COMPASS: Future trends and developments

Marco Bozzano - Fondazione Bruno Kessler

Model-Based System and Software Engineering - Future directions

ESA-ESTEC, December 8th, 2016

Outline

- COMPASS
- COMPASS 3.0
- The Future of COMPASS
- Needs and Solutions

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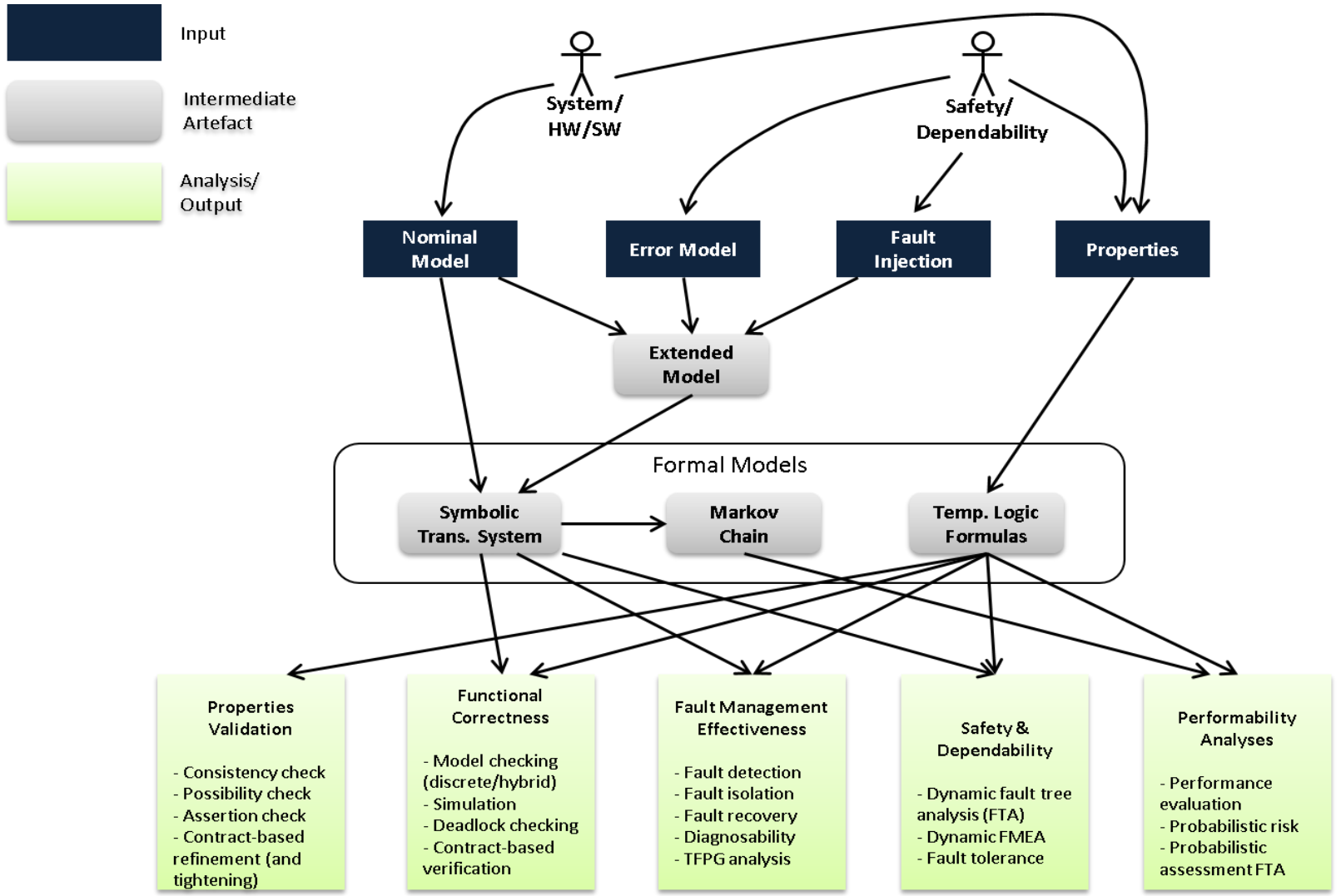
COMPASS

- Consortium
  - Fondazione Bruno Kessler, Trento (Italy)
  - RWTH Aachen University (Germany)

