



# 23rd International Systems and Software Product Line Conference

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## Proceedings - Volume A

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# Table of Contents

<b>Welcome Message</b> . . . . .	<b>xi</b>
<b>Organizing Committee</b> . . . . .	<b>xii</b>
<b>Program Committees</b> . . . . .	<b>xiv</b>
<b>Keynotes</b>	
Performance Analysis for Highly-Configurable Systems . . . . . <i>Christian Kästner</i>	xviii
Becoming and Being a Researcher – What I Wish Someone Would Have Told me When I Started Doing Research . . . . . <i>Carlo Ghezzi</i>	xix
Variability Variations in Cyber-Physical Systems . . . . . <i>Lidia Fuentes</i>	xx
DSLs, Formal Methods, and Feature Models . . . . . <i>Björn Engelmann</i>	xxi
SAT Oracles, for NP-Complete Problems and Beyond . . . . . <i>Daniel Le Berre</i>	xxii
<b>Joint SPLC/ECSA Panel "Women in Software Engineering"</b> . . . . .	<b>xxiii</b>
<b>Testing</b>	
[Research] Automating Test Reuse for Highly Configurable Software: An Experiment . . . <i>Stefan Fischer, Rudolf Ramler, Lukas Linsbauer, and Alexander Egyed</i>	1
[Journal First] Mutation Operators for Feature-Oriented Software Product Lines . . . . . <i>Jacob Krüger, Mustafa Al-Hajjaji, Thomas Leich, and Gunter Saake</i>	12
[Journal First] Extended Abstract of "Spectrum-Based Fault Localization in Software Prod- uct Lines" . . . . . <i>Aitor Arrieta, Sergio Segura, Urtzi Markiegi, Goiuria Sagardui, and Leire Etxeberria</i>	13

[Industry] Applying Product Line Testing for the Electric Drive System . . . . .	14
<i>Rolf Ebert, Jahir Jolianis, Stefan Kriebel, Matthias Markthaler, Benjamin Pruenster, Bernhard Rumpe, and Karin Samira Salman</i>	

## Domain Implementation

[Journal First] Feature-Oriented Contract Composition . . . . .	25
<i>Thomas Thüm, Alexander Knüppel, Stefan Krüger, Stefanie Bolle, and Ina Schaefer</i>	
[Industry] Extraction of Configurable and Reusable Microservices from Legacy Systems: An Exploratory Study . . . . .	26
<i>Luiz Carvalho, Alessandro Garcia, Wesley K. G. Assunção, Rodrigo Bonifácio, Leonardo P. Tizzei, and Thelma Elita Colanzi</i>	
[Journal First] Journal First Presentation of a Comparative Study of Workflow Customiza- tion Strategies: Quality Implications for Multi-Tenant SaaS . . . . .	32
<i>Majid Makki, Dimitri Van Landuyt, Bert Lagaisse, and Wouter Joosen</i>	
[Industry] App Variants and Their Impact on Mobile Architecture: An Experience Report . . . . .	33
<i>Marc Dahlem, Ricarda Rahm, and Martin Becker</i>	

## Solution-Space Analysis

[Research] Static Analysis of Featured Transition Systems . . . . .	39
<i>Maurice H. ter Beek, Ferruccio Damiani, Michael Lienhardt, Franco Mazzanti, and Luca Paolini</i>	
[Research] Learning from Difference: An Automated Approach for Learning Family Mod- els from Software Product Lines . . . . .	52
<i>Carlos Diego N. Damasceno, Mohammad Reza Mousavi, and Adenilso Simao</i>	
[Journal First] Feature-Family-Based Reliability Analysis of Software Product Lines . . . . .	64
<i>Andre Lanna, Thiago Castro, Vander Alves, Genaina Rodrigues, Pierre-Yves Schobbens, and Sven Apel</i>	
[Research] Variability-Aware Semantic Slicing Using Code Property Graphs . . . . .	65
<i>Lea Gerling and Klaus Schmid</i>	

