



ERCIM "ALAIN BENSOUSSAN" FELLOWSHIP
PROGRAMME



Scientific Report

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First Name / family name of the <i>Scientific Coordinator</i>	Hallvard Trætteberg
Period of the fellowship	01/10/2018 to 31/10/2019

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

This fellowship covered the study of a recurrent research topic in Software Engineering. Entitled “*Extending Behavior-Driven Development to Investigate Assessment Opportunities for Conceptual Modelling Artifacts*”, the research project targeted the need of guaranteeing consistency between requirements and software development artefacts, which is a long-term problem in the literature of requirements engineering and software testing. Most of the research intended to ensure some level of consistency between requirements and artefacts is centred on just tracing requirements throughout the development process. Proposed solutions to promote traceability between requirements and artefacts can then simply identify whether a requirement is present or not in a given artefact, not allowing to effectively test it by checking the consistency and correct representation of such a requirement in a given set of artefacts.

In recent years, User Stories have been widely adopted, especially by agile methods, as an artefact allowing to specify user requirements in natural language, using scenarios in a simple and understandable way for different stakeholders. Besides that, scenarios from User Stories may be directly tested from their textual specifications, once they encompass

in a single artefact both the specification itself and the set of acceptance criteria, required to certify whether the system behaves accordingly to the requirements.

Our proposed research is motivated by the fact that there was not a common ground to specify user requirements for each artefact model during the software development. In a scenario-based approach, they could be freely described following few or no templates, from informal descriptions such as textual narratives until more formal ones such as pre-formatted lists of tasks extracted from task models. This made it very hard to identify similar requirements that eventually could describe the same features but in different perspectives. To face this problem, previous works have investigated an ontological support aiming at describing common interactive behaviours with a standard vocabulary for writing User Stories as scenario artefacts. As the common vocabulary has been set using well-established concepts, it established indeed the searched common ground for a scenario-based approach considering multiple workflow-based artefacts.

During this fellowship, we aimed to extend such contributions by investigating assessment opportunities for new model-based artefacts. We aimed more specifically to investigate whether and how conceptual modelling artefacts could fit such an approach. Conceptual modelling artefacts are focused on the relationship between concepts involved in a business domain, while workflow-based artefacts are focused on the flow of activities and user tasks to be performed in the system. As such, ensuring the consistency of conceptual modelling artefacts, workflow-based artefacts and user requirements is a very challenging task. Secondary goals included to investigate whether model-driven development (MDD) techniques could benefit from this approach once it is expected we could also generate testable user requirements from consistent both conceptual and workflow-based models.

More specific goals also included:

- investigating the vocabulary used by different projects to specify user requirements in a given business domain in order to establish a ground of concepts for our approach,
- extending the present ontological solution to cover concepts related to conceptual modelling artefacts,
- implementing an automated solution to support the consistency checking of conceptual modelling artefacts, workflow-based artefacts and user requirements expressed in User Stories, and
- identifying opportunities to use model-driven development (MDD) techniques to generate consistent and testable user requirements.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

Thiago Rocha Silva, Marco Winckler and Cédric Bach (2019). *Evaluating the usage of predefined interactive behaviors for writing user stories: an empirical study with potential product owners*. Cognition, Technology & Work, Springer London. DOI: <http://doi.org/10.1007/s10111-019-00566-3>.

Thiago Rocha Silva, Marco Winckler and Hallvard Trætteberg (2019). *Ensuring the Consistency between User Requirements and Graphical User Interfaces: A Behavior-Based Automated Approach*. In: Proceedings of the 19th International Conference on Computational Science and its Applications (ICCSA 2019), pp. 616-632, vol. 11619, Part I. Lecture Notes in Computer Science, Springer International Publishing. DOI: http://doi.org/10.1007/978-3-030-24289-3_46.

Thiago Rocha Silva, Marco Winckler and Hallvard Trætteberg (2019). *Extending Behavior-Driven Development for Assessing User Interface Design Artifacts*. In: Proceedings of the 31st International Conference on Software Engineering and Knowledge Engineering (SEKE 2019), pp. 485-488. KSI Research Inc. DOI: <http://doi.org/10.18293/SEKE2019-054>.

Thiago Rocha Silva, Marco Winckler and Hallvard Trætteberg (2019). *Ensuring the Consistency between User Requirements and GUI Prototypes: A Behavior-Based Automated Approach*. In: Proceedings of the 17th IFIP TC.13 International Conference on Human-Computer Interaction (INTERACT 2019), pp. 644-665, vol. 11746, Part I. Lecture Notes in Computer Science, Springer International Publishing. DOI: https://doi.org/10.1007/978-3-030-29381-9_39.

III – ATTENDED SEMINARS, WORKSHOPS, CONFERENCES

- 2019 Catch IDI – Norwegian University of Science and Technology, Trondheim, Norway – January 2019.
- Seminar on Software Engineering, AI and Ethics 2019, Trondheim, Norway – March 2019.
- 2019 Symposium of the Norwegian AI Society (NAIS 2019), Trondheim, Norway – May 2019.
- 19th International Conference on Computational Science and Applications (ICCSA 2019), St. Petersburg, Russia – July 2019.
Ensuring the Consistency between User Requirements and Graphical User Interfaces: A Behavior-Based Automated Approach.
- 31st International Conference on Software Engineering & Knowledge Engineering (SEKE 2019), Lisbon, Portugal – July 2019.
Extending Behavior-Driven Development for Assessing User Interface Design Artifacts.
- 17th IFIP TC.13 International Conference on Human-Computer Interaction (INTERACT 2019), Paphos, Cyprus – September 2019.
Ensuring the Consistency between User Requirements and GUI Prototypes: A Behavior-Based Automated Approach

IV – RESEARCH EXCHANGE PROGRAMME (REP)

REP was held in June 2019 at *Centrum Wiskunde & Informatica (CWI)* in Amsterdam, The Netherlands, under the supervision of Prof. Tijs van der Storm in the Software Analysis and Transformation (SWAT) team. The visit was motivated by the fact that SWAT team has long-time expertise in Domain-Specific Languages (DSLs), having designed Rascal, a DSL for meta-programming. This has been an important topic addressed by our approach, so the visit aimed at investigating whether Rascal would be a good candidate to support the implementation of our approach.