Editors Board

David Hutchison
  Lancaster University, UK
Takeo Kanade
  Carnegie Mellon University, Pittsburgh, PA, USA
Josef Kittler
  University of Surrey, Guildford, UK
Jon M. Kleinberg
  Cornell University, Ithaca, NY, USA
Alfred Kobsa
  University of California, Irvine, CA, USA
Friedemann Mattern
  ETH Zurich, Switzerland
Bernhard Steffen
  TU Dortmund University, Germany
Madhu Sudan
  Microsoft Research, Cambridge, MA, USA
Demetri Terzopoulos
  University of California, Los Angeles, CA, USA
Doug Tygar
  University of California, Berkeley, CA, USA
Gerhard Weikum
  Max Planck Institute for Informatics, Saarbruecken, Germany
Preface

Message from the SSBSE 2013 General Chair

It is my pleasure to welcome you to the proceedings of the 5th Symposium on Search-Based Software Engineering, SSBSE 2013, held in St. Petersburg, Russia, once the imperial capital of Russia. For the second time in the history of SSBSE, the symposium was co-located with the joint meeting of the European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering, ESEC/FSE. With work on search-based software engineering (SBSE) now becoming common in mainstream software engineering conferences like ESEC/FSE, SBSE offers an increasingly popular and exciting field to work in. The wide range of topics covered by SBSE is reflected in the strong collection of papers presented in this volume.

Many people contributed to the organization of this event and its proceedings, and so there are many people to thank. I am grateful to Bertrand Meyer, the General Chair of ESEC/FSE, and the ESEC/FSE Steering Committee for allowing us to co-locate with their prestigious event in St. Petersburg. Thanks in particular are due to Nadia Polikarpova and Lidia Perovskaya, who took care of the local arrangements and the interface between ESEC/FSE and SSBSE.

It was a pleasure to work with Yuanyuan Zhang and Guenther Ruhe, our Program Chairs. Many thanks for their hard work in managing the Program Committee, review process, and putting the program together. Thanks also go to Gregory Kapfhammer, who managed the Graduate Student Track with a record number of submissions. I would also like to thank Phil McMinn, who fearlessly accepted the challenge of setting up the new SSBSE challenge track. The SSBSE challenge is a wonderful opportunity to showcase the advances and achievements of our community, and will hopefully become an integral part of this series of events. I would like to thank the Program Committee, who supported all these tracks throughout a long and fragmented review process with their invaluable efforts in reviewing and commenting on the papers. I am very happy we were able to host two outstanding keynote speakers, Xin Yao and Westley Weimer, and David White with a tutorial. Finally, the program could not be formed without the work of the authors themselves, whom we thank for their high-quality work.

Thanks are also due to the Publicity Chairs, Shin Yoo, Kirsten Walcott-Justive, and Dongsum Kim. In particular I would like to thank Shin Yoo for managing our social networks on Twitter and Facebook, and maintaining our webpage, even from within airport taxis. Thanks to Fedor Tsarev, our Local Chair. I am grateful to Springer for publishing the proceedings of SSBSE. Thanks also to the Steering Committee, chaired by Mark Harman, and the General Chair of SSBSE 2012, Angelo Susi, who provided me with useful suggestions during the preparation of the event.
Finally, thanks are due to our sponsors, and to Tanja Vos for her support in securing industrial sponsorship. Thanks to UCL CREST, Google, Microsoft Research, Berner & Mattner, IBM, the FITTEST project, the RISCOSS project, and Softeam. Thanks also to Gillian Callaghan and Joanne Suter at the University of Sheffield, who assisted me in managing the finances of this event.

If you were not able to attend SSBSE 2013, I hope that you will enjoy reading the papers contained in this volume, and consider submitting a paper to SSBSE 2014.

June 2013

Gordon Fraser
Message from the SSBSE 2013 Program Chairs

On behalf of the SSBSE 2013 Program Committee, it is our pleasure to present these Proceedings of the 5th International Symposium on Search-Based Software Engineering. This year, the symposium was held in the beautiful and historic city of St. Petersburg, Russia. SSBSE 2013 continued the established tradition of bringing together the international SBSE community in an annual event to discuss and to celebrate the most recent results and progress in the field.

