Formal Methods and Analysis in Software Product Line Engineering

4th edition of FMSPLE workshop series

Dave Clarke
KU Leuven, Belgium &
Uppsala University, Sweden
dave.clarke@cs.kuleuven.be

Ina Schaefer
Technische Universität
Braunschweig, Germany
i.schaefer@tu-bs.de

Maurice H. ter Beek
ISTI–CNR
Pisa, Italy
m.terbeek@isti.cnr.it

Sven Apel
University of Passau,
Germany
apel@uni-passau.de

Joanne M. Atlee
University of Waterloo,
Canada
jmatlee@uwaterloo.ca

ABSTRACT

FMSPLE 2013 is the fourth edition of the FMSPLE workshop series aimed at connecting researchers and practitioners interested in raising the efficiency and the effectiveness of software product line engineering through the application of innovative analysis approaches and formal methods.

Categories and Subject Descriptors

D.2.2 [**Software Engineering**]: Design Tools and Techniques; D.2.4 [**Software Engineering**]: Software/Program Verification—*Formal methods, Model checking, Validation*; D.2.5 [**Software Engineering**]: Testing and Debugging; D.2.11 [**Software Engineering**]: Software Architectures; D.2.13 [**Software Engineering**]: Reusable Software

General Terms

Design, Theory, Verification

Keywords

Formal methods, Software Product Lines, Variability, Verification, Testing, Semantics, Evolution

1. MOTIVATION AND OBJECTIVES

The aim of Software Product Line Engineering (SPLE) is to develop families of (software) systems or products using systematic, large-scale reuse in order to reduce both their cost and time to market and to increase their quality. To achieve these goals, formal methods and analysis techniques are promising approaches, which, to maximise their overall efficiency and effectiveness, are best applied throughout the product line life cycle, at the level of the product line, rather than on individual generated products, where possible.

In the last couple of years, numerous analysis approaches and formal methods have been applied in SPLE. Considerable potential remains unexploited and despite recent efforts, the various research communities working on these topics seem to be only loosely connected. To this end, the long-term objectives of the FMSPLE workshop series are:

1. to raise awareness and to find a common understanding of practical challenges and existing solution approaches in the different communities working on formal methods and analysis techniques for SPLE, and

2. to create a broader community interested in formal methods and analysis techniques for software product lines in order to keep SPLE research and tools up-to-date with the latest technologies and in line with practical challenges.

FMSPLE 2013 focuses on the application of formal methods and analysis approaches in all phases of SPLE in order to ensure the correctness of individual artefacts as well as the consistency among them. The topics of interest include analysis approaches and formal methods for:

- domain analysis and scoping
- variability modelling
- specification and verification of functional and non-functional properties in SPLE
- safety and security aspects in SPLE
- product line architectures and component-based product line development
- product line implementation, such as type systems, programming languages, formal semantics
- formal verification of product lines and product line artefacts
- correctness-by-construction techniques in SPLE
- automated test case generation and model-based testing in SPLE
- product derivation and application engineering

- product line life-cycle management (e.g., consistency assurance)

- reuse and evolution of software product lines

along with proofs of concept, industrial experiences and empirical evaluations, tool presentations, and vision and position papers on formal methods and analyses applied in software product line engineering.

2. IMPACT AND RELEVANCE

Software product line engineering has matured much over the last decade, but there are still many challenges remaining. Among them are efficient variability management and product derivation, assuring consistency between domain and application engineering, the reduction of quality assurance efforts, the functional verification of software product lines, and the consistent and sustainable evolution of product families.

Applying formal methods and analysis techniques in SPLE is a promising way of addressing many such challenges. Formal approaches to variability modelling, for instance, provide a solid basis for improving SPLE activities like early validation during product derivation by detecting inconsistencies or interactions for given feature configurations. By formally verifying critical requirements of reusable product line artefacts, the quality of the product line artefacts as well as the derived products can be increased, which in turn reduces additional quality assurance efforts. Formal modelling of product lines accompanied with suitable analysis approaches helps maintaining consistency between product line artefacts in both the domain engineering and the application engineering processes. During product line evolution, formal methods help analysing what effects of changing individual product line artefacts have on the overall properties of the product line.

3. PRESENTATIONS

FMSPLE 2013 followed a traditional workshop format, consisting of an invited presentation, a number of regular presentations, allowing time for fruitful interaction, and finally a panel discussion.

The following papers were presented:

- *Example-Driven Modeling and Exploration of Feature Interactions with Clafer* by Andrzej Wąsowski (invited presentation)

- *Variability-Aware Safety Analysis using Delta Component Fault Diagrams* by Christoph Seidl, Ina Schaefer, and Uwe Assmann

- *Combining Declarative and Procedural Views in the Specification and Analysis of Product Families* by Maurice H. ter Beek, Alberto Lluch Lafuente, and Marinella Petrocchi

- *A Methodology for Software Product Platform Design Based on Features* by Hamad Alsawalqah, Sungwon Kang, and Danhyung Lee

- *Behavioral Refinement of Non-deterministic State Transition Diagrams based on Behavior Elimination* by Christian Prehofer amd Peter Scholz

- *Discrete Time Markov Chain Families: Modeling and Verification of Probabilistic Software Product Lines* by Mahsa Varshosaz, Ramtin Khosravi

- *A Decision Table Analyzer for Detecting Variability in Source Code* by Masahiro Sakai, Takeo Imai, Mikito Iwamasa, Takeshi Nagaoka and Mari Inoki (presenation and tool demonstration).

The workshop concluded with a panel discussion on the topic: *The future role of formal methods in software product line engineering: Challenges, Open Problems, Perspectives.*

4. HISTORY OF THE WORKSHOP SERIES

The Tokyo edition of FMSPLE was the fourth incarnation in the FMSPLE workshop series. The first FMSPLE workshop was held in 2010.[1] Its second edition,[2] in 2011, was the result of a merge with ASPL 2008, the first workshop on Analyses of Software Product Lines.[3] The third edition occurred in 2012.[4]

5. PROGRAM COMMITTEE

The Program Committee was composed of a diverse group of members from eight different countries, including two members from industry. We thank the following members of the FMSPLE 2013 Program Committee for reviewing and discussing the papers that were selected for inclusion in the final program:

- Dave Clarke (chair) — KU Leuven, Belgium (Chair)
- Maurice H. ter Beek — ISTI-CNR, Pisa, Italy
- Dirk Beyer — University of Passau, Germany
- Richard Bubel — TU Darmstadt, Germany
- Andreas Classen — Intec Software Engineering, Belgium
- Ferruccio Damiani — Università di Torino, Italy
- Kathi Fisler — Worcester Polytechnic Institute, USA
- Stefania Gnesi — ISTI-CNR, Pisa, Italy
- Dilian Gurov — KTH, Sweden
- Reiner Hähnle — TU Darmstadt, Germany
- Patrick Heymans — University of Namur, Belgium
- Atsushi Igarashi — Kyoto University, Japan
- Kim G. Larsen — Aalborg University, Denmark
- Martin Leucker — University of Lübeck, Germany
- Alice Miller — University of Glasgow, Scotland
- Natsuko Noda — NEC, Japan
- Ina Schaefer — Technische Universität Braunschweig, Germany

6. ACKNOWLEDGEMENT

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[1] http://www.iese.fraunhofer.de/en/events/fmsple2010.html
[2] http://www.iese.fraunhofer.de/en/events/fmsple2011.html
[3] http://www.isa.us.es/aspl08
[4] http://www.iese.fraunhofer.de/en/events/fmsple2012.html