partners:

- Aalborg
- CFV
- INRIA/Rennes
- VERIMAG

# Oil Pump Control Problem

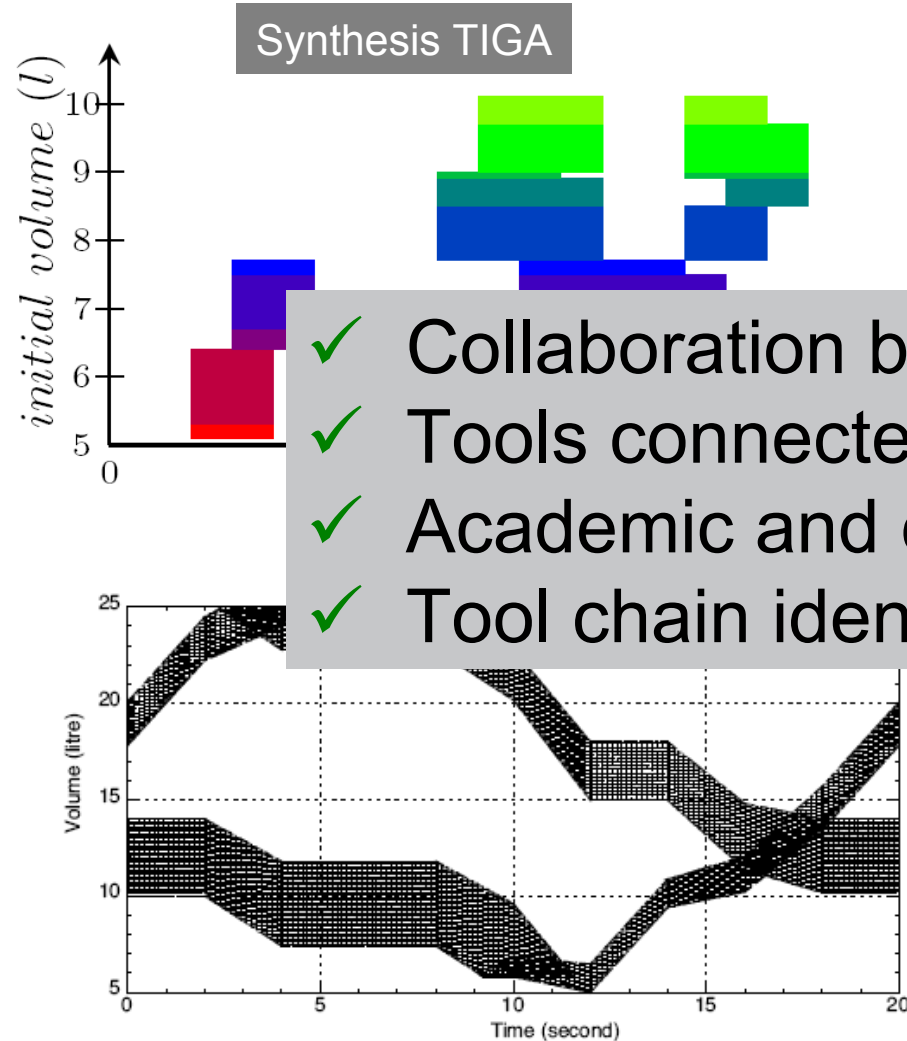


- **R1**: stay within safe interval [ 5 , 25 ]
- **R2**: minimize average/overall oil volume

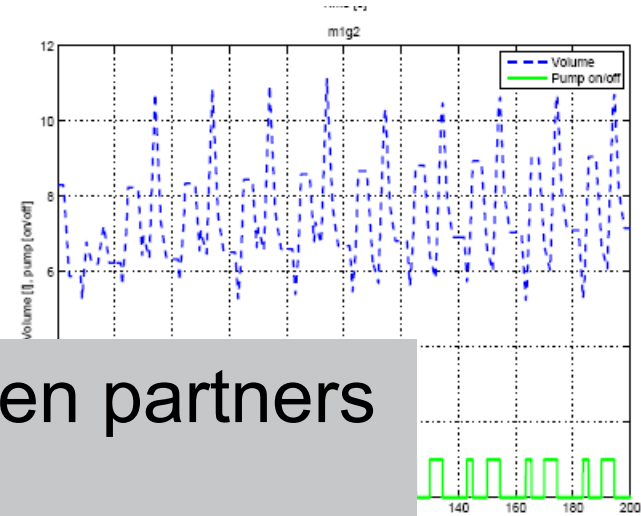
$$\int_{t=0}^{t=T} v(t)dt / T$$



# Tool Chain



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



evaluation  
K

Guaranteed  
**Correctness**  
**Robustness**  
 with  
**40% Improvement**

Verification PHAVER

## 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
- MLQA, Models and Logics for Quantitative Analysis.  
Satellite event at ETAPS 2009, York, March 22-29
- 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**  
(November 2009; Joost-Pieter Katoen, Kim G Larsen).