



ESEC/FSE'05

Proceedings of the
**Joint 10th European Software Engineering
Conference (ESEC)**
and the
**13th ACM SIGSOFT Symposium on the
Foundations of Software Engineering (FSE-13)**

September 5-9, 2005 • Lisbon, Portugal

Edited by
Harald Gall

Sponsored by
ACM SIGSOFT and CEPIS

With corporate support from
ATX Software, Microsoft Portugal, TAP Portugal & Paperdyne
and additional support from
**The Open University, University of Zurich,
Universidade Nova de Lisboa, Lisbon Tourism & Lisbon Council**

**The Association for Computing Machinery
1515 Broadway
New York, New York 10036**

Copyright © 2005 by the Association for Computing Machinery, Inc. (ACM). Permission to make digital or hard copies of portions of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyright for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permission to republish from: Publications Dept., ACM, Inc. Fax +1 (212) 869-0481 or <permissions@acm.org>.

For other copying of articles that carry a code at the bottom of the first or last page, copying is permitted provided that the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

Notice to Past Authors of ACM-Published Articles

ACM intends to create a complete electronic archive of all articles and/or other material previously published by ACM. If you have written a work that has been previously published by ACM in any journal or conference proceedings prior to 1978, or any SIG Newsletter at any time, and you do NOT want this work to appear in the ACM Digital Library, please inform permissions@acm.org, stating the title of the work, the author(s), and where and when published.

ISBN: 1-59593-014-0

Additional copies may be ordered prepaid from:

ACM Order Department
PO Box 11405
New York, NY 10286-1405

Phone: 1-800-342-6626
(US and Canada)
+1-212-626-0500
(all other countries)
Fax: +1-212-944-1318
E-mail: acmhelp@acm.org

ACM Order Number 594050
Printed in the USA

Foreword

Greetings and welcome to *ESEC/FSE'05, the Joint 10th European Software Engineering Conference and 13th ACM SIGSOFT Symposium on the Foundations of Software Engineering!*

ESEC/FSE is an internationally renowned forum for researchers, practitioners, and educators to present and discuss the most recent innovations, trends, experiences, and challenges in the field of software engineering. Held bi-yearly, ESEC/FSE brings together experts from academia and industry to exchange the latest research results, state of the art, and state of the practice. The conference offers an exciting program of events, including keynote talks by leaders in the field, technical paper presentations, workshops, tutorials, research tool demonstrations, and a doctoral symposium on innovative research in software engineering.

ESEC/FSE'05 takes place in Lisbon, a city with a rich and eventful history. According to legend, it was founded by Ulysses; Romans and Moors dwelled here for centuries. In the 15th century, it was the starting point for several of the sea voyages of the Discoveries Age that brought East and West closer together. Lisbon hosted the European Capital of Culture in 1994, a World Exhibition in 1998, and the UEFA Cup in 2004. All these and many other events left their mark, shaping Lisbon into a city that displays old and new architectural, gastronomical and cultural influences.

This year there were 201 technical paper submissions (the largest number of submissions to ESEC/FSE). Each submission was reviewed by at least three members of the Program Committee, and in many cases four. On the basis of these reviews, the Program Committee accepted 32 full papers for inclusion in the proceedings and presentation in the technical program. We were pleased that the quality of paper submissions was very high and the Program Committee spent a great deal of time deliberating and discussing final decisions in a face-to-face meeting.

Besides the technical papers, we offer research tool demonstrations, a doctoral symposium, tutorials and workshops. For these tracks, the scientific committees accepted 7 (out of 17) workshops, 8 (out of 25) tutorials, 8 (out of 21) research tool demos, and 6 (out of 12) papers for the doctoral symposium, which reflects the high competition among the contributions.

The topics covered showcase the diversity and breadth of software engineering and its applications: software evolution, requirements, modeling, specification, verification, testing, middleware, web services, configuration management, product lines, components, patterns, or aspects. ESEC/FSE'05 provides ample opportunities for participants to exchange ideas, discuss results, and start collaborations. Student participation is especially encouraged through a doctoral symposium with free registration, the ACM SIGSOFT conference attendance programme, and the availability of inexpensive rooms at the student residence.

