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 Deparment 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)

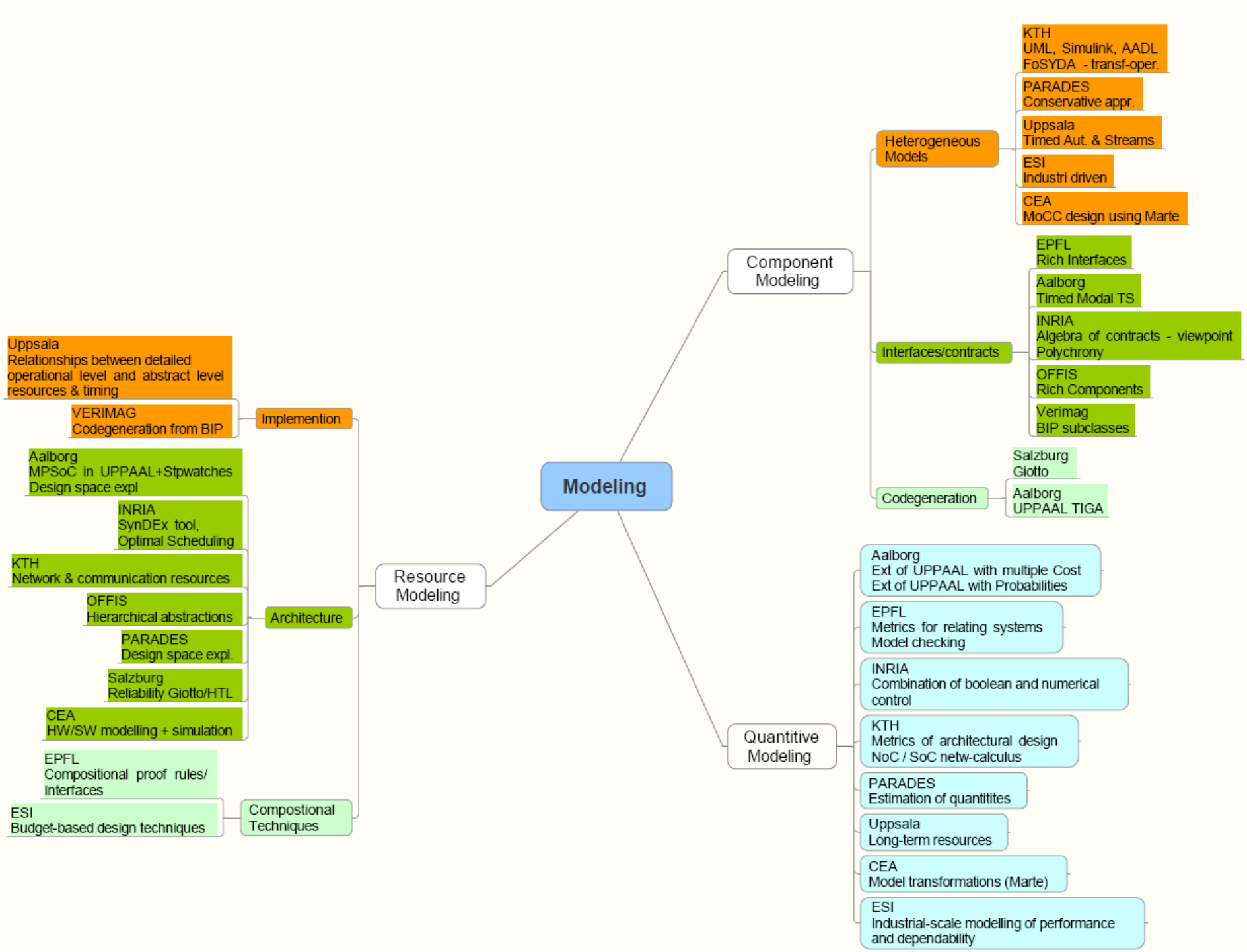
- Marius Minea (Institute e-Austria Timisoara, Romania);
- Christophe Gaston (CEA LIST)*;*
- Roberto Passerone (Trento – Italy);
- Jean-Francois Raskin (CVF – Belgium);
- Joost-Pieter Katoen (Aachen – Germany);
- Holger Hermanns (Saarlandes U – Germany);
- Christel Baier (Dresden – Germany);
- Francois 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