## Challenges and Solutions

[Challenge Proposal] Applying Product Line Engineering Concepts to Deep Neural Net- works . . . . .	72
<i>Javad Ghofrani, Ehsan Kozegar, Anna Lena Fehlhaber, and Mohammad Divband Soorati</i>	

[Challenge Proposal] Product Sampling for Product Lines: The Scalability Challenge . . .	78
<i>Tobias Pett, Thomas Thüm, Tobias Runge, Sebastian Krieter, Malte Lochau, and Ina Schaefer</i>	
[Challenge Solution] t-wise Coverage by Uniform Sampling . . . . .	84
<i>Jeho Oh, Paul Gazzillo, and Don Batory</i>	
[Challenge Solution] A Graph-Based Feature Location Approach Using Set Theory . . . .	88
<i>Richard Müller and Ulrich Eisenecker</i>	
[Challenge Solution] Comparison-Based Feature Location in ArgoUML Variants . . . . .	93
<i>Gabriela Karoline Michelin, Lukas Linsbauer, Wesley K. G. Assunção, and Alexander Egyed</i>	
[Challenge Solution] Migrating Java-Based Apo-Games into a Composition-Based Software Product Line . . . . .	98
<i>Jamel Debiche, Oskar Lignell, Jacob Krüger, and Thorsten Berger</i>	
[Challenge Solution] Migrating the Android Apo-Games into an Annotation-Based Software Product Line . . . . .	103
<i>Jonas Åkesson, Sebastian Nilsson, Jacob Krüger, and Thorsten Berger</i>	

## Emerging Application Areas

[Research] DNA as Features: Organic Software Product Lines . . . . .	108
<i>Mikaela Cashman, Justin Firestone, Myra B. Cohen, Thammasak Thianniwet, and Wei Niu</i>	
[Research] Automated Search for Configurations of Convolutional Neural Network Architectures . . . . .	119
<i>Salah Ghamizi, Maxime Cordy, Mike Papadakis, and Yves Le Traon</i>	
[Research] Piggyback IDE Support for Language Product Lines . . . . .	131
<i>Thomas Kühn, Walter Cazzola, Nicola Pirritano Giampietro, and Massimiliano Poggi</i>	
[Industry] Industrial Perspective on Reuse of Safety Artifacts in Software Product Lines .	143
<i>Christian Wolschke, Martin Becker, Sören Schneickert, Rasmus Adler, and John MacGregor</i>	

## Community Efforts

[Industry] How Domain-Specific Modeling Languages Address Variability in Product Line Development: Investigation of 23 Cases . . . . .	155
<i>Juha-Pekka Tolvanen and Steven Kelly</i>	
[Research] Software Product Line Engineering: A Practical Experience . . . . .	164
<i>Jose-Miguel Horcas, Mónica Pinto, and Lidia Fuentes</i>	

[Research] Facing the Truth: Benchmarking the Techniques for the Evolution of Variant-Rich Systems . . . . .	177
<i>Daniel Strüßer, Mukelabai Mukelabai, Jacob Krüger, Stefan Fischer, Lukas Linsbauer, Jabier Martinez, and Thorsten Berger</i>	

[Research] Industrial and Academic Software Product Line Research at SPLC: Perceptions of the Community . . . . .	189
<i>Rick Rabiser, Klaus Schmid, Martin Becker, Goetz Botterweck, Matthias Galster, Iris Groher, and Danny Weyns</i>	

## Requirements Engineering

[Industry] Feature Oriented Refinement from Requirements to System Decomposition: Quantitative and Accountable Approach . . . . .	195
<i>Masaki Asano, Yoichi Nishiura, Tsuneo Nakanishi, and Keiichi Fujiwara</i>	

[Journal First] Enabling Automated Requirements Reuse and Configuration . . . . .	206
<i>Yan Li, Tao Yue, Shaukat Ali, and Li Zhang</i>	

## Metrics and Refactoring

[Research] Formal Foundations for Analyzing and Refactoring Delta-Oriented Model-Based Software Product Lines . . . . .	207
<i>Christopher Pietsch, Udo Kelter, Timo Kehrler, and Christoph Seidl</i>	