For the first time, SSBSE 2013 invited submissions to the SBSE Challenge Track. We challenged researchers to use their SBSE expertise and apply their existing tools by analyzing all or part of a software program from a selected list. We were happy to receive submissions from 156 authors coming from 24 different countries (Australia, Austria, Brazil, Canada, China, Czech Republic, Finland, France, Germany, India, Ireland, Luxembourg, New Zealand, Norway, Portugal, Russia, Spain, Sweden, Switzerland, The Netherlands, Tunisia, Turkey, UK and USA).

In all, 50 papers were submitted to the Research, Graduate Student and SBSE Challenge Tracks (39 to the Research Track - full and short papers, 4 to the SBSE Challenge Track, and 9 to the PhD Student Track). All submitted papers were reviewed by at least three experts in the field. After further discussions, 28 papers were accepted for presentation at the symposium. Fourteen submissions were accepted as full research papers and six were accepted as short papers. Six submissions were accepted as Graduate Student papers. In the SBSE Challenge Track, two papers were accepted.

We would like to thank all the members of the SSBSE 2013 Program Committee. Their continuing support was essential in improving the quality of accepted submissions and the resulting success of the conference. We also wish to especially thank the General Chair, Gordon Fraser, who managed the organization of every single aspect in order to make the conference special to all of us. We thank Gregory Kapfhammer, SSBSE 2013 Student Track Chair, for managing the submissions of the bright young minds who will be responsible for the future of the SBSE field. We also thank Phil McInn, who managed the challenge of attracting submissions and successfully running the new challenge track. Last, but certainly not least, we would like to thank Kornelia Streb for all her enthusiastic support and contribution in preparation of these proceedings.

Maintaining a successful tradition, SSBSE 2013 attendees had the opportunity to learn from experts both from the research fields of search as well as software engineering, in two outstanding keynotes and one tutorial talk. This year, we had the honor of receiving a keynote from Westley Weimer on “Advances in Automated Program Repair and a Call to Arms” and providing a survey on the recent success and momentum in the subfield of automated program repair. Furthermore, we had a keynote from Xin Yao, who talked about the state of the art in “Multi-objective Approaches to Search-Based Software Engineering.” In addition, a tutorial was presented by David White on the emerging topic of “Cloud Computing and SBSE.”
We would like to thank all the authors who submitted papers to SSBSE 2013, regardless of acceptance or rejection, and everyone who attended the conference. We hope that with these proceedings, anybody who did not have the chance to be in St. Petersburg will have the opportunity to feel the liveliness, growth and increasing impact of the SBSE community. Above all, we feel honored for the opportunity to serve as Program Chairs of SSBSE and we hope that everyone enjoyed the symposium!

June 2013

Guenther Ruhe
Yuanyuan Zhang
Conference Organization

General Chair

Gordon Fraser
University of Sheffield, UK

Program Chairs

Guenther Ruhe
University of Calgary, Canada
Yuanyuan Zhang
University College London, UK

Doctoral Symposium Chair

Gregory M. Kapfhammer
Allegheny College, USA

Program Committee

Enrique Alba
University of Málaga, Spain
Nadia Alshahwan
University of Luxembourg, Luxembourg
Giuliano Antoniol
Ecole Polytechnique de Montréal, Canada
Andrea Arcuri
Simula Research Laboratory, Norway
Marcio Barros
Universidade Federal do Estado do Rio de Janeiro, Brazil
Leonardo Bottaci
University of Hull, UK
Francisco Chicano
University of Málaga, Spain
John Clark
University of York, UK
Mel Ó Cinnéide
University College Dublin, Ireland
Myra Cohen
University of Nebraska at Lincoln, USA
Massimiliano Di Penta
University of Sannio, Italy
Robert Feldt
University of Blekinge, Chalmers University of Technology, Sweden
Vahid Garousi
University of Calgary, Canada
Mathew Hall
University of Sheffield, UK
Mark Harman
University College London, UK
Rob Hierons
Brunel University, UK
Colin Johnson
University of Kent, UK
Fitsum Mesakesha Kifetew
University of Trento, Italy
Yvan Labiche
Carleton University, Canada
Kiran Lakhotia
University College London, UK
Spiros Mancoridis
Drexel University, USA
Phil McMinn
University of Sheffield, UK
Alan Millard
Leandro Minku
Pasqualina Potena
Simon Poulding
Xiao Qu
Marek Reformat
Marc Roper
Federica Sarro
Jerffeson Souza
Angelo Susi
Paolo Tonella
Silvia Vergilio
Tanja Vos
Joachim Wegener
Westley Weimer
David White