compass-toolset.org

COMPASS

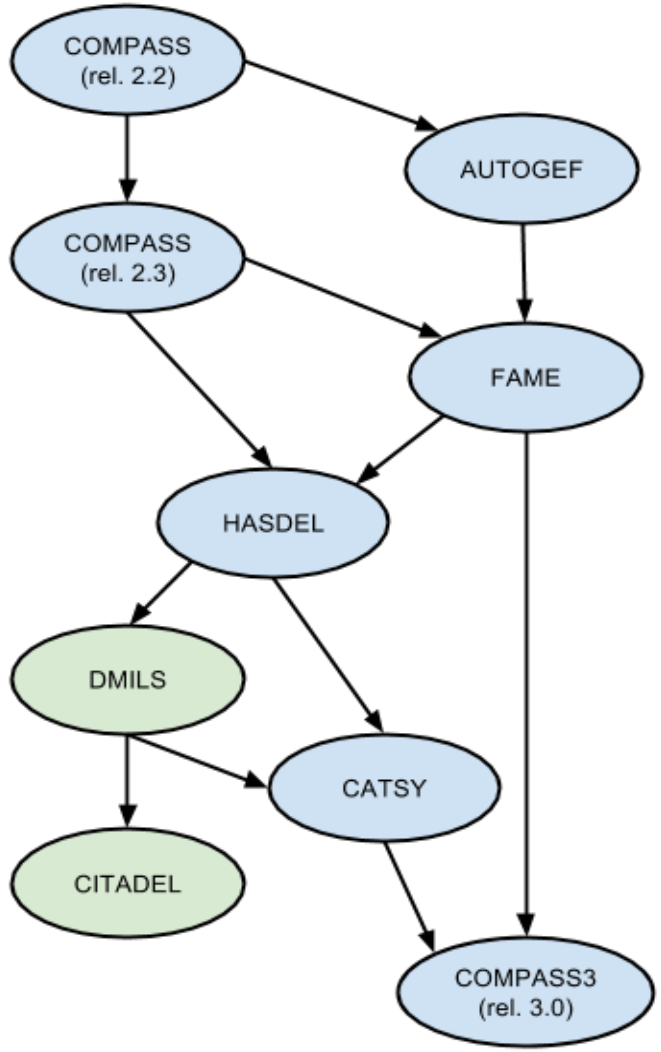
- Highlights
  - Modeling language is **SLIM**, a variant of AADL)
  - Based on **formal verification** engines (**model checking**)
  - Automated model extension



History of COMPASS

- Developed within several projects
  - COMPASS (2008 - 2011)
  - AUTOGEF (2011 - 2013)
  - FAME (2012 - 2014)
  - HASDEL (2013 - 2014)
  - DMILS (2013 - 2015)
  - CATSY (2014 - 2016)
  - CITADEL (2016 - 2018)

  - COMPASS3 (2015 - 2016)



ESA - funded

EU-funded

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The COMPASS3 Project

- **ESA Contract No. 4000115870/15/NL/FE/as**
- **ESA Technical Officer: Marcel Verhoef**
- Time span:
  - December 2015 - December 2016
- Project Goals
  - Consolidation of existing COMPASS toolchain
  - Pick, integrate, and harmonize selected features from previous projects

COMPASS 3.0

- Implementation
  - GUI + Command Line Interface
  - Python & PyGTK
  - Packaging as a python module
- Distribution
  - Release COMPASS 3.0
  - **Expected delivery date: December 16th, 2016**
  - Released as source code and as a pre-installed virtual machine
  - Available for ESA member states
  - Download page: http://www.compass-toolset.org/tools-download
  - Support: compass-support@lists.rwth-aachen.de
  - Announcements: compass-announce@lists.rwth-aachen.de

COMPASS 3.0 Highlights

- SLIM 3.0
  - Consolidated input language
  - Syntax and semantics - updated and fully documented
  - Improved alignment with AADL
- Functionality
  - Property validation, functional correctness, FDIR analysis, safety and dependability analysis, performability analysis, contract-based design
- Improved code quality, portability and maintainability
- New example suite
  - Examples picked /extended from previous projects + new examples
- Documentation: user manual, tutorial, web portal

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The Future of COMPASS

- COMPASS Roadmap
  - **Public document (draft) open for feedback**
  - See https://indico.esa.int/indico/event/161
  - Analyzes the current status and the future of COMPASS
  - **Final version due on December 16th**

COMPASS Roadmap: Overview

- Goals: improve usability, accessibility, visibility, market penetration, industrial usage; integrate with other ESA initiatives (TASTE, OSRA)
- Summary of future directions
  - Toolset
    - Enhance usability, TRL, compatibility with AADL
    - Develop front-end for other input languages, integration with design environments
  - Process
    - Generation of ECSS documentation, support for certification
  - Research
    - Various open research directions
    - Publications, dissemination (tutorials, courses, PhD schools)
  - Community
    - Involve the community in the identification of the needs and solutions
    - Push industrial usage/adoption of the toolset
  - Integration with ESA initiatives
    - TASTE, OSRA, …

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COMPASS-STAR

- Need: enhance usability in existing toolchains/industrial processes
- Solution 1: integration with other input modeling languages
  - COMPASS-STAR = COMPASS + front-end for other input languages
    - Altarica, Simulink, SysML, …
  - Strategic collaborations with other communities

MBSSE "PITCH": COMPASS without AADL – towards COMPASS-STAR?