[Research] Covert and Phantom Features in Annotations: Do They Impact Variability Analysis? . . . . .	218
<i>Kai Ludwig, Jacob Krüger, and Thomas Leich</i>	

[Research] Identifying and Visualizing Variability in Object-Oriented Variability-Rich Systems . . . . .	231
<i>Xhevahire Tërnavaj, Johann Mortara, and Philippe Collet</i>	

[Journal First] Metrics for Analyzing Variability and Its Implementation in Software Product Lines: A Systematic Literature Review . . . . .	244
<i>Sascha El-Sharkawy, Nozomi Yamagishi-Eichler, and Klaus Schmid</i>	

## Feature-Model Evolution

[Research] Semantic Evolution Analysis of Feature Models . . . . .	245
<i>Imke Drave, Oliver Kautz, Judith Michael, and Bernhard Rumpe</i>	

[Journal First] Achieving Change Requirements of Feature Models by an Evolutionary Approach . . . . .	256
<i>Paolo Arcaini, Angelo Gargantini, and Marco Radavelli</i>	

[Research] Foundations of Collaborative, Real-Time Feature Modeling . . . . .	257
<i>Elias Kuiter, Sebastian Krieter, Jacob Krüger, Thomas Leich, and Gunter Saake</i>	

## Configuration and Sampling

[Research] Process Mining to Unleash Variability Management: Discovering Configuration Workflows Using Logs . . . . .	265
<i>Ángel Jesús Varela-Vaca, José A. Galindo, Belén Ramos-Gutiérrez, María Teresa Gómez-López, and David Benavides</i>	

[Research] Towards Quality Assurance of Software Product Lines with Adversarial Configurations . . . . .	277
<i>Paul Temple, Mathieu Acher, Gilles Perrouin, Battista Biggio, Jean-Marc Jézéquel, and Fabio Roli</i>	

[Research] Uniform Random Sampling Product Configurations of Feature Models That Have Numerical Features . . . . .	289
<i>Daniel-Jesus Munoz, Jeho Oh, Mónica Pinto, Lidia Fuentes, and Don Batory</i>	

## Problem-Space Analysis

[Journal First] Automated Analysis of Feature Models: Quo Vadis? . . . . .	302
<i>José A. Galindo, David Benavides, Pablo Trinidad, Antonio-Manuel Gutiérrez-Fernández, and Antonio Ruiz-Cortés</i>	

[Research] A Kconfig Translation to Logic with One-Way Validation System . . . . .	303
<i>David Fernandez-Amoros, Ruben Heradio, Christoph Mayr-Dorn, and Alexander Egyed</i>	

[Industry] Using Relation Graphs for Improved Understanding of Feature Models in Software Product Lines . . . . .	309
<i>Slawomir Duszynski, Saura Jyoti Dhar, and Tobias Beichter</i>	

## Workshops

Second International Workshop on Variability and Evolution of Software-Intensive Systems (VariVolution 2019) . . . . .	320
<i>Michael Nieke, Lukas Linsbauer, Jacob Krüger, and Thomas Leich</i>	

Second International Workshop on Experiences and Empirical Studies on Software Reuse (WEESR 2019) . . . . .	321
<i>Jaime Chavarriaga and Julio Ariel Hurtado</i>	
Fourth International Workshop on Software Product Line Teaching (SPLTea 2019) . . . .	322
<i>Mathieu Acher, Rick Rabiser, and Roberto E. Lopez-Herrejon</i>	
First International Workshop on Languages for Modelling Variability (MODEVAR 2019) .	323
<i>David Benavides, Rick Rabiser, Don Batory, and Mathieu Acher</i>	
Seventh International Workshop on Reverse Variability Engineering (REVE 2019) . . . .	324
<i>Mathieu Acher, Tewfik Ziadi, Roberto E. Lopez-Herrejon, and Jabier Martinez</i>	

