Computing in Civil Engineering 2017

Sensing, Simulation, and Visualization



Seattle, Washington
June 25–27, 2017

Edited by Ken-Yu Lin, Ph.D.; Nora El-Gohary, Ph.D.; and Pingbo Tang, Ph.D., P.E.



Computing in Civil Engineering 2017

SENSING, SIMULATION, AND VISUALIZATION

SELECTED PAPERS FROM THE ASCE INTERNATIONAL WORKSHOP ON COMPUTING IN CIVIL ENGINEERING 2017

June 25–27, 2017 Seattle, Washington

SPONSORED BY Computing and Information Technology Division of the American Society of Civil Engineers

> EDITED BY Ken-Yu Lin, Ph.D. Nora El-Gohary, Ph.D. Pingbo Tang, Ph.D., P.E.



1801 ALEXANDER BELL DRIVE RESTON, VIRGINIA 20191–4400

Published by American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia, 20191-4382 www.asce.org/publications | ascelibrary.org

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefor. The information contained in these materials should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing such information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

Photocopies and permissions. Permission to photocopy or reproduce material from ASCE publications can be requested by sending an e-mail to permissions@asce.org or by locating a title in ASCE's Civil Engineering Database (http://cedb.asce.org) or ASCE Library (http://ascelibrary.org) and using the "Permissions" link.

Errata: Errata, if any, can be found at https://doi.org/10.1061/9780784480830

Copyright © 2017 by the American Society of Civil Engineers. All Rights Reserved. ISBN 978-0-7844-8083-0 (PDF) Manufactured in the United States of America.

Preface

Welcome to Seattle, the Emerald City in Washington!

The 2017 ASCE International Workshop on Computing in Civil Engineering (IWCCE) was held in Seattle from June 25-27, 2017. The workshop was hosted by the University of Washington with sponsorship from ASCE's Computing Division. The workshop is the Computing Division's major meeting event and is held biannually in the United States, with participation from scholars worldwide.

The workshop has a long history of success and serves as a platform for sharing research innovation as well as valuable lessons. We introduced several pioneering changes this year, including the inaugural all-stakeholder meeting for the Computing Division. We had a strong and engaged Technical Committee which provided rigorous reviews for the abstracts and full papers, with each submission being reviewed by at least two members of our Technical Committee.

The 2017 workshop, as a standalone event, received more than 300 abstracts, 184 full papers, and 32 extended abstracts for the poster and demonstration sessions. The participation from our growing community has set a record and a total of 162 full papers were accepted and included in the proceedings. Among these papers, Building Information Modeling and Civil Information Modeling formed the most popular technical interests while Energy, Sustainability and Resilience topped the list of application contexts.

We would like to thank the Department of Construction Management at The University of Washington for its support of the workshop. We are also grateful for the guidance from the Computing Division's Executive Committee and the assistance from ASCE.

We hope that you enjoyed the technical sessions at the workshop and had a memorable and meaningful IWCCE experience in Seattle this year.

Ken-Yu Lin, Ph.D. Chair, Organizing Committee, IWCCE 2017

Nora El-Gohary, Ph.D. Chair, Technical Committee, IWCCE 2017

Pingbo Tang, Ph.D., P.E. Vice Chair, Organizing Committee, IWCCE 2017

Acknowledgments

Special thanks are due to the following individuals at the University of Washington for their continuous and tireless support throughout the organization of the workshop:

Name	Title
Julie Angeley	IWCCE Local Administrator
Mark Baratta	IWCCE Local IT Lead
Brian Vogt	IWCCE Local Web Consultant
Zhenyu Zhang	IWCCE Secretary

A sincere appreciation goes to the Microsoft Corporation for providing the editors free access to Microsoft's Academic Conference Management Service and for customizing the online platform for the workshop.