We are more than pleased that ESEC/FSE'05 features three exciting keynote addresses by *Oscar Nierstrasz* (Professor of Computer Science at the University of Bern, Switzerland), *António Câmara* (CEO of YDreams and Professor at the New University of Lisbon, Portugal), and the two ACM SIGSOFT Outstanding Research Award recipients *Jeff Kramer* (Professor of Distributed Computing at Imperial College London, UK) and *Jeff Magee* (Professor in Computing at Imperial College London, UK). Invited papers of the presentations are included in the proceedings so that they may be remembered and referenced in the future.

We are greatly appreciative of all those individuals who helped in the organization and realization of ESEC/FSE'05. The program committee was extremely diligent and timely during the review process. Their expertise and high standards are what make ESEC/FSE such a successful event. Luciano Baresi, Schahram Dustdar, Wolfgang Emmerich, and Michele Lanza did a great job in putting together the special tracks. We also thank Cristóvão Oliveira for his tireless efforts in maintaining the Web site, Dirk Peters for running the Paperdyne submission/reviewing software, Antónia Lopes for local arrangements, our finance chair Margarida Mamede, Leonor Barroca for the publicity work, Angélica Ruivo who handled all registration and accommodation, and Lisa Tolles from Sheridan Printing who handled the proceedings management so smoothly.

Further, we would like to thank the ESEC Steering Committee, especially Paola Inverardi, Mehdi Jazayeri, and Alexander Wolf, for their guidance and advice in many phases of this conference endeavour.

We are grateful to our sponsors: the Association for Computing Machinery (ACM), the ACM Special Interest Group on Software Engineering (SIGSOFT), and the Council of European Professional Informatics Societies (CEPIS). And we would like to thank our corporate donors ATX Software, Microsoft Portugal, Paperdyne, and TAP Portugal as well as our supporters, the New University of Lisbon, The Open University, and the University of Zurich. We also thank the Lisbon Tourism Office for their promotional support and the Lisbon Council for hosting the reception at the City Museum.

In conclusion, we extend once more our words of gratitude to all who contributed to making ESEC/FSE'05 a reality and we wish those attending the conference a pleasant and stimulating experience!

Harald C. Gall
Program Chair
University of Zurich, Switzerland

Michel Wermelinger
General Chair
The Open University, UK

Table of Contents

ESEC/FSE 2005 Conference Organization	ix
Additional Reviewers	x
Sponsors & Supporters	xii

Keynote

- **The Story of Moose: an Agile Reengineering Environment**..... 1
O. Nierstrasz, S. Ducasse, T. Gîrba (*University of Berne*)

Software Change Analysis

- **Automatic Generation of Suggestions for Program Investigation** 11
M. P. Robillard (*McGill University*)
- **ASTEC: A New Approach to Refactoring C** 21
B. McCloskey, E. Brewer (*University of California at Berkeley*)
- **Permissive Interfaces** 31
T. A. Henzinger (*EPFL and University of California at Berkeley*),
R. Jhala (*University of California at San Diego*),
R. Majumdar (*University of California at Los Angeles*)

Requirements

- **Reasoning About Confidentiality at Requirements Engineering Time** 41
R. De Landtsheer, A. van Lamsweerde (*Université Catholique de Louvain*)
- **Detecting and Resolving Semantic Pathologies in UML Sequence Diagrams** 50
P. Baker, P. Bristow, C. Jervis, D. King, R. Thomson (*Motorola Labs*),
B. Mitchell (*University of Surrey*), S. Burton (*DaimlerChrysler*)
- **A Case Study on Value-based Requirements Tracing** 60
M. Heindl, S. Biffl (*Vienna University of Technology*)

Models and Components

- **Fluent Temporal Logic for Discrete-Time Event-Based Models** 70
E. Letier (*Université Catholique de Louvain*), J. Kramer, J. Magee, S. Uchitel (*Imperial College London*)
- **Towards a Unified Formal Model for Supporting Mechanisms of Dynamic Component Update** 80
J. Shen, X. Sun, G. Huang, W. Jiao, Y. Sun, H. Mei (*Peking University*)
- **Arithmetic Program Paths** 90
M. Renieris, S. Ramaprasad, S. P. Reiss (*Brown University*)

