

PROCEEDINGS
SEKE 2015

**The 27th International Conference on
Software Engineering &
Knowledge Engineering**

Sponsored by

KSI Research Inc. and Knowledge Systems Institute Graduate School, USA

Technical Program

July 6 – 8, 2015

Wyndham Pittsburgh University Center, Pittsburgh, USA

Organized by

KSI Research Inc. and Knowledge Systems Institute Graduate School, USA

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written consent of the publisher.

ISBN: 1-891706-37-3

ISSN: 2325-9000 (print)

2325-9086 (online)

Additional copies can be ordered from:

KSI Research Inc. and Knowledge Systems Institute Graduate School

3420 Main Street

Skokie, IL 60076 USA

Tel: +1-847-679-3135

Fax: +1-847-679-3166

Email: seke@ksiresearch.org

Web: <http://www.ksi.edu>

Proceedings preparation, editing and printing are sponsored by KSI Research Inc. and Knowledge Systems Institute Graduate School, USA.

Printed by KSI Research Inc. and Knowledge Systems Institute Graduate School

FOREWORD

Welcome to the 27th International Conference on Software Engineering and Knowledge Engineering (SEKE), in Pittsburgh, Pennsylvania, USA, the City of Champions. In over a quarter of century, SEKE has established itself as a major international forum to foster, among academia, industry, and government agencies, discussion and exchange of ideas, research results and experience in software engineering and knowledge engineering. The SEKE community has grown to become a very important and influential source of ideas and innovations on the interplays between software engineering and knowledge engineering, and its impact on the knowledge economy has been felt worldwide. On behalf of the Program Committee Co-Chairs and the entire Program Committee, it is my great pleasure to invite you to participate, not only in the technical program of SEKE 2015 and its rich assortment of activities, but also in enjoying the beautiful and historical Steel City and people of Pittsburgh.

This year, we received 238 submissions from 35 countries. Through a rigorous review process where a majority (90 percent) of the submitted papers received three reviews, and the rest with two reviews, we were able to select 69 full papers for the general conference (29 percent), and 80 short papers (34 percent). Out of that, 6 papers have been accepted for special tracks, and 128 papers are scheduled for presentation in thirty-nine sessions during the conference. In addition, the technical program includes excellent keynote speeches, poster and demo presentations, as well as special tracks: Software Assurance, Intelligent Transportation Systems, and Testing.

The high quality of the SEKE 2015 technical program would not have been possible without the tireless effort and hard work of many individuals. First of all, I would like to express my sincere appreciation to all the authors whose technical contributions have made the final technical program possible. I am very grateful to all the Program Committee members whose expertise and dedication made my responsibility that much easier. My gratitude also goes to the keynote speakers who graciously agreed to share their insight on important research issues, to the conference organizing committee members for their superb work, and to the external reviewers for their contribution.

Personally, I owe a debt of gratitude to a number of people whose help and support with the technical program and the conference organization are unfailing and indispensable. I am deeply indebted to Dr. S. K. Chang, Chair of the Steering Committee, for his constant guidance and support that are essential to pull off SEKE 2015. My heartfelt appreciation goes to Dr. Marek Reformat of University of Alberta, Canada, the Conference Chair, for his help and experience, and to the Program Committee Co-Chairs, Dr. Kehan Gao of Eastern Connecticut State University, USA, and Dr. Shihong Huang of Florida Atlantic University, USA, for their outstanding team work.

I am truly grateful to the special track organizers, Dr. Dianxiang Xu of Boise State University, USA, Dr. Behrouz Far of University of Calgary, Canada, Dr. Jerry Gao of San Jose State University, USA, and Dr. Genny Tortora of University of Salerno, Italy, for their excellent job in organizing the special tracks.

I would like to express my great appreciation to all the Publicity Co-Chairs, Dr. Xiaoying Bai of Tsinghua University, China, and Dr. Jun Suzuki of University of Massachusetts Boston, USA, for their important contributions, to the Asia, Europe, India, and South America liaisons, Dr. Hironori Washizaki of Waseda University, Japan, Dr. Raul Garcia Castro of Universidad Politecnica de Madrid, Spain, Dr. Swapan Bhattacharya of National Institute of Technology Karnataka, India, and Dr. Jose Carlos Maldonado of University of Sao Paulo, Brazil, for their great efforts in helping expand the SEKE community, and to the Demo&Poster session Co-Chairs, Dr. Farshad Samimi of Enphase Energy, USA, and Dr. Dragutin Petkovic of San Francisco State University, USA, for their work.