## Tutorials

Machine Learning and Configurable Systems: A Gentle Introduction . . . . .	325
<i>Hugo Martin, Juliana Alves Pereira, Mathieu Acher, and Paul Temple</i>	
Software Reuse for Mass Customization . . . . .	327
<i>Mike Mannion and Hermann Kaindl</i>	
Variability Modeling and Implementation with EASy-Producer . . . . .	328
<i>Klaus Schmid, Holger Eichelberger, and Sascha El-Sharkawy</i>	
Describing Variability with Domain-Specific Languages and Models . . . . .	329
<i>Juha-Pekka Tolvanen and Steven Kelly</i>	
Automated Evaluation of Embedded-System Design Alternatives . . . . .	330
<i>Maxime Cordy and Sami Lazreg</i>	
Feature-Based Systems and Software Product Line Engineering: PLE for the Enterprise .	331
<i>Charles W. Krueger and Paul C. Clements</i>	
Variability Modeling and Management of MATLAB/Simulink Models . . . . .	332
<i>Aitor Arrieta</i>	

# Achieving Change Requirements of Feature Models by an Evolutionary Approach

Extended Abstract

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## CCS CONCEPTS

• **Software and its engineering** → **Software product lines;**  
*Search-based software engineering*; • **Theory of computation** →  
*Evolutionary algorithms*;

## KEYWORDS

feature models, software product lines, mutation, search-based software engineering

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## DESCRIPTION OF THE JOURNAL-FIRST PAPER

Software Product Lines (SPLs) are families of products that share some common features, and differ on some others. The variability of SPLs is usually described at design time by using *variability models*; one of the main used variability models are *feature models* (FMs).

Overtime, feature models need to be updated in order to avoid the risk of having a model with wrong features and/or wrong constraints. Two main causes for *change requirements* exist: either the model is incorrect (it excludes/includes some products that should be included/excluded), or the SPL has changed. The change requirements come from different sources: *failing tests* identifying configurations evaluated not correctly, or *business requirements* to add new products, to allow new features, to not support some products any more, and so on. All these change requirements identify configurations/features to add or remove, but do not identify a way to modify the feature model to achieve them. Manually updating a feature model to achieve all the change requirements can be particularly difficult and, in any case, error-prone and time consuming.

In the corresponding *journal-first paper* [1], we propose an approach (shown in Fig. 1) to automatically update a feature model upon change requirements. The user must only specify an *update request*, based on the change requirements coming from testing or from business requirements. The update request is composed of

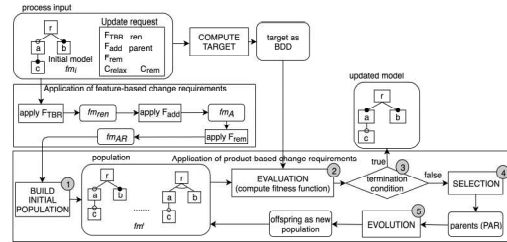


Figure 1: Proposed evolutionary approach

three kinds of *feature-based* change requirements and two kinds of *product-based* ones; the feature-based ones consist in features that must be renamed, and features that must be added to and removed from the products of the original feature model; the product-based ones, instead, consist in configurations that should be no more accepted as products by the final model, and configurations that should instead be accepted as new products. Starting from the update request, the approach tries to apply the feature-based change requirements directly on the starting model; however, some of these requirements could be not completely fulfilled. Then, by means of an evolutionary algorithm, the approach tries to obtain a feature model that captures all the change requirements: the feature-based ones not fulfilled in the previous phase, and the product-based ones. The process iteratively generates, from the current population of candidate solutions, a new population of feature models by mutation. Population members are evaluated considering primarily the percentage of correctly evaluated configurations, and secondly a measure of the *structural complexity* of the model, defined in terms of number of cross-tree constraints. When a correct model is found or some other termination condition holds, the process terminates returning as final model the one having the highest fitness value.

The approach has been evaluated on real-world feature models; experiments show that, on average, around 89% of requested changes are applied.

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- [1] Paolo Arcaini, Angelo Gargantini, and Marco Radavelli. 2019. Achieving change requirements of feature models by an evolutionary approach. *Journal of Systems and Software* 150 (2019), 64–76. <https://doi.org/10.1016/j.jss.2019.01.045>

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