Research Tool Demonstrations I

- **Moose: an Agile Reengineering Environment** 99
S. Ducasse, T. Gîrba, O. Nierstrasz (*University of Berne*)
- **Dynamically Discovering Architectures with DiscoTect** 103
B. Schmerl, D. Garlan, H. Yan (*Carnegie Mellon University*)

• HATARI: Raising Risk Awareness	107
J. Śliwerski (<i>Max-Planck-Institut für Informatik</i>), T. Zimmermann, A. Zeller (<i>Saarland University</i>)	
• CHARMY: An Extensible Tool for Architectural Analysis	111
P. Inverardi, H. Muccini, P. Pelliccione (<i>University of L'Aquila</i>)	

Application Performance

• Context- and Path-sensitive Memory Leak Detection	115
Y. Xie, A. Aiken (<i>Stanford University</i>)	
• Performance Data Collection Using a Hybrid Approach	126
E. Metz, R. Lencevicius (<i>Nokia Research Center</i>), T. F. Gonzalez (<i>University of California</i>)	
• Summarizing Application Performance from a Components Perspective	136
K. Srinivas (<i>IBM Research</i>), H. Srinivasan (<i>IBM Software Group</i>)	

Patterns and Aspects

• Applying Classification Techniques to Remotely-Collected Program Execution Data	146
M. Haran (<i>Pennsylvania State University at University Park</i>), A. Karr (<i>National Institute of Statistical Sciences</i>), A. Orso (<i>Georgia Institute of Technology</i>), A. Porter, A. Sanil (<i>University of Maryland at College Park</i>),	
• Detecting Higher-level Similarity Patterns in Programs	156
H. A. Basit, S. Jarzabek (<i>National University of Singapore</i>)	
• Information Hiding Interfaces for Aspect-Oriented Design	166
K. Sullivan (<i>University of Virginia</i>), W. G. Griswold (<i>University of California at San Diego</i>), Y. Song, Y. Cai (<i>University of Virginia</i>), M. Shonle (<i>University of California at San Diego</i>), N. Tewari, H. Rajan (<i>University of Virginia</i>)	

Keynote

• Innovations in Pervasive Computing	176
A. S. Camara (<i>New University of Lisbon and YDreams</i>)	

Software Evolution Analysis

• Facilitating Software Evolution Research with Kenyon	177
J. Bevan, E. J. Whitehead Jr., S. Kim (<i>University of California at Santa Cruz</i>), M. Godfrey (<i>University of Waterloo</i>)	
• An Empirical Study of Code Clone Genealogies	187
M. Kim, V. Sazawal, D. Notkin (<i>University of Washington</i>), G. C. Murphy (<i>University of British Columbia</i>)	
• Matching Execution Histories of Program Versions	197
X. Zhang, R. Gupta (<i>The University of Arizona</i>)	

Objects and Datatypes

• Relational Analysis of Algebraic Datatypes	207
V. Kuncak, D. Jackson (<i>Massachusetts Institute of Technology</i>)	
• Lightweight Object Specification with Typestates	217
K. Bierhoff, J. Aldrich (<i>Carnegie Mellon University</i>)	
• Joining Dataflow with Predicates	227
J. Fischer (<i>University of California at Los Angeles</i>), R. Jhala (<i>University of California at San Diego</i>), R. Majumdar (<i>University of California at Los Angeles</i>)	

Research Tool Demonstrations II

- **Strathcona Example Recommendation Tool**.....237
R. Holmes, R. J. Walker (*University of Calgary*), G. C. Murphy (*University of British Columbia*)
- **Parameterized Unit Tests with Unit Meister**.....241
N. Tillmann, W. Schulte (*Microsoft Research*)
- **KenyaEclipse: Learning to Program in Eclipse**.....245
R. Chatley, T. Timbul (*Imperial College London*)
- **Visual Tool for Generative Programming**.....249
P. Grigorenko, A. Saabas, E. Tyugu (*Tallinn University of Technology*)