Last but certainly not the least, I must acknowledge the important contributions that the KSI staff members have made. Their timely and dependable support and assistance throughout the entire process have been truly remarkable. It has been a great pleasure to work with all of them. Finally, I sincerely thank you for finding your way to Pittsburgh to participate in SEKE 2015, and hope you will enjoy this experience that may leave you long lasting memories.

Haiping Xu

SEKE 2015 Program Chair

SEKE 2015

The 27th International Conference on Software Engineering & Knowledge Engineering

July 6 – 8, 2015

Wyndham Pittsburgh University Center, Pittsburgh, USA

Conference Organization

CONFERENCE CHAIR

Marek Reformat, University of Alberta, Canada

PROGRAM COMMITTEE CHAIR

Haiping Xu, University of Massachusetts Dartmouth, USA

PROGRAM COMMITTEE CO-CHAIRS

Kehan Gao, Eastern Connecticut State University, USA
Shihong Huang, Florida Atlantic University, USA

STEERING COMMITTEE CHAIR

Shi-Kuo Chang, University of Pittsburgh, USA

STEERING COMMITTEE

Vic Basili, University of Maryland, USA
Bruce Buchanan, University of Pittsburgh, USA
C. V. Ramamoorthy, University of California, Berkeley, USA

ADVISORY COMMITTEE

Jerry Gao, San Jose State University, USA
Swapna Gokhale, University of Connecticut, USA
Natalia Juristo, Universidad Politecnica de Madrid, Spain
Taghi Khoshgoftaar, Florida Atlantic University, USA
Guenther Ruhe, University of Calgary, Canada
Masoud Sadjadi, Florida International University, USA
Du Zhang, California State University, USA

PROGRAM COMMITTEE

Silvia Teresita Acuna, Universidad Autonoma de Madrid, Spain
Shadi Alawneh, C-CORE, Canada
Izzat Alsmadi, Boise State University, USA
Taiseera Albalushi, Sultan Qaboos University, Oman
Mark Allison, University of Michigan - Flint, USA
John Anvik, Central Washington University, USA
Omar El Ariss, Penn State University at Harrisburg, USA
Doo-hwan Bae, Korea Advanced Institute of Science and Technology, Korea
Ebrahim Bagheri, Ryerson University, Canada
Hamid Bagheri, George Mason University and Massachusetts Institute of Technology, USA
Xiaoying Bai, Tsinghua University, China
Purushotham Bangalore, University of Alabama at Birmingham, USA
Fevzi Belli, University of Paderborn, Germany
Ateet Bhalla, Oriental Institute of Science & Technology, Bhopal, India
Swapan Bhattacharya, NITK, Surathakl, India
Alessandro Bianchi, University of Bari, Italy
Ivo Bukovsky, Czech Technical University in Prague, Czech Republic
Raul Garcia Castro, Universidad Politecnica de Madrid, Spain
Chih-Hung Chang, Hsiuping University of Science and Technology, Taiwan
Keith Chan, Hong Kong Polytechnic University, Hong Kong
Kuang-nan Chang, Eastern Kentucky University, USA
Meiru Che, University of Texas at Austin, USA
Shu-Ching Chen, Florida International University, USA
Wen-Hui Chen, National Taipei University of Technology, Taiwan
Stelvio Cimato, University of Milan, Italy
Nelly Condori-fernandez, University of Twente, The Netherlands
Fabio M. Costa, Universidade Federal de Goias, Brazil
Maria Francesca Costabile, University of Bari, Italy
Jose Luis De La Vara, Simula Research Laboratory, Norway
Massimiliano Di Penta, University of Sannio, Italy
Scott Dick, University of Alberta, Canada
Junhua Ding, East Carolina University, USA
Fei Dong, Google Inc., USA
Derek Doran, Wright State University, USA
Weichang Du, University of New Brunswick, Canada
Philippe Dugerdil, HEG - Univ. of Applied Sciences, Switzerland
Christof Ebert, Vector Consulting Services, Germany
Ali Ebneenasir, Michigan Technological University, USA
Raimund Ege, NIU, USA
Magdalini Eirinaki, San Jose State University, USA
Mahmoud Elish, King Fahd University of Petroleum and Minerals, Saudi Arabia