- Solution 2: integration with existing design environments
  - Eclipse, Capella, …

MBSSE TALK: Connecting COMPASS to Capella

Industrial Exploitation

- Need: push industrial exploitation
- Solution
  - Find exploitation schemas to make use of COMPASS appealing for industries
    - Evaluation in past programs / case studies?
    - Exploitation in existing programs / within ongoing studies?
  - Internship of students in industries
    - PhD, NPI, visiting researchers, …
  - Need to find suitable funding schema
    - Internal funding
    - TRPs
    - joint PhD programs
    - …

Case Studies

- Need: demonstrate COMPASS on realistic-size (industrial) models
- Solution: develop bigger case studies
  - Develop case studies within the COMPASS Consortium
  - Develop case studies in industries
    - Related with previous point on industrial exploitation
    - Case studies must be publicly distributable

Scalability

- Need: enhance scalability of the toolset
- Solution: profile verification engines, find bottlenecks and investigate enhancements of verification routines; use contract-based design and compositional reasoning
  - Need a set of benchmarks
  - Need realistic-size case studies

Software Licenses

- Need: enhance accessibility of COMPASS
  - Currently restricted to ESA member states
  - Several past requests from non-ESA member states, including major industries
- Solution: investigate possibility of license for non-ESA member states
  - Grant licenses under specific terms / restrictions?
  - Grant-back of evaluation reports / case studies?
  - Requires feasibility analysis, to be discussed with ESA

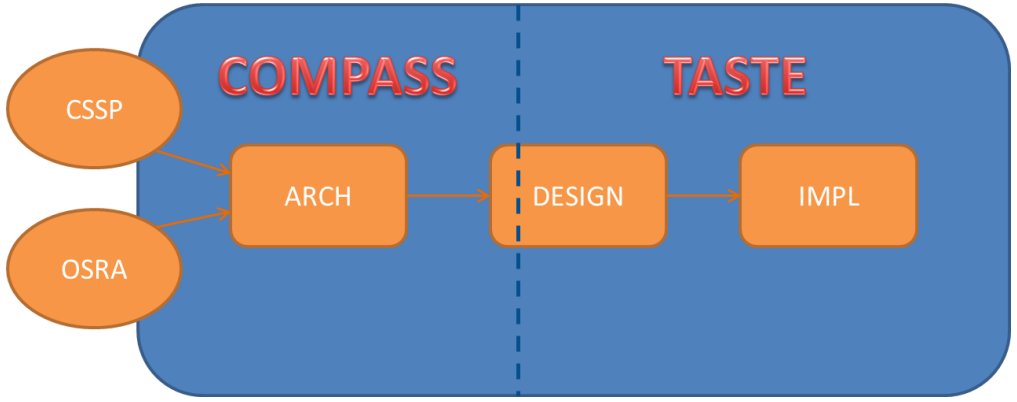
SLIM and AADL

- Need: exploit synergies with the AADL language community
  - Share case studies
  - Share tools, e.g. OSATE
- Solution
  - Further improve alignment / compatibility between SLIM and AADL
  - Continue collaboration with AADL Committee

Integration with ESA Initiatives: TASTE, OSRA

- Need: bridge the gap between architectural modeling and implementation /deployment

- Solution
  - Integrate COMPASS with OSRA (On-Board Software Reference Architecture) and TASTE
  - Ensure compliance of the models used in COMPASS/TASTE with the component model of OSRA
  - Enhance COMPASS with the library of components used in OSRA
  - Enhance OSRA components with CSSP (Catalogue of Software and System Properties)



Continuous Integration

- Need: improve software development process / infrastructure of COMPASS
- Solution: improve existing COMPASS continuous integration environment
  - Based on git repository and gitlab repository manager
  - Automatic testing facilities based on Jenkins
  - Consider continuous integration / testing on ESA server, compare TASTE experience

ECSS Standard

- Need: make COMPASS compliant with ECSS, make it usable for certification purposes
- Solution
  - Extend COMPASS to generate artifacts / documentation / reports compliant with ECSS standards
  - Produce artifacts that can be used for design reviews and for certification

Future Research Directions

- Need: extend COMPASS to cover functionality gaps
- Solution: several research directions to be investigated
  - Model simulation
  - Model-to-model-comparison
  - Property validation
  - FDIR design process, FDIR reference architecture
  - Dynamic fault tree analysis
  - Contract-based fault injection
  - Parameter synthesis
  - Multi-Objective verification
  - Model-Based Testing
  - …

Dissemination

- Need: dissemination, publicity and advertisement
- Solution
  - New web portal: compass-toolset.org
  - Mailing lists: compass-announce (already existing), …
  - Publications: journal conferences
  - Tutorials, student courses
  - Wikipedia, ResearchGate entries
  - …

Dissemination: Future Events

- Conferences in September 2017
  - **SEFM** (Software Engineering and Formal Methods) (06-08 Sept. 2017)
  - **IMBSA** (Model-Based Safety and Assessment) (11-13 Sept. 2017)
  - **Safecomp** (Computer Safety, Reliability and Security) (13-15 Sept. 2017)
- Organized by FBK, co-located in Trento, Italy
- IMBSA/Safecomp joint session on aerospace
- Web sites:
  - http://sefm17.fbk.eu
  - http://imbsa2017.fbk.eu
  - http://safecomp17.fbk.eu

Community Involvement

- Need: involve community in the development of COMPASS, share strategy and goals
- Solution
  - Exploit dissemination opportunities
  - Share roadmap
  - Questionnaire for end users, to collect feedback