Testing

- **Parameterized Unit Tests**253
N. Tillmann, W. Schulte (*Microsoft Research*)
- **CUTE: A Concolic Unit Testing Engine for C**.....263
K. Sen, D. Marinov, G. Agha (*University of Illinois at Urbana-Champaign*)
- **Online Testing with Model Programs**.....273
M. Veanes, C. Campbell, W. Schulte, N. Tillmann (*Microsoft Research*)

Keynote ACM SIGSOFT Outstanding Research Award

- **Engineering Distributed Software: a Structural Discipline**.....283
J. Kramer, J. Magee (*Imperial College London*)

Bug Localization

- **SOBER: Statistical Model-based Bug Localization**286
C. Liu, X. Yan (*University of Illinois at Urbana-Champaign*), L. Fei (*Purdue University*),
J. Han (*University of Illinois at Urbana-Champaign*), S. P. Midkiff (*Purdue University*)
- **DynaMine: Finding Common Error Patterns by Mining Software Revision Histories**.....296
B. Livshits (*Stanford University*), T. Zimmermann (*Saarland University*)
- **PR-Miner: Automatically Extracting Implicit Programming Rules
and Detecting Violations in Large Software Code**.....306
Z. Li, Y. Zhou (*University of Illinois at Urbana-Champaign*)

Product Lines and Middleware

- **Reuse and Variability in Large Software Applications**316
J. Estublier, G. Vega (*LSR-IMAG*)
- **Industrial Experience with Building a Web Portal Product Line using
a Lightweight, Reactive Approach**326
U. Pettersson (*ST Electronics Pte. Ltd.*), S. Jarzabek (*National University of Singapore*)
- **Inconsistency Detection and Resolution for Context-Aware Middleware Support**.....336
C. Xu, S. C. Cheung (*Hong Kong University of Science and Technology*)

Effort Estimation

- **Anchoring and Adjustment in Software Estimation**346
J. Aranda, S. Easterbrook (*University of Toronto*)
- **Combining Self-reported and Automatic Data to Improve Programming Effort Measurement**.....356
L. Hochstein (*University of Maryland*),
V. R. Basili, M. V. Zelkowitz (*University of Maryland & Fraunhofer Center*),
J. K. Hollingsworth (*University of Maryland*), J. Carver (*Mississippi State University*)

Doctoral Symposium

- **Quantitative Assessment of UML Dynamic Models**366
A. L. Baroni (*Universidade Nova de Lisboa*)
- **Reengineering Towards Components Using “Reconn-exion”**370
A. Le Gear, J. Buckley (*University of Limerick*)
- **UPEX — User Participation by EXample**.....374
I. Erfurth, W. Rossak (*Friedrich-Schiller-University Jena*)
- **A Refinement Calculus for Software Components and Architectures**377
M. A. Barbosa (*Universidade do Minho*)
- **Utilizing Verification and Validation Certificates to Estimate Software Defect Density**.....381
M. Sherriff (*North Carolina State University*)
- **Surveying the Factors that Influence Maintainability**.....385
W. Hordijk, R. Wieringa (*University of Twente*)