Davide Falessi, Cal Poly, USA
 Behrouz Far, University of Calgary, Canada
 Liana Fong, IBM, USA
 Ellen Francine Barbosa, University of Sao Paulo, Brazil
 Fulvio Frati, University of Milan, Italy
 Felix Garcia, University of Castilla-La Mancha, Spain
 Ignacio Garcia Rodriguez De Guzman, University of Castilla-La Mancha, Spain
 Swapna Gokhale, Univ. of Connecticut, USA
 Wolfgang Golubski, Zwickau University of Applied Sciences, Germany
 Desmond Greer, Queen's University Belfast, United Kingdom
 Christiane Gresse Von Wangenheim, UFSC - Federal University of Santa Catarina, Brazil
 Katarina Grolinger, University of Western Ontario, Canada
 Hassan Haghghi, Shahid Beheshti University, Iran
 Hao Han, National Institute of Informatics, Japan
 Xudong He, Florida International University, USA
 Miguel Herranz, University of Alcala, Spain
 Rubing Huang, Jiangsu University, China
 Shihong Huang, Florida Atlantic University, USA
 Bassey Isong, North-West University, South Africa
 Clinton Jeffery, University of Idaho, USA
 Jason Jung, Chung-Ang University, Korea
 Selim Kalayci, Florida International University, USA
 Marcos Kalinowski, Fluminense Federal University, Brazil
 Ananya Kanjilal, B.P. Poddar Institute of Technology and Management, India
 Eric Kasten, Michigan State University, USA
 Taghi Khoshgoftaar, Florida Atlantic University, USA
 Claudiu V. Kifor, Lucian Blaga University of Sibiu, Romania
 Jun Kong, North Dakota State University, USA
 Aneesh Krishna, Curtin University of Technology, Australia
 Vinay Kulkarni, Tata Consultancy Services, India
 Jeff Lei, University of Texas at Arlington, USA
 Meira Levy, Shenkar College of Engineering and Design, Israel
 Bixin Li, Southeast University, China
 Ming Li, Nanjing University, China
 Xin Li, Google Inc., USA
 Yuan-Fang Li, Monash University, Australia
 Zhi Li, Guangxi Normal University, China
 Jianhua Lin, Eastern Connecticut State University, USA
 Xiaoqing Frank Liu, Missouri University of Science and Technology, USA
 Shih-hsi Liu, California State University, Fresno, USA
 Ting Liu, Xian Jiaotong University, China
 Xiaodong Liu, Edinburgh Napier University, United Kingdom
 Yi Liu, Georgia College & State University, USA
 Luanna Lopes Lobato, Federal University of Goias, Brazil
 Baojun Ma, Beijing University of Posts and Telecommunications, China
 Ivan do Carmo Machado, Federal University of Bahia, Brazil
 Marcelo de Almeida Maia, Federal University of Uberlândia, Brazil
 Beatriz Marin, Universidad Diego Portales, Chile
 Riccardo Martoglia, University of Modena and Reggio Emilia, Italy
 Santiago Matalonga, Universidad ORT Uruguay, Uruguay
 Hong Mei, Peking University, China
 Hsing Mei, Fu Jen Catholic University, Taiwan
 Andre Menolli, Universidade Estadual do Norte do Parana (UENP), Brazil
 Ali Mili, NJIT, USA
 Alok Mishra, Atılım University, Turkey
 Manuel Mora, Autonomous University of Aguascalientes, Mexico