University of York, UK
University of Birmingham, UK
University of Bergamo, Italy
University of York, UK
ABB Corporate Research, USA
University of Alberta, USA
University of Strathclyde, UK
University College London, UK
State University of Ceara, Brazil
Fondazione Bruno Kessler – IRST, Italy
Fondazione Bruno Kessler – IRST, Italy
Universidade Federal do Paraná, Brazil
Universidad Politécnica de Valencia, Spain
Berner and Mattner, Germany
University of Virginia, USA
University of Glasgow, UK

Challenge Chair
Phil McMinn
University of Sheffield, UK

Publicity Committee
Shin Yoo
Kristen Walcott-Justice
Dongsun Kim
University College London, UK (Chair)
University of Colorado/Colorado Spring, USA
Hong Kong University of Science & Technology, Hong Kong

Local Chair
Fedor Tsarev
St. Petersburg State University of Information Technologies, Mechanics and Optics, Russia

Steering Committee
Mark Harman
Andrea Arcuri
Myra Cohen
Massimiliano Di Penta
Gordon Fraser
Phil McMinn
Mel Ó Cinnéide
Jerffeson Souza
Joachim Wegener
UCL, UK
Simula, Norway
University of Nebraska Lincoln, USA
University of Sannio, Italy
University of Sheffield, UK
University of Sheffield, UK
University College Dublin, Ireland
Universidade Estadual do Ceará, Brazil
Berner and Mattner, Germany
Sponsors
Table of Contents

Keynote Addresses

Advances in Automated Program Repair and a Call to Arms 1
Westley Weimer

Some Recent Work on Multi-objective Approaches to Search-Based Software Engineering 4
Xin Yao

Tutorial

Cloud Computing and SBSE 16
David R. White

Full Papers

On the Application of the Multi-Evolutionary and Coupling-Based Approach with Different Aspect-Class Integration Testing Strategies 19
Wesley Klewerton Guez Assunção, Thelma Elita Colanzi, Silvia Regina Vergilio, and Aurora Pozo

An Experimental Study on Incremental Search-Based Software Engineering 34
Márcio de Oliveira Barros

Competitive Coevolutionary Code-Smells Detection 50
Mohamed Boussa, Wael Kessentini, Marouane Kessentini, Slim Bechikh, and Soukeina Ben Chikha

A Multi-objective Genetic Algorithm to Rank State-Based Test Cases 66
Lionel Briand, Yvan Labiche, and Kathy Chen

Validating Code-Level Behavior of Dynamic Adaptive Systems in the Face of Uncertainty 81
Erik M. Fredericks, Andres J. Ramirez, and Betty H.C. Cheng

Model Refactoring Using Interactive Genetic Algorithm 96
Adnane Ghannem, Ghizlane El Boussaidi, and Marouane Kessentini

