Modelling and Validation of Distributed Systems
- overview of current research activities
- presentation of selected topics

Lars M. Kristensen (lmkristensen@daimi.au.dk)
People

Permanent Staff:
Kurt Jensen
Søren Christensen
Lars M. Kristensen

Post Docs:
Michael Westergaard
Sami Evangelista

PhD Students:
Simon Tjell
Jacob Andersen
Kristian B. Lassen
Morten T. Hansen

Student Programmers:
Surayya Urazimbetova
Mads K. Kjeldsen
Raphael Dobers

MSc Students:
Jacob Frølund
Kristian Dorland
Elvar Olafsson
Henrik Andersen
Raphael Dobers
Kristian L. Espensen
Mads K. Kjeldsen
Jonathan Frumer
The Research Area

- Our research is focussing on **distributed systems** (keywords: concurrency, synchronisation, and communication):

- **Engineering of distributed systems:**
  - Modelling languages for requirements specification and design.
  - Functional **verification** (deadlocks, safety, and reachability).
  - Performance **evaluation** (delay, throughput, and utilisation).
  - Implementation and deployment of **prototypes**.
Research Project Portfolio

A Platform for Galileo Based Pervasive Positioning [2008-10]
WP: Location-aware routing protocols for mobile ad-hoc networks

Sensor-based Surveillance in the Constructions Industry [2007-11]
Low frequency, power-efficient data collection in sensor networks

Advanced State Space Methods and Computer Tools for Verification of Communication Protocols [2006-09]
Computer tools and algorithms for model checking

Mobile Internet Services for Online Support of Agricultural Machinery [2006-09]
Publish-subscribe middleware for mobile ad-hoc networks.
Current PhD Projects


- Jacob Andersen: *Medical Sensor Network Infrastructure.*

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The ASCoVeCo Project

- State space exploration is one of the main approaches to computer-aided verification:

  - System
  - Model
  - State space

  Nodes ➔ reachable states
  Arcs ➔ transition executions
  Paths ➔ execution sequences

- A main research challenge is techniques for alleviating the state explosion problem.
The ASAP Platform

[M. Westergaard, M.K. Kjeldsen, S. Urazimbetova, and L.M. Kristensen (PNDS’08)]

- New computer tool for state space analysis of CPN models:
  - Intended as a platform for:
    - educational,
    - industrial, and
    - research
  - Job Specification and Execution Language (JoSEL) for creating verification jobs.
  - Implements a set of memory-efficient state space methods [bit-state hashing, hash compaction, comback, and sweep-line methods]
  - Version 1.0 will be released end of June 2008.

Eclipse Rich Client Platform

Standard ML

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Dynamically Delayed Duplicate Detection
[S. Evangelista (SPIN’08)]

- Uses external storage to address state explosion:
  - Delayed duplicate detection is essential, but the useful amount varies:
    - New states decreasing (many duplicates)
      - Delaying becomes harmful
    - New states increasing (few duplicates)
      - Delaying is useful
    - Dynamically estimate the amount of duplicate states:
      - Visited states
      - Candidate states

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The SensoByg Project

- Sensor networks for structural health monitoring:
  - Sensor networks for measuring moisture in concrete (beton).
  - Research challenges for protocols:
    - Low frequency measurement (~months)
    - Long lifetime (~100 years)
    - Number of sensor nodes (~1000s)
Initial Sensor System Prototype

[Morten T. Hansen]

- Skovdigt Vestbro being monitored by Rambøll A/S:
  - Base station
  - Routing
  - TinyOS2
  - TOSSIM
  - Virtual sensor network

- Data collection protocols exploit the geographical positions of the sensor nodes.
- B-processor being developed by Alexandra Instituttet A/S is being used as GUI to the sensor network.
New CPN Book
[K. Jensen and L.M. Kristensen]

- Based on experience with teaching and industrial use of Coloured Petri Nets for modelling and analysis of systems.

- Emphasises the practical use of Coloured Petri Nets and CPN Tools.
- Developed in conjunction with the CPN Course (2005-08).
- Replaces the “old” 3-volume textbook by K. Jensen.

- Publication by Springer-Verlag winter 2008/9.
Modelling and Validation of Distributed Systems

Thank you for your attention!