

COST Action IC 1402 ArVI: Runtime Verification Beyond Monitoring Activity Report

Working Group 4 - Application areas

Abstract. This report presents the activities of the fourth working group of the COST Action ArVI, Runtime Verification beyond Monitoring.

The purpose of Working Group 4 as defined in the memorandum is as follows:

This group studies the potential applications of RV to important application areas beyond software and hardware reliability, including medical devices and legal contracts. This task requires the direct interaction with experts from the respective communities. The Working Group will **organize workshops with invited experts from application domains**. For example, for the safe interoperability of medical devices, it is important to enrich the interface COST specifications with temporal properties about the intended interaction of two devices and to synthesize monitoring code for runtime. If monitoring identifies unwanted behavior, the systems might go into some fail-safe mode. Another interesting application area that will be explored is how to monitor legal e-contracts (e.g., computer-mediated transactions). Some efforts have recently been done to formalize legal contracts using formal languages, where skeletons of runtime monitors could be extracted from the formal semantics. The time is now right to apply these techniques successfully to real case studies, which is planned for this working group. Other applications include robotic and hybrid systems, monitoring for business models and systems security.

Concrete output of this Working Group will consist of **documents describing challenges and potential applications of runtime verification to these application areas**. Moreover, **a concrete case study in the medical domain will be performed** identifying the safety enhancements of medical devices by using runtime verification techniques.

The rest of the document expands on each of the deliverable highlighted in the COST action memorandum.

1 Workshops

A number of workshops have been organised throughout the lifetime of the action covering a number of important application areas:

Financial Transactions A workshop on the runtime verification of financial transactions has been organised in Malta in April 2015. Further details are available at https://www.cost-arvi.eu/?page_id=166.

Medical Cyber Physical Systems A workshop on the runtime verification of medical cyber physical systems has been organised in Vienna in April 2016. Further details are available at http://mlab-upenn.github.io/medcps_workshop/

Electronic Contracts A workshop on the runtime verification of electronic contracts has been organised in Prague in March 2017. Further details are available at https://www.cost-arvi.eu/?page_id=862

Security and Privacy A workshop on runtime verification in the context of security and privacy has been organised in Syracuse in September 2018. Further details are available at https://www.cost-arvi.eu/?page_id=1431

One-off Sessions Other sessions for Working Group 4 were organised during COST meetings. In particular during the Tallinn meeting (December 2015) talks covered the following areas: medical devices, electrical energy storage, challenges for RV in industry. Further details are available at https://www.cost-arvi.eu/?page_id=500. Similarly, during the Madrid meeting (September 2016), talks covered financial transactions and medical devices. Further details are available at https://www.cost-arvi.eu/?page_id=758.

2 Application Areas

An accompanying report covers the main application areas which have been explored through the COST action. The report consists of a section for each of the following, including reflections from discussions which took place during the respective workshops:

- Financial transactions
- Medical devices
- Electronic contracts
- Security and privacy
- Electrical energy storage.

3 Case Study in the Medical Domain

Runtime Verification is a prominent verification techniques that seems to be applicable especially in safety-critical domains. Within the OR.NET project, a communication stack for medical devices was developed. With the help of this COST action, the implementation was analyzed and improved using runtime verification approaches. Further details can be found at https://www.cost-arvi.eu/?page_id=247.

4 Other Activities

As a way of facilitating exchange of case studies for runtime verification applications, a webpage (https://www.cost-arvi.eu/?page_id=241) was set up to host a list of case studies from the community. The collection is organised under two headings: Case studies which have been successfully completed and those which would be nice to have.