The editors would also like to thank the following Technical Committee members for their assistance and effort with the paper review and selection process:

Name	Institution
Abbas Rashidi	Georgia Southern University
Albert Chen	National Taiwan University
Ali Mostafavi	Florida International University
Amin Hammad	Concordia University
Amir Behzadan	Missouri State University
Andre Barbosa	Oregon State University
Andre Borrmann	The Technical University of Munich
Atefeh Mohammadpour	Indiana University-Purdue University Fort Wayne
Auroop R. Ganguly	Northeastern University (United States)
Baabak Ashuri	Georgia Institute of Technology
Behzad Esmaeili	University of Nebraska-Lincoln
Bon-Gang Hwang	National University of Singapore
Brenda McCabe	University of Toronto
Burcin Becerik	University of Southern California
Carl Haas	University of Waterloo
Carlos Caldas	University of Texas at Austin
Carol Menassa	University of Michigan
Changbum Ahn	University of Nebraska-Lincoln
Chao Wang	Louisiana State University
Chen Feng	Mitsubishi Electric Research Laboratories

Chien-Cheng Chou National Central University (Taiwan) Chimay Anumba University of Florida Christian Koch University of Nottingham David Lattanzi George Mason University Dong Zhao Michigan State University **Dulcy** Abraham Purdue University Ebrahim Karan Millersville University **Eduardo Santos** University of Sao Paulo Esin Ergen Istanbul Technical University Fadi Castronovo California State University East Bay Farrokh Jazizadeh Virginia Tech Fei Dai West Virginia University Feng Li Research Institute of Highway (China) Fernanda Leite University of Texas at Austin Frank Boukamp Royal Melbourne Institute of Technology Frederic Bosche Heriot-Watt University Guangbin Wang Tongji University Hanbin Luo Huazhong University of Science and Technology Hubo Cai Purdue University Ecole Polytechnique Federale (Switzerland) Ian Smith **Ioannis Brilakis** Cambridge University Islam El-adaway University of Tennessee **Ivan Mutis** Illinois Institute of Technology Jack Cheng Hong Kong University of Science and Technology Jiansong Zhang Western Michigan University Jiayu Chen City University of Hong Kong Jie gong **Rutgers University** Jing Du Texas A&M University Jinyue Zhang **Tianjin University** John Messner Penn State University John Taylor Georgia Tech Jun Yang Northwestern Polytechnical University (China) Justin Ker-Wei Yeoh National University of Singapore Koji Makanae Miyagi University Lu Zhang Florida International University Lucio Soibelman University of Southern California Mani Golparvar-Fard University of Illinois at Urbana-Champaign Mario Berges Carnegie Mellon University Menghan Tsai National Taiwan University Michael Olsen **Oregon State University** University of Alberta Ming Lu

Mounir El Asmar Arizona State University Nai-Wen Chi National Taiwan University Nan Li Tsinghua University Nipesh Pradhananga Florida International University Nobuyoshi Yabuki Osaka University Omar El-Anwar Cairo University Oswald Chong Arizona State University Paul Goodrum University of Colorado at Boulder Pin-Chao Liao **Tsinghua University** Ray Issa University of Florida **Renate Fruchter** Stanford University Ren-Jye Dzeng National Chiao-Tung University Reza Akhavian California State University East Bay **Rishee Jain** Stanford University Robert Amor University of Auckland Tongji University Rucheng Xiao Rui Liu University of Florida Saiedeh Razavi McMaster University Sanghoon Lee University of Hong Kong SangHyun Lee University of Michigan SangUk Han University of Alberta Semiha Ergan New York University Seokho Chi Seoul National University Shang-Hsien Hsieh National Taiwan University Sheryl Staub-French University of British Columbia Steven Ayer Arizona State University RIKEN Takashi Michikawa Tamer El-Diraby University of Toronto **Timo Hartmann** Technical University of Berlin Walid Tizani University of Nottingham Wen Xiong Southeast University Xiangyu Wang Curtin University Xianzhong Zhao Tongji University Xiaowei Luo City University of Hong Kong Xiaolong Xue Harbin Institute of Technology Xuesong Liu Carnegie Mellon University Xuesong Shen University of New South Wales Yelda Turkan Oregon State University Yimin Zhu Louisiana State University Ying Zhou Huazhong University of Science and Technology Yong Cho Georgia Institute of Technology

