Verification and Validation in Cyber Physical Systems

LS XXII – Chair for Software Engineering
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Who we are …

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Verification and Validation in CPSs
Challenges

• Trial and error testing (which is the state of the practice) does not provide sufficient rigor in error detection
• Formal methods provide a desired level of expressiveness but are neither intuitive nor scalable
• Existing simulation tools are limited in their capabilities to jointly model physical and cyber components
• Requirements engineering does not yet provide satisfactory techniques, often neglected → GIGO
• Fast online detection and localization of faults and intrusions

Goal

- Understanding
  - The concept of CPSs
  - Problems in V&V of CPSs and solutions
  - Challenges and the way forward

- Exposure to scientific method
  - Critically reading, understanding, summarizing, explaining and presenting existing scientific work
Tasks Overview

• Mainly independent working
  - Read and understand different concepts
  - Look for papers/material beyond the initial suggestion
    • E.g. online libraries, TUM library
    • **No** Wikipedia
    • **No** blogs, forums etc.
  - Reproduce your understanding in form of a written term paper
  - Present your understanding in front of an audience

• Guidance from the lecturer whenever required
Rules

• Compliance with the prescribed deadlines
• Compliance with the writing formats
• Presence in all meetings
• Participation in the final presentations in one or two block-seminar
• Usage of Moodle and SVN repository
Rules

Grading

• Intermediate submission
• Term paper (50% of the grades)
• Presentation (50% of the grades)
Intermediate Submission

• Optional help offer from us (strongly recommended!)
• Ca. 2-3 pages
• Table of content
  - Detailed with subsections
• Extended abstract
  - Introduction
  - Problem statement and goals
  - A short description/summery of the content of each subsection
  - Clear sketch of own contribution/critical assessment
• Bibliography
Term paper

• Max 15 pages including appendix, LNCS format
• Independent work
• No Plagiarism!
  - Blatant copy-paste, summarizing some else’s ideas/results without reference etc. **will result in immediate expulsion from the course.**
• Discussion of own contribution
• Complete bibliography
• Appendix, if needed
Content

- Don’t deviate from the allotted topic
- Logical and contradiction-free reasoning
- Argue with sources properly cited
- If you find any contradiction in the papers you read, point them out, don’t hide them
Content

• Bibliography
  - Must be referenced in the text
  - Must have consistent numbering
  - No Wikipedia, blogs, forums as sources

• Recommended: BibTeX
Content

• Tables and Pictures
  - Sources must be properly cited
  - Must not be blurry
  - Large enough to be clearly read in print
  - Must be referenced in the text
  - Must have consistent numbering
  - Useful caption
    - Tables have caption above, pictures have captions below
Possible Structure

• Title page
• Introduction
• Related work
• Topic content
• Results
• Conclusion and discussion
• Bibliography
• Appendix
Presentation

• Ca. 30 minutes of talk
  - Clear, easily understandable presentation of the term paper content

• Ca. 10 minutes of discussion at the end
  - Be prepared for questions on your topic
  - Ask questions on the presented topic
Finding Literature

• Moodle Page
• TUM Library
  - Informatik
  - Others
• Search engines
  - Springer (http://www.springerlink.com/)
  - ACM (http://dl.acm.org)
  - IEEE (http://ieeexplore.ieee.org/Xplore/guesthome.jsp)
• Meta search engines
  - Scopus (www.scopus.com)
  - Google Scholar (www.scholar.google.com)
Registration

- TUM Online Matching System
  - [http://docmatching.in.tum.de/](http://docmatching.in.tum.de/)
  - More details from info point
Registration

- Choose 3 topics from the list
- Mail to golagha@in.tum.de
- Order of preference: 1 highest, 3 lowest

- Get a topic by email
Deadlines

• Intermediate Submission
• Term paper submission
• Submission of the presentation slides

• Individual appointment for feedback
• Final seminar-day

• To be announced in Moodle
Topics Overview
Topics Overview

1. The algorithmic analysis of hybrid systems

2. Automatic abstraction for verification of cyber-physical systems

3. Systematic Model-Based Testing of Embedded Automotive Software
4. Empirically studying the role of selection operators during search-based test suite prioritization
5. Search-based automated testing of continuous controllers
6. Test Case Generation by OCL Mutation and Constraint Solving
7. Test case selection strategies based on Boolean specifications
8. AUSTIN: An open source tool for search based software testing of C programs
9. Detection of Faults and Intrusions in Cyber-Physical Systems from Physical Correlations
10. Fault localization in embedded control system software
11. Modeling and Mitigation of Faults in Cyber-physical Systems with Binary Sensors
12. Optimization of a knowledge-based system by a meta-heuristic approach for the automotive diagnosis
13. A hybrid-logic approach towards fault detection in complex cyber-physical systems
Topics Overview

14. Integrated cyber-physical fault injection for reliability analysis of the smart grid

15. Adaptive fault-tolerance for cyber-physical systems
You may also write to us if you would like to do your own topic on verification and validation in cyber physical systems.