Welcome to the first COEMS Newsletter.
Within the COEMS project the five players, University of Lübeck, Accemic Technologies, Thales, University of Bergen and Airbus joined their forces to develop a novel continuous observation solution for embedded multicore systems. We would like to inform you about our achievements so far, current developments and COEMS-related events in the near future. Topics in this issue include a project overview, our specification language TeSSLa, our open data portal and multicore-systems in avionic systems.

COEMS at a glance

Within COEMS a novel platform for online monitoring of multicore systems is developed. It gives insight to the system’s behaviour without affecting it. This insight is crucial to detect non-deterministic failures as for example caused by race conditions and access to inconsistent data. The left-hand figure depicts the COEMS architecture. A binary generated by a C-compiler is executed on the device under test (DuT). From high-level test specifications, observation and monitor specifications are extracted by the front end. The analyser component generates an observation configuration. At the same time the TeSSLa compiler component generates a monitor configuration. Both configurations are transmitted to the respective components of the COEMS hardware platform. The trace information from the DuT is then used to generate the necessary control flow events which are then analysed with respect to the monitor specification. The results are emitted as a continuous report.

COEMS Meeting at Airbus

We had a successful status meeting at Airbus facilities in Ottobrunn/Munich from November 7th to 8th, 2017. The main topics discussed were our current achievements in observation technology, runtime verification, static analysis and railway and avionic use-cases.

External expert Dr. Andreas Griesmayer from ARM, Cambridge/UK, gave valuable feedback and invited us to present COEMS technology at the ARM Research Summit in September 2018 in Cambridge.
TeSSLa (Temporal Stream-based Specification Language) is a high-level, declarative language to describe properties and analyses for timed, embedded systems. It is developed within COEMS as a convenient way for the users to specify testing and debug properties and other analyses that are then run on the COEMS hardware platform. The right-hand figure depicts a simple monitor specification in the language TeSSLa. The property is specified in terms of signals (a,b,c,x) and event streams (e,r). Time increases from left to right. In this example c is defined as the sum of a and b. The signal x is defined as the number of events of e since an event on r. Events and signal changes always carry timestamps which can be referenced in property specifications. These abstractions allow a precise and concise specification of timed events. The specifications are compiled to hardware configurations by the TeSSLa compiler.

### Modified Condition Decision Coverage (MC/DC)

Modified condition/decision coverage (MC/DC) is a coverage criterion that is required for the certification of safety-critical software-systems used in the avionics industry.

Due to a limitation in size of traces which becomes unfeasible very quickly, an online approach is proposed to measure MC/DC using COEMS FPGA hardware to reconstruct the trace and calculate the MC/DC information. It combines current research on online trace reconstruction with online monitoring of trace information.

To satisfy MC/DC, the following criteria need to be fulfilled:

- every point of entry and exit in the program should be invoked at least once
- every basic condition in a decision in the program should take on all possible outcomes at least once
- each basic condition should be shown to independently affect the decision’s outcome (varying just that condition while holding fixed all other possible conditions, changes the outcome)

### Papers & Talks

Torben Scheffel presented
Torben Scheffel, Normann Decker, Martin Leucker, Malte Schmitz, Philip Gottschling, Alexander Weiss and Christian Hochberger: Rapidly Adjustable Non-Intrusive Online Monitoring for Multi-core Systems at the XX Brazilian Symposium on Formal Methods in Recife

http://sbmf2017.cin.ufpe.br

Martin Leucker presented
Svetlana Jakšić, Martin Leucker, Dan Li and Volker Stolz: COEMS — open traces from the industry at RV-Cubes 2017 in Seattle

http://rv2017.cs.manchester.ac.uk/rv-cubes

Philip Gottschling from TU Darmstadt will present

https://www.date-conference.com

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement no. 732016.
Integration of multicore systems is rather new in the context of avionic systems. Even though there are many initiatives to enable multicores for avionic use cases, reality is still the use of single-core systems.

The reason for this are manifold regulations and the long product cycles: any product developed for application in airborne systems needs to be certified. This certification is extremely expensive and, hence, once a system is certified it will be used for many years. Novel developments require a good reason that must be more than just higher integration. Moreover, if higher integration is an argument, multiple systems are affected. Accordingly, re-certification must be done for all these systems, resulting in even higher cost...

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**Multicore Integration in Avionic Systems**

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**COEMS & Open Data**

Our project is contributing to the European Open Research Data Pilot that makes scientific data available to other researchers. We publish FAIR data: findable, accessible, interoperable and reusable.

The University of Lübeck is hosting the repository. Data can be referenced by DOIs in scientific publications and therefore further increase the value of the data. We use data stories to show-case the use and advantages of COEMS tools.

As the distribution platform for our open data repository, we have chosen Dkan. It features an easy-to-use interface for cataloguing, maintaining and visualizing data, which allows data to be easily shared and referenced. Data is easy to explore, search, add, describe, tag, and group. We have developed our own micro-service that converts between trace data formats, for example conversion between TeSSLa and CTF, the Common Trace Format.

Our repository will also host The International Competition on Runtime Verification which will be held in autumn 2018. We hope for fruitful synergies between Runtime Verification researchers and the COEMS partners!

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**Upcoming**

Lukas Convent, Albert Schulz and Alexander Weiss will demonstrate online trace data processing with COEMS tools at exhibition of European projects at DATE 2018 in Dresden from March 20 to 22.

[https://www.date-conference.com/exhibition](https://www.date-conference.com/exhibition)

ARM Research Summit
17-19 September 2018 in Cambridge, UK
[https://www.arm.com/company/events/research-summit](https://www.arm.com/company/events/research-summit)

Consortium:

[UNIVERSITÄT ZU LÜBECK INSTITUTE FOR SOFTWARE ENGINEERING AND PROGRAMMING LANGUAGES](https://www.uni-luebeck.de/inf/)
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