ASCENS
Autonomic Service Component Ensembles

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AWARENESS Inter-Project Workshop
Ensembles

- Massive numbers of nodes
- Extremely heterogeneous
- Complex interactions between nodes
- Complex interactions with humans or other systems
- Operating in open and non-deterministic environments
- Dynamic adaptation to
  - new requirements
  - technologies and
  - environmental conditions
Approach

Service Component Ensemble (SCE)
reliable, predictable, self-adaptive,
balances efficient execution and
flexible behaviour via
dynamic self-expression

Service Component (SC)
self-aware, adaptive
secure and safe
based on
knowledge

Engineering Emergence
Design and runtime control
of intended and
emergent behaviours,
static and dynamic
support from
formal methods

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Approach

Service Component Ensemble (SCE)

Case Studies
- Science Clouds
- Swarm Robotics
- Collaborating E-Vehicles

Tool Integr. Platform
Engineering
SCEL

Open-Ended Environment

SCE Language
(SCEL)

Correctness of SCs and SCEs
Foundational Models

Tool Integr. Platt.
Engineering
SCEL

Knowledge
Self-Awareness
Adaptation & Self-Expression

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ascens
Build a coherent and **integrated suite of models and techniques for constructing**

**Autonomic Service-Component Ensembles**

- Open environments
- Changing requirements
- Non-determinism
- Complexity Scale
- Reliable
- Predictable
- Resilient
- Fault tolerant
Summary of Results Year 1

- Languages SCEL V1.0, BIP, KnowLang for modeling, analyzing and specifying knowledge in ensembles
- System model GEM for adaptive and self-aware ensembles
- SOTA approach for specifying and analyzing adaptation requirements
- Verification techniques for qualitative and quantitative properties of systems in uncertain environments
- Application requirements and system needs for case studies
  - Robot ensembles, science cloud, collaborative e-vehicles

- Dissemination
  - Website with blog
  - 50 publications
  - 2 summer schools (co-organized)
  - ASCENS results taught in > 15 courses and tutorials
Confidence and Reliability: Difficulties

- Ensembles are
  - infinite state systems with varying members and environments
  - concurrent systems suffering the state space explosion problem
- Uncertain environment and changing requirements
- Heterostatic ensembles (Klopf ~1975)
  - maximize performance instead of simple goal satisfaction

- Confidence vs. confidentiality
  - Confidence in reliability of a system = subjective reliability of the system
  - Confidentiality = notion of information security
Confidence and Reliability Ideas: A Formal Methods Approach

- Specify confidentiality and reliability requirements
  - in a (continuous/discrete time stochastic) temporal logic
- Validate and verify requirements for SC ensembles
  - A posteriori verification
    - Compositional techniques for
      - specific properties (e.g. deadlock)
      - specific architectures (e.g. controllers, from synchronous to asynchronous communication, ...)
  - Correctness by supervised construction
    - Correctness preserving architectural principles for system construction and adaptation
    - Runtime monitoring of global/emergent properties
    - Predictive model analysis (at design and runtime)
Confidence and Reliability

- **Advice from other projects**
  - Trust models for measuring confidence and reliability
  - Measures for confidence of/in (self-) aware components
  - Designing emergence

- **Challenges for measuring confidence**
  - Monitoring global and emergent properties
  - Specifying and controlling adaptation
  - Combining formal reasoning techniques with models of trust
  - „Pervasive formal methods“ for enhancing confidence
  - Interaction of global and local confidence