



ABCDE



## Scientific Report

First name / Family name

Dhaminda Abeywickrama

Nationality

Australian

Name of the *Host Organisation*

Fraunhofer FOKUS

First Name / family name  
of the *Scientific Coordinator*

Nikola Šerbedžija

Period of the fellowship

09/09/2013 to 08/09/2014



## I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

The main research activities followed during my ABCDE Research Training Program are summarized here:

- *Proposed and designed* a novel monitoring and visualization framework for autonomic systems at runtime based on a language defined for expressing autonomic components such as jRESP.
- *Developed* an Eclipse plug-in called the Awareness Visualizer (AVis) to visualize and observe the behavior of the awareness mechanism and their changes (adaptation) of any application executing in jRESP.
- *Collaborated* and worked with a research group at Università degli Studi di Firenze to define appropriate knowledge mapping between the knowledge ontology used by the AVis plug-in and their jRESP runtime framework. Shared and discussed research results during project meetings in July 2014 and October 2013 (see seminars section).
- *Validated and assessed* the approach and plug-in using two scenarios of the *swarm robotics* case study of the ASCENS project. They are: 1) different types of robots for different roles (*disaster scenario* with landmark and worker robots); 2) the same type of robot for several different roles (e.g. explorer, rescuer, help rescuer, low battery).
- *Evaluated* the research approach using several criteria for assessing visualization of autonomic systems.
- *Reported* the findings of the research as in a research paper and a user guide for the plug-in.
- Additionally, completed research tasks on the engineering and implementation of self-adaptation patterns based on complex feedback loops. This resulted in finalizing two research papers (1 conference paper published, 1 journal article to be submitted).

I *discussed* my research work and findings with my scientific coordinator at Fraunhofer FOKUS on a continuous basis, which were very useful in completing the project. My colleagues (including Marko Fabiunke) and the working environment at the institute were helpful in conducting the project work. I am also very thankful to Mr. Friedrich Schön and other directors at the institute for facilitating my stay during the research.

## II – PUBLICATION(S) DURING YOUR FELLOWSHIP

Research paper under review:

- [ASL14] **D. B. Abeywickrama**, N. Šerbedžija and M. Loreti. “Monitoring and visualizing adaptation of autonomic systems at runtime”. *Submitted to the Special Track on Coordination Models, Languages and Applications held at 30th ACM Symposium on Applied Computing (SAC'15)*, 6 pages.
  - **Abstract.** Monitoring an autonomic system at runtime, which typically contains a large number of nodes operating in highly dynamic and open-ended environments, is very challenging for software architects. Solid software engineering methods and tools to support this process are therefore highly required. This paper proposes a novel monitoring and visualization framework for autonomic systems at runtime. Our approach is illustrated by



an Eclipse plug-in for tracing the runtime awareness and adaptation capabilities using graph-like representation. A key benefit here is to provide feedback to the engineer about the behavior of the complex awareness mechanism used, thus helping the system evaluation process. We validate and assess our approach and plug-in with a concrete application scenario from swarm robotics domain.

Research paper published:

- [AHZ14a] **D. B. Abeywickrama**, N. Hoch and F. Zambonelli. “An integrated Eclipse plug-in for engineering and implementing self-adaptive systems”. In *Proceedings of the 23rd International WETICE Conference (WETICE’14)*, pages 3–8, June 2014. IEEE Computer Society.
  - Received **Best Paper Award** at the ACEC track of the conference.
  - **Abstract.** A highly decentralized system of autonomous service components consists of multiple and possibly interacting feedback loops. These loops can be organized into a variety of architectural patterns. Although several authors have addressed the need to make feedback loops first-class entities, little attention has been given to providing solid tool support for their engineering and implementation. In this paper, we present SimSOTA—an integrated Eclipse plug-in tool to architect, engineer and implement self-adaptive systems based on our feedback loop-based approach. SimSOTA adopts model-driven development to model and simulate complex self-adaptive architectural patterns, and to automate the generation of Java-based implementation code for the patterns. The approach is validated using a case study in cooperative electric vehicles.

Research paper to be submitted:

- [AHZ14b] **D. B. Abeywickrama**, N. Hoch and F. Zambonelli. “Engineering and Implementing Software Architectural Patterns based on Feedback Loops”. *To be submitted on September 15<sup>th</sup> to the SCPE Journal on Enabling Technologies for Collaboration*, pages 20.
  - **Abstract.** A highly decentralized system of autonomous service components consists of multiple and interacting feedback loops. These feedback loops can be organized into a variety of architectural patterns. However, the highly complex and decentralized nature of these loops make engineering and implementation of architectural patterns a very challenging task for software architects. While several works have addressed the need to make feedback loops first-class entities, little attention has been drawn to providing solid tool support for their engineering and implementation. Towards bridging this gap, in this paper we present SimSOTA—an integrated Eclipse plug-in to architect, engineer and implement self-adaptive systems based on our feedback loop-based approach. SimSOTA adopts model-driven development to model and simulate complex self-adaptive architectural patterns, and to automate the generation of Java-based implementation code for the patterns. The approach and the SimSOTA plug-in are validated and assessed using a case study in cooperative electric vehicles or e-mobility.
  - Invited extended Journal version of [AHZ14a]



### III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

- Participated and presented at the *23rd International WETICE Conference (WETICE'14)* from June 23-25, 2014, in Parma, Italy.
- Participated and presented at the ABCDE Seminar III from October 31 - November 1 in Athens, Greece.
- Participated and presented at the Autonomic Service Component-Ensembles (ASCENS) EU project meeting from June 28-30 at Volkswagen AG in Braunschweig, Germany.
- Presented at the E-mobility working meeting of the ASCENS project from October 28-29, 2013 at Fraunhofer FOKUS in Berlin, Germany.

### IV – RESEARCH EXCHANGE PROGRAMME (REP)

- REP 1
  - Institute: Inria Paris-Rocquencourt, France
  - Dates: May 19-23, 2014
  - Local Scientific Coordinator (host): Professor Valerie Issarny
  - Outcome:
    - I presented my current ERCIM project to the research group on May 20, 2014. The group provided useful insights on evaluating my research and plug-in (performance evaluation).
    - I individually met all the available PhD students, post-docs, researchers in the group to understand their individual research at the institute.
    - I was offered to apply for a possible collaboration after the ERCIM fellowship, a joint project performed at the University of California, Berkeley and Inria.
- REP 2
  - Swedish Institute of Computer Science, Stockholm, Sweden
  - Dates: September 1-5, 2014
  - Local Scientific Coordinator (host): Professor Jakob Axelsson
  - Outcome:
    - I presented my current ERCIM project to the research group on September 1, 2014. Professor Axelsson provided useful insights on improving the research further.
    - I individually met researchers interested in my research work and interests. During the discussions I further explained my current and previous research results of relevance, and I was given a summary of their research interests.
    - I was invited to participate at the annual kick-off meeting of the institute for the current year, and a Lab meeting of the group. The presentations by the CEO of SICS and by Ericsson Research were very inspiring.