Author Index.....389

ESEC/FSE'05 Conference Organization

- General Chair:** Michel Wermelinger, *The Open University, UK*
- Program Chair:** Harald C. Gall, *University of Zurich, Switzerland*
- Workshops Chair:** Luciano Baresi, *Politecnico di Milano, Italy*
- Tutorials Chair:** Schahram Dustdar, *Technical University of Vienna, Austria*
- Doctoral Symposium Chair:** Wolfgang Emmerich, *University College London, UK*
- Research Demos Chair:** Michele Lanza, *University of Lugano, Switzerland*
- Local Arrangements Chair:** Antónia Lopes, *University of Lisbon, Portugal*
- Finance Chair:** Margarida Mamede, *New University of Lisbon, Portugal*
- Publicity Chair:** Leonor Barroca, *The Open University, UK*
- Web Chair:** Cristóvão Oliveira, *New University of Lisbon, Portugal*
- Registration Chair:** Angélica Ruivo, *Abreu Viagens SA, Portugal*
- Program Committee:** Mikio Aoyama, *Nanzan University, Japan*
Antonia Bertolino, *ISTI-CNR, Italy*
Jan Bosch, *Nokia Research Center, Finland*
Gerardo Canfora, *RCOST, University of Sannio, Italy*
Prem Devanbu, *University of California, Davis, USA*
Matthew Dwyer, *University of Nebraska, USA*
Wolfgang Emmerich, *University College London, UK*
Jacky Estublier, *Grenoble University, France*
Pascal Fenkam, *Technical University of Vienna, Austria*
Anthony Finkelstein, *University College London, UK*
Carlo Ghezzi, *Politecnico di Milano, Italy*
Martin Glinz, *University of Zurich, Switzerland*
Paul Grünbacher, *Johannes Kepler University Linz, Austria*
Volker Gruhn, *University of Leipzig, Germany*
Paola Inverardi, *Università dell'Aquila, Italy*
Mehdi Jazayeri, *Technical University of Vienna, Austria & University of Lugano, Switzerland*
Jeff Kramer, *Imperial College London, UK*
Philippe Kruchten, *University of British Columbia, Canada*
Nenad Medvidovic, *University of Southern California, USA*
Roland T. Mittermeir, *Klagenfurt University, Austria*
Carlo Montangero, *Università di Pisa, Italy*
Alessandro Orso, *Georgia Institute of Technology, USA*
Harold Ossher, *IBM T.J. Watson Research Center, USA*
Juan F. Ramil, *The Open University, UK*
David S. Rosenblum, *University College London, UK*
Wilhelm Schäfer, *University of Paderborn, Germany*
Sebastian Uchitel, *Imperial College London, UK*
Andre van der Hoek, *University of California, Irvine, USA*

- Program Committee (continued):** Claes Wohlin, *Blekinge Institute of Technology, Sweden*
Alexander L. Wolf, *University of Colorado, USA & University of Lugano, Switzerland*
Andreas Zeller, *Saarland University, Germany*
- Doctoral Symposium Committee:** Daniel Berry, *University of Waterloo, Canada*
Paola Inverardi, *Università dell'Aquila, Italy*
Gregg Rothermel, *University of Nebraska - Lincoln, USA*
Wilhelm Schäfer, *University of Paderborn, Germany*
- Research Demos Committee:** Jean-Marie Favre, *ADELE-IMAG, University of Grenoble, France*
Houari Sahraoui, *University of Montreal, Canada*
Margaret-Anne Storey, *University of Victoria, Canada*
- ESEC Steering Committee:** Paola Inverardi (*chair*), *Università dell' Aquila, Italy*
Pere Botella, *Universitat Politècnica de Catalunya, Spain*
Harald C. Gall, *University of Zurich, Switzerland*
Volker Gruhn, *University of Leipzig, Germany*
Mehdi Jazayeri, *Technical University of Vienna, Austria & University of Lugano, Switzerland*
Michel Lemoine, *ONERA - Toulouse Research Center, France*
Oscar Nierstrasz, *University of Bern, Switzerland*
Jukka Paakki, *University of Helsinki, Finland*
Wilhelm Schäfer, *University of Paderborn, Germany*
Hans-Werner Six, *Fern Universität Hagen, Germany*
A Min Tjoa, *Technical University of Vienna, Austria*
Michel Wermelinger, *The Open University, UK*
Alexander L. Wolf, *University of Colorado, USA & University of Lugano, Switzerland*
- Additional Reviewers:** Vincenzo Ambriola, *Università di Pisa, Italy*
Christopher Anderson, *Imperial College London, UK*
Taweessup Apiwattanapong, *Georgia Institute of Technology, USA*
Björn Axenath, *University of Paderborn, Germany*
Davide Balzarotti, *Politecnico di Milano, Italy*
Luciano Baresi, *Politecnico di Milano, Italy*
Andreas Bollin, *Klagenfurt University, Austria*
Yves Bontemps, *Facultés Universitaires Notre-Dame de la Paix, Belgium*
Matthias Book, *University Leipzig, Germany*
Abdelhamid Bouchachia, *Klagenfurt University, Austria*
Ivor Bosloper, *University of Groningen, Netherlands*
Victor Braberman, *University of Buenos Aires, Argentina*
Pietro Braione, *Politecnico di Milano, Italy*
Tobias Bruckmann, *University Leipzig, Germany*
Antonio Bucchiarone, *IMT Lucca Institute for Advanced Studies, Italy*
Sven Burmester, *University of Paderborn, Germany*
Mauro Caporuscio, *Università dell' Aquila, Italy*
Perry Cheng, *IBM T. J. Watson Research Center, USA*
Givanni A. Cignoni, *Università di Pisa, Italy*
Christoph Csallner, *Georgia Institute of Technology, USA*
Andrea Corradini, *Università di Pisa, Italy*