Kia Ng, ICSRiM - University of Leeds, United Kingdom
 Allen Nikora, Jet Propulsion Laboratory, USA
 Amjad Nusayr, University of Houston-Victoria, USA
 Edson Oliveira Jr, State University of Maringá, Brazil
 Xin Peng, Fudan University, China
 Oscar Pereira, University of Aveiro, Portugal
 Antonio Piccinno, University of Bari, Italy
 Alfonso Pierantonio, University of L'Aquila, Italy
 Daniel Plante, Stetson University, USA
 Rick Rabiser, Johannes Kepler University, Austria
 Filip Radulovic, Universidad Politécnica de Madrid, Spain
 Damith C. Rajapakse, National University of Singapore, Singapore
 Rajeev Raje, IUPUI, USA
 Henrique Rebelo, Universidade Federal de Pernambuco, Brazil
 Marek Reformat, University of Alberta, Canada
 Robert G. Reynolds, Wayne State University, USA
 Elder Macedo Rodrigues, Pontifical Catholic University of Rio Grande do Sul, Brazil
 Daniel Rodriguez, Universidad de Alcala, Spain
 Ivan Rodero, The State University of New Jersey, USA
 Samira Sadaoui, University of Regina, Canada
 Masoud Sadjadi, Florida International University, USA
 Claudio Sant'Anna, Universidade Federal da Bahia, Brazil
 Akila Sarirete, Effat University, Saudi Arabia
 Abdelhak-Djamel Seriai, University of Montpellier 2 for Sciences and Technology, France
 Andreas Schoenberger, Siemens AG, Germany
 Michael Shin, Texas Tech University, USA
 Martin Solari, Universidad ORT Uruguay, Uruguay
 Qinbao Song, Xi'an Jiaotong University, China
 George Spanoudakis, City University, United Kingdom
 Jing Sun, University of Auckland, New Zealand
 Yanchun Sun, Peking University, China
 Gerson Sunye, University of Nantes, France
 Jeff Tian, Southern Methodist University, USA
 Genny Tortora, University of Salerno, Italy
 Mark Trakhtenbrot, Holon Institute of Technology, Israel
 Peter Troeger, TU Chemnitz, Germany
 T. H. Tse, The University of Hong Kong, Hong Kong
 Burak Turhan, Oulu University, Finland
 Christelle Urtado, Ecole des Mines d'Alès, France
 Sylvain Vauttier, Ecole des Mines d'Alès, France
 Silvia Vergilio, Federal University of Parana (UFPR), Brazil
 Sergiy Vilkomir, East Carolina University, USA
 Aaron Visaggio, University of Sannio, Italy
 Arndt Von Staa, PUC-Rio, Brazil
 Gurisimran Walia, North Dakota State University, USA
 Huanjing Wang, Western Kentucky University, USA
 Jiacun Wang, Monmouth University, USA
 Linzhang Wang, Nanjing University, China
 Xiaoyin Wang, University of Texas at San Antonio, USA
 Ye Wang, Zhejiang Gongshang University, China
 Yong Wang, New Mexico Highlands University, USA
 Hironori Washizaki, Waseda University, Japan
 Victor Winter, University of Nebraska at Omaha, USA
 Guido Wirtz, Bamberg University, Germany
 W. Eric Wong, University of Texas at Dallas, USA
 Franz Wotawa, TU Graz, Austria

Dianxiang Xu, Boise State University, USA
Frank Weifeng Xu, Gannon University, USA
Haiping Xu, University of Massachusetts Dartmouth, USA
Zhiwei Xu, University of Michigan - Dearborn, USA
Guowei Yang, Texas State University, USA
Hongji Yang, Bath Spa University, United Kingdom
Huiqun Yu, East China University of Science and Technology, China
Jiang Yue, Fujian Normal University, China
Du Zhang, California State University, USA
Yong Zhang, Tsinghua University, China
Zhenyu Zhang, Institute of Software, Chinese Academy of Sciences, China
Jiang Zheng, ABB US Corporate Research Center, USA
Jianlin Zhu, South-Central University for Nationalities, China
Xingquan Zhu, Florida Atlantic University, USA
Eugenio Zimeo, University of Sannio, Italy

DEMO&POSTER SESSIONS CO-CHAIRS

Farshad Samimi, Enphase Energy, USA
Dragutin Petkovic, San Francisco State University, USA

PUBLICITY CHAIR

Xiaoying Bai, Tsinghua University, China
Jun Suzuki, University of Massachusetts Boston, USA

ASIA LIAISON

Hironori Washizaki, Waseda University, Japan

EUROPE LIAISON

Raul Garcia Castro, Universidad Politecnica de Madrid, Spain

INDIA LIAISON

Swapan Bhattacharya, National Institute of Technology Karnataka, Surathakl, India

SOUTH AMERICA LIAISON

Jose Carlos Maldonado, ICMC-USP, Brazil