A Fine-Grained Parallel Multi-objective Test Case Prioritization on GPU 111
Zheng Li, Yi Bian, Ruilian Zhao, and Jun Cheng
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search-Based Refactoring Detection Using Software Metrics Variation</td>
<td>126</td>
</tr>
<tr>
<td><em>Rim Mahouachi, Marouane Kessentini, and Mel Ó Cinnéide</em></td>
<td></td>
</tr>
<tr>
<td>Automated Model-in-the-Loop Testing of Continuous Controllers Using</td>
<td>141</td>
</tr>
<tr>
<td>Search</td>
<td></td>
</tr>
<tr>
<td><em>Reza Matinnejad, Shiva Nejati, Lionel Briand, Thomas Bruckmann, and Claude Poull</em></td>
<td></td>
</tr>
<tr>
<td>Predicting Regression Test Failures Using Genetic Algorithm-Selected</td>
<td>158</td>
</tr>
<tr>
<td>Dynamic Performance Analysis Metrics</td>
<td></td>
</tr>
<tr>
<td><em>Michael Mayo and Simon Spacey</em></td>
<td></td>
</tr>
<tr>
<td>A Recoverable Robust Approach for the Next Release Problem</td>
<td>172</td>
</tr>
<tr>
<td><em>Matheus Henrique Esteves Paixão and Jerffeson Teixeira de Souza</em></td>
<td></td>
</tr>
<tr>
<td>A Systematic Review of Software Requirements Selection and Prioritization Using SBSE Approaches</td>
<td>188</td>
</tr>
<tr>
<td><em>Antônio Mauricio Pitangueira, Rita Suzana P. Maciel, Márcio de Oliveira Barros, and Aline Santos Andrade</em></td>
<td></td>
</tr>
<tr>
<td>Regression Testing for Model Transformations: A Multi-objective Approach</td>
<td>209</td>
</tr>
<tr>
<td><em>Jeffery Shelburg, Marouane Kessentini, and Daniel R. Tauritz</em></td>
<td></td>
</tr>
<tr>
<td>Provably Optimal and Human-Competitive Results in SBSE for Spectrum Based Fault Localisation</td>
<td>224</td>
</tr>
<tr>
<td><em>Xiaoyuan Xie, Fei-Ching Kuo, Tsong Yueh Chen, Shin Yoo, and Mark Harman</em></td>
<td></td>
</tr>
<tr>
<td><strong>Short Papers</strong></td>
<td></td>
</tr>
<tr>
<td>On the Synergy between Search-Based and Search-Driven Software</td>
<td>239</td>
</tr>
<tr>
<td>Engineering</td>
<td></td>
</tr>
<tr>
<td><em>Colin Atkinson, Marcus Kessel, and Marcus Schumacher</em></td>
<td></td>
</tr>
<tr>
<td>Preference-Based Many-Objective Evolutionary Testing Generates Harder Test Cases for Autonomous Agents</td>
<td>245</td>
</tr>
<tr>
<td><em>Sabrine Kalboussi, Slim Bechikh, Marouane Kessentini, and Lamjed Ben Said</em></td>
<td></td>
</tr>
<tr>
<td>Efficient Subdomains for Random Testing</td>
<td>251</td>
</tr>
<tr>
<td><em>Matthew Patrick, Rob Alexander, Manuel Oriol, and John A. Clark</em></td>
<td></td>
</tr>
<tr>
<td>Applying Genetic Improvement to MiniSAT</td>
<td>257</td>
</tr>
<tr>
<td><em>Justyna Petke, William B. Langdon, and Mark Harman</em></td>
<td></td>
</tr>
</tbody>
</table>
Using Contracts to Guide the Search-Based Verification of Concurrent Programs .................................................... 263

Christopher M. Poskitt and Simon Poulding

Planning Global Software Development Projects Using Genetic Algorithms 269

Sriharsha Vathsavayi, Outi Sievi-Korte, Kai Koskimies, and Kari Systä

Challenge Track Papers

What Can a Big Program Teach Us about Optimization? .......... 275

Máricio de Oliveira Barros and Fábio de Almeida Farzat

eCrash: An Empirical Study on the Apache Ant Project .......... 282

Ana Filipa Nogueira, José Carlos Bregieiro Ribeiro, Francisco Fernández de Vega, and Mário Alberto Zenha-Rela

Graduate Track Papers

A Multi-objective Genetic Algorithm for Generating Test Suites from Extended Finite State Machines 288

Nesa Asoudeh and Yvan Labiche

An Approach to Test Set Generation for Pair-Wise Testing Using Genetic Algorithms 294

Priti Bansal, Sangeeta Sabharwal, Shreya Malik, Vikhyat Arora, and Vineet Kumar

Generation of Tests for Programming Challenge Tasks Using Helper-Objectives 300

Arina Buzdalova, Maxim Buzdalov, and Vladimir Parfenov

The Emergence of Useful Bias in Self-focusing Genetic Programming for Software Optimisation 306

Brendan Cody-Kenny and Stephen Barrett

Exploring Optimal Service Compositions in Highly Heterogeneous and Dynamic Service-Based Systems 312

Dionysios Efstathiou, Peter McBurney, Steffen Zschaler, and Johann Bourcier

Applying Search in an Automatic Contract-Based Testing Tool 318

Alexey Kolesnichenko, Christopher M. Poskitt, and Bertrand Meyer

Author Index .................................................. 325