



ERCIM "ALAIN BENSOUSSAN"  
FELLOWSHIP PROGRAMME



## Scientific Report

First name / Family name

Muhammad Atif / Javed

Nationality

Pakistani

Name of the *Host Organisation*

RISE SICS Västerås

First Name / family name  
of the *Scientific Coordinator*

Mehrdad / Saadatmand

Period of the fellowship

01/02/2021 to 30/11/2021

## I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

We targeted the fault and threat tolerant platooning for materials transportation in production environments. Our functional use cases include the platoon control for collision avoidance, data acquisition and processing by considering range, and connectivity with fog and cloud levels. To perform the safety and security analyses, the Hazard and Operability (HAZOP) and Threat and Operability (THROP) techniques are used. Based on the results obtained from them, the safety and security requirements are derived for the identification and prevention/mitigation of potential platooning hazards, threats and vulnerabilities. The assurance cases are constructed to show the acceptable safety and security of materials transportation using Automated Guided Vehicle (AGV) platooning. We leveraged a simulation-based digital twin for performing the verification and validation as well as finetuning of the platooning strategy. Simulation data is gathered from digital twin to monitor platoon operations, identify unexpected or incorrect behaviour, evaluate the potential implications, trigger control actions to resolve them, and continuously update assurance case.

We leveraged the Natural Language Processing (NLP) for compliance management of software engineering processes with standard documents [2, 3]. The rules are created for extracting and structuring information, in which both syntactic features (captured using NLP tasks) and semantic features (captured using ontology) are encoded. During

the planning phase, the standard requirements, process models and compliance mappings are generated in the Eclipse Process Framework (EPF) Composer; it supports major parts of the OMG's Software & Systems Process Engineering Metamodel (SPEM) 2.0. In the context of reverse compliance that can be carried out during execution phase, the gaps with extended or pre-existing process models are detected and resolution measures are provided.

We also targeted the automated transformations and formal verification of reconfigurable systems [4]. Specifically, the objectives and related requirements of reconfigurable systems are mapped to a feature model, which in turns automatically transformed into the formal constraints, i.e., Linear Temporal Logic (LTL); whereas the units related to operational modes selected in individual configurations are transformed into state based Symbolic Model Verifier (SMV) language. The formal verification is carried out with the NuSMV 2.6.0, a new version of symbolic model checker. The analysis of model checker results is performed for the identification and resolution of deviations (i.e., incompleteness, inconsistency and conflict), in order to satisfy the configuration(s) with a feature model.

## II – PUBLICATION(S) DURING YOUR FELLOWSHIP

1. Muhammad Atif Javed, Faiz Ul Muram, Sasikumar Punnekkat, Hans Hansson, "Safe and secure platooning of automated guided vehicles in Industry 4.0", Journal of Systems Architecture, Volume 121 (2021)  
<https://doi.org/10.1016/j.sysarc.2021.102309>
2. Faiz Ul Muram, Muhammad Atif Javed, and Samina Kanwal, "Facilitating the Compliance of Process Models with Critical System Engineering Standards using Natural Language Processing", 16th International Conference on Evaluation of Novel Approaches to Software Engineering (ENASE 2021), Online Streaming, April 26-27, 2021  
<https://www.scitepress.org/Papers/2021/104559/104559.pdf>
3. Muhammad Atif Javed, Faiz Ul Muram, and Samina Kanwal, "Ontology-based Natural Language Processing for Process Compliance Management", 16th International Conference on Evaluation of Novel Approaches to Software Engineering (ENASE 2021), Online Streaming, April 26-27, 2021, Revised Selected Papers, Communications in Computer and Information Science, Springer
4. Faiz Ul Muram, Samina Kanwal, Muhammad Atif Javed, "Supporting Automated Verification of Reconfigurable Systems with Product Lines and Model Checking", 16th International Conference on Evaluation of Novel Approaches to Software Engineering (ENASE 2021), Online Streaming, April 26-27, 2021  
<https://www.scitepress.org/Papers/2021/104557/104557.pdf>

### III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

I have attended the 25th Ada-Europe International Conference on Reliable Software Technologies (AEiC 2021). It was held virtually from 7-10 June 2021.

### IV – RESEARCH EXCHANGE PROGRAMME (REP)

I have not visited any other ERCIM institute.