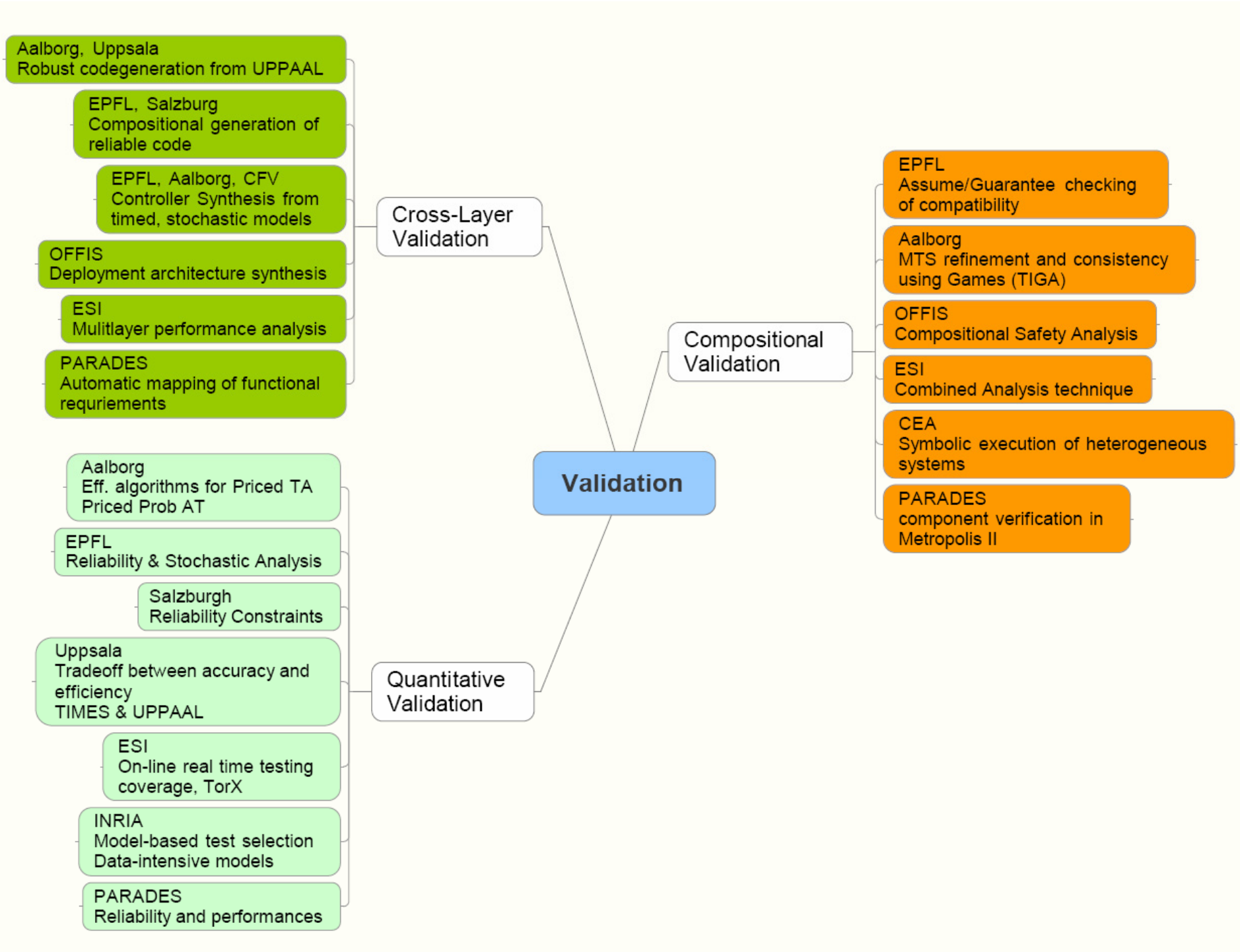

Modeling
Component Modeling
Heterogeneous Models
KTH
UML, Simulink, AADL
FoSYDA - transf-oper.
PARADES
Conservative appr.
Uppsala
Timed Aut. & Streams
ESI
Industri driven
CEA
MoCC design using Marte
Interfaces/contracts
EPFL
Rich Interfaces
Aalborg
Timed Modal TS
INRIA
Algebra of contracts - viewpoint
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 quantitites
Uppsala
Long-term resources
CEA
Model transformations (Marte)
ESI
Industrial-scale modelling of performance and dependability
Resource Modeling
Implemention
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
Compostional Techniques
EPFL
Compositional proof rules/ Interfaces
ESI
Budget-based design techniques