Youngjib Ham	Florida International University
Yunfeng Chen	Georgia Southern University
Zhenhua Zhu	Concordia University
Zheng Yang	Stanford University
Zhiliang Ma	Tsinghua University

Finally, the editors would also like to thank the following Poster and Demonstration Organization Committee members for their help with the related review process:

Name	Institution
Cheng Zhang	Arizona State University
Hamid Abdirad	University of Washington
Jiawei Chen	Arizona State University
Kadir Amasyali	University of Illinois at Urbana-Champaign
Kaijian Liu	University of Illinois at Urbana-Champaign
Lufan Wang	University of Illinois at Urbana-Champaign
Luming Shang	University of Washington
Vamsi Sai Kalasapudi	Arizona State University
Xuan Lv	University of Illinois at Urbana-Champaign
Zhenyu Zhang	University of Washington

Contents

Design Management and Collaboration

Simultaneous Data Exchange between BIM and VR for Collaborative
Decision Making
Jing Du, Zhengbo Zou, Yangming Shi, and Dong Zhao
The Need for Taxonomies in the Ontological Approach for Interoperability of Heterogeneous Information Models
Aaron M. Costin, Charles Eastinan, and Kaja K. A. Issa
Hybridizing Topology Optimization and Evolutionary Computation to Support Computer-Aided Engineering Design18 Achyuthan Jootoo and David Lattanzi
Education
When Is a Construction Educational Serious Game Too Serious? Striking a Balance between Engagement and Learning
Learning Advanced Decision-Making Techniques and Technologies through a Collaborative Project
ICT-Enabled Cross-Cultural Education in Sustainable Urbanization43 Nan Li, Deland Chan, Kevin Hsu, Zhiyong Fu, and Quan Mao
An Augmented Reality Environment for Students' Learning of Steel Connection Behavior
A New Learning Model, Guided Soft Classroom, Integrating MOOCs into Conventional Classrooms for University Students
Hybrid Real/Virtual Simulation in an Engineering Laboratory Course68 Yupeng Luo and Jeevjyot Chhabda

Intelligent Sensing and Monitoring

Automated Monitoring of the Utilization Rate of Onsite Construction
Xiaoning Ren, Zhenhua Zhu, Chantale Germain, Roger Belair, and Zhi Chen
A Personalized HVAC Control Smartphone Application Framework for Improved Human Health and Well-Being
Automated Change Diagnosis of Single-Column-Pier Bridges Based on 3D Imagery Data
Feasibility of Field Measurement of Construction Workers' Valence Using a Wearable EEG Device
Houtan Jebelli, Sungjoo Hwang, and SangHyun Lee
Using Photometric Stereo Method in Evaluating the Volume of Potholes107 Peng-Yuan Chen and Shih-Chung Kang
Comparison of Traditional Laser Scanning and Mobile Lidar Technology for AECO Applications113 Nathan Blinn and Raja R. A. Issa
Mobile Asset Tracking for Dynamic 3D Crane Workspace Generation in Real Time122
Jingdao Chen, Yihai Fang, and Yong K. Cho
A Smart Construction Object (SCO)-Enabled Proactive Data Management System for Construction Equipment Management
Potential Use of Cyber-Physical Systems (CPS) for Planning and Operation of Mobile Cranes on Construction Sites139 C. Kan, C. J. Anumba, and J. I. Messner
Proactive Construction Project Controls via Predictive Visual Data Analytics
A Compact and Versatile Wireless Sensor Prototype for Affordable Intelligent Sensing and Monitoring in Smart Buildings