Additional Reviewers (Continued): Sybren Deelstra, *University of Groningen, Netherlands*
Pierpaolo Degano, *Università di Pisa, Italy*
Giovanni Denaro, *Università degli Studi di Milano-Bicocca, Italy*
Xianghua Deng, *Kansas State University, USA*
Antinisca Di Marco, *University College London, UK*
Massimiliano Di Penta, *RCOST, University of Sannio, Italy*
Sebastian Elbaum, *University of Nebraska-Lincoln, USA*
Michael Ernst, *Massachusetts Institute of Technology, USA*
Gianluigi Ferrari, *Università di Pisa, Italy*
Eelke Folmer, *University of Groningen, Netherlands*
Samuel Fricker, *ABB Research and University of Zurich, Switzerland*
Giorgio Gallo, *Università di Pisa, Italy*
Matthias Gehrke, *University of Paderborn, Germany*
Holger Giese, *University of Paderborn, Germany*
Bernd Greifeneder, *dynaTrace software GmbH, Austria*
Richard Hall
Madeline Hardojo, *University of Nebraska-Lincoln, USA*
Martin Hirsch, *University of Paderborn, Germany*
Karin Hodnigg, *Klagenfurt University, Austria*
Malte Hulder, *University Leipzig, Germany*
Michael Huth, *Imperial College London, UK*
Mugurel T. Ionita, *University of Groningen, Netherlands*
Anton Jansen, *University of Groningen, Netherlands*
James Jones, *Georgia Institute of Technology, USA*
Gregory M. Kapfhammer, *Allegheny College, Meadville, PA, USA*
Nicolás Kicillof, *University of Buenos Aires, Argentina*
Florian Klein, *University of Paderborn, Germany*
Gabriele Kotsis, *Johannes Kepler University Linz, Austria*
Christopher Krügel, *Technical University of Vienna, Austria*
Michael Kurz, *Technical University of Vienna, Austria*
Ralf Laue, *University Leipzig, Germany*
Ben Liblit, *University of Wisconsin, Madison, USA*
Bev Littlewood, *City University, London, UK*
Andrea Maggiolo-Schettini, *Università di Pisa, Italy*
Eda Marchetti, *ISTI-CNR, Pisa, Italy*
Peter McBrien, *Imperial College London, UK*
Nancy Merlo-Schett, *University of Zurich, Switzerland*
Matthias Meyer, *University of Paderborn, Germany*
Mattia Monga, *University of Milano, Italy*
Leonardo Mostarda, *Università dell' Aquila, Italy*
Arun Mukhija, *University of Zurich, Switzerland*
Iulian Ober
Johann Oberleitner, *Technical University of Vienna, Austria*
Frank Padberg, *Technical University Clausthal, Germany*
Suzette Person, *University of Nebraska-Lincoln, USA*
Dirk Peters, *University Leipzig, Germany*
Andrea Polini, *ISTI-CNR, Pisa, Italy*
Adam Porter, *University of Maryland, USA*
Rudolf Ramler, *Software Competence Center Hagenberg, Austria*

Sponsors:



ACM Special Interest Group on
Software Engineering



Council of European Professional Informatics
Societies

Corporate Donors:



ATX Software



Microsoft Portugal



Paperdyne Conference Management
System



TAP Portugal

Supporters:



Universidade Nova de Lisboa,
Portugal



Faculdade de Economia, Universidade Nova de
Lisboa, Portugal



The Open University, UK



University of Zurich, Switzerland



Lisbon Tourism



Lisbon Council