Overview of Clusters Activities

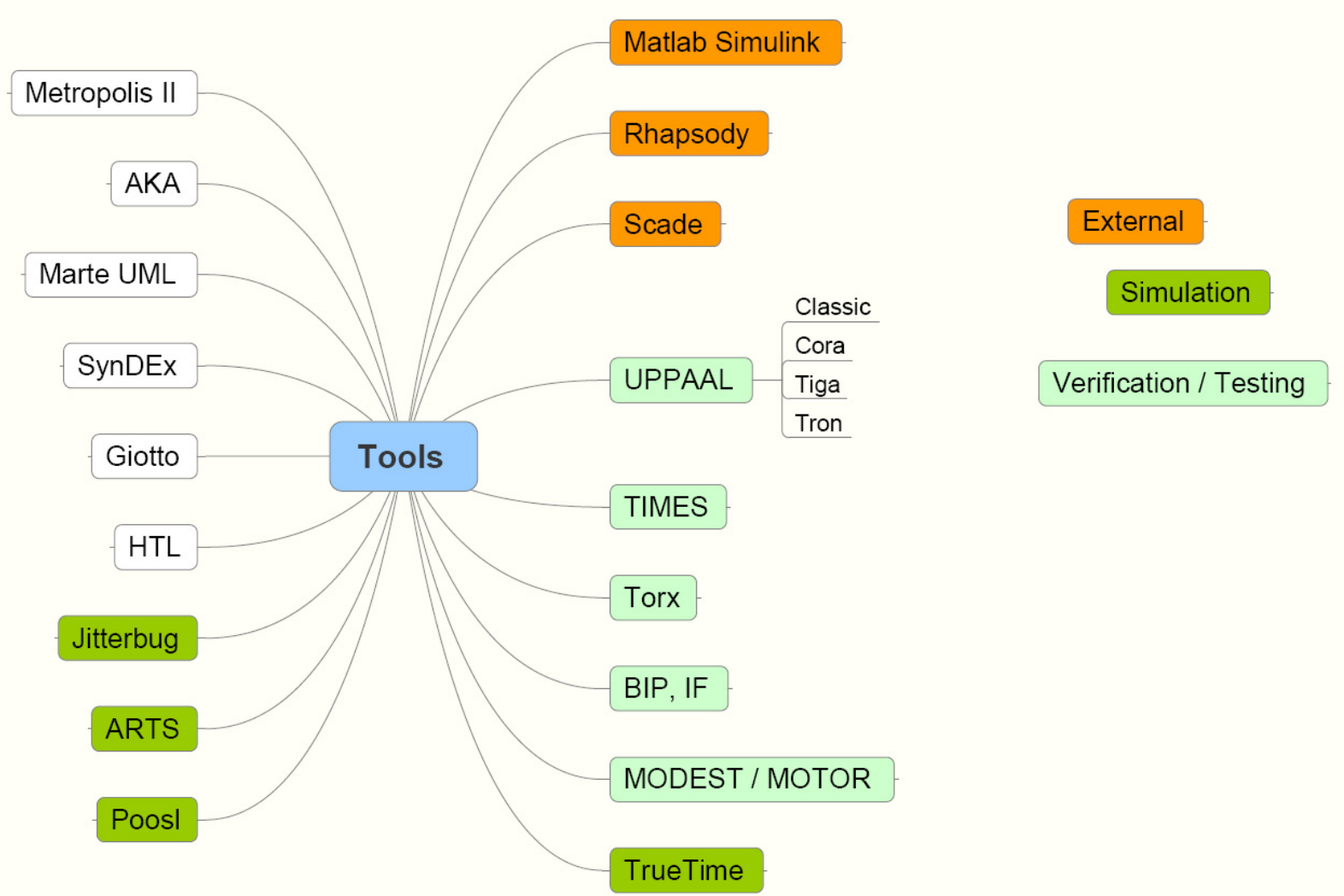
Validation

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


Validation
Cross-Layer Validation
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
Mulitlayer performance analysis
PARADES
Automatic mapping of functional requriements
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
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

Tools


Metropolis II
AKA
Marte UML
SynDEx
Giotto
HTL
Jitterbug
ARTS
Poosl
Tools
Matlab Simulink
Rhapsody
Scade
UPPAAL
Classic
Cora
Tiga
Tron
TIMES
Torx
BIP, IF
MODEST / MOTOR
TrueTime
External
Simulation
Verification / Testing

Projects

- National
  - DaNES
  - ..
- EU STREP / IP / Support Action
  - Quasimodo (AAU, ESI,..)
  - Multiform (AAU, ESI, VERIMAG, ..)
  - SPEEDS (OFFIS, VERIMAG, INRIA, PARADES,..)
  - COMBEST (OFFIS, …)
  - ATESST1, ATESST2 (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.