

Computing in Civil Engineering 2019

Visualization, Information Modeling, and Simulation

Selected Papers from the ASCE International Conference on
Computing in Civil Engineering 2019

Atlanta, Georgia, USA
17 – 19 June 2019

Editors:

Yong K. Cho
Fernanda Leite

Amir Behzadan
Chao Wang

ISBN: 978-1-5108-8909-5

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2019) by American Society of Civil Engineers
All rights reserved.

Printed by Curran Associates, Inc. (2019)

For permission requests, please contact American Society of Civil Engineers
at the address below.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, VA 20191
USA

Phone: (800) 548-2723
Fax: (703) 295-6333

www.asce.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

Contents

Visualization (nD, VR, AR)

3D Registration of Indoor Point Clouds for Augmented Reality	1
Bilawal Mahmood and SangUk Han	
As-Built BIM Updating Based on Image Processing and Artificial Intelligence	9
Cheng Zhang and Hong Huang	
Comparing Virtual Reality and 2-Dimensional Drawings for the Visualization of a Construction Project	17
Claudia Calderon-Hernandez, Daniel Paes, Javier Irizarry, and Xavier Brioso	
The Relevance of Visual Cues in Immersive Environments: Does Pictorial Realism Matter?	25
Daniel Paes and Javier Irizarry	
Annotating 2D Imagery with 3D Kinematically Configurable Assets of Construction Equipment for Training Pose-Informed Activity Analysis and Safety Monitoring Algorithms	32
Dominic Roberts, Yunpeng Wang, Ali Sabet, and Mani Golparvar-Fard	
A First Step in Generating a Decision-Making Framework for the Development of Interactive Workspaces	39
F. Castronovo, M. Barbosa Silva, S. Mastrolembo Ventura, and R. Akhavian	
An Immersive Approach to Construction Cost Estimating	48
Fopefoluwa M. Bademosi, Ralph Tayeh, and Raja R. A. Issa	
Hazard Identification Training Using 360-Degree Panorama vs. Virtual Reality Techniques: A Pilot Study	55
H. Frank Moore, Ricardo Eiris, Masoud Gheisari, and Behzad Esmaeili	
Immersion into Holographic Spaces to Enhance Engineering and Architecture Design Interpretations	63
Ivan Mutis and Rohit Desai	
Human-in-the-Loop Simulation for Crane Lift Planning in Modular Construction On-Site Assembly	71
JianTsen Goh, Songbo Hu, and Yihai Fang	
Comprehensible and Interactive Visualizations of Spatial Building Data in Augmented Reality	79
Joao P. Carneiro, Mahsa Pahlavikhah Varnosfaderani, Vahid Balali, and Arsalan Heydarian	

Development of a Virtual Reality Integrated Community-Scale Eco-Feedback System.....	87
Lei Xu, Abigail Francisco, Neda Mohammadi, and John E. Taylor	
Virtual Manipulation in an Immersive Virtual Environment: Simulation of Virtual Assembly.....	95
Mojtaba Noghabaei, Khashayar Asadi, and Kevin Han	
Participatory and Evolutionary Fire Simulation via a Sensitive Control of Key Scenery Parameters	103
Qi Zhu, Jing Du, Yangming Shi, Qi Wang, and Yingzi Lin	
Interactive Holograms for Better Construction Information Communication	112
Ralph Tayeh, Fopefoluwa M. Bademosi, and Raja R. A. Issa	
Integrating BIM and Game Engine for Simulation Interactive Life Cycle Analysis Visualization	120
Sagid M. Omaran, Abdulaziz A. Alghamdi, Salam C. Alharishawi, and Decker B. Hains	
Application of Virtual Reality to Investigate Driver's Route Choice in an Interstate Freeway	129
Sanaz Saeidi, Zhen Xu, Yimin Zhu, Supratik Mukhopadhyay, and Ravindra Gudishala	
Understanding Roofer's Risk Compensatory Behavior through Passive Haptics Mixed-Reality System.....	137
Sogand Hasanzadeh and Jesus M. de la Garza	
Using Immersive Virtual Reality to Improve Choosing by Advantages System for the Selection of Fall Protection Measures	146
Xavier Brioso, Claudia Calderon-Hernandez, Javier Irizarry, and Daniel Paes	
First Responders' Spatial Working Memory of Large-Scale Buildings: Implications of Information Format	154
Yangming Shi, Jing Du, Shyam Prathish Sargunam, Eric D. Ragan, and Qi Zhu	
Capabilities of Mixed Reality Applications for Architecture and Construction: A Comparative Review with HoloLens	162
Yilei Huang, Samjhana Shakya, and Lianbo Zhu	
Integrating Biometric Sensors, VR, and Machine Learning to Classify EEG Signals in Alternative Architecture Designs	169
Zhengbo Zou, Xinran Yu, and Semiha Ergan	

BIM, Ontologies, and Semantic Approaches

Evaluation of IFC for the Augmentation of Intelligent Transportation Systems (ITS) into Bridge Information Models (BrIM)	177
Alireza Adibfar and Aaron M. Costin	
BIM-Based Estimation of Wood Waste Stream: The Case of an Institutional Building Project	185
Amal Bakchan, Beatriz C. Guerra, Kasey M. Faust, and Fernanda Leite	
Applying Deep Learning and Building Information Modeling to Indoor Positioning Based on Sound.....	193
Chih-Hsiung Chang, Chia-Ying Lin, Ru-Guan Wang, and Chien-Cheng Chou	
A BIM-Enabled Design Method for Green Plantation on Building Sites	200
Ching-Chun Chou, Yun-Tsui Chang, and Shang-Hsien Hsieh	
Identifying Damage-Related Social Media Data during Hurricane Matthew: A Machine Learning Approach	207
Faxi Yuan and Rui Liu	
Formalizing Construction Sequencing Knowledge and Mining Company-Specific Best Practices from Past Project Schedules	215
Fouad Amer and Mani Golparvar-Fard	
Integration of Building Information Modeling and Facilities Management: A Case Study at Worcester Polytechnic Institute	224
Guillermo F. Salazar, Mohamed Aboulezz, and Sergio Alvarez	
Developing a BIM-Assisted 3D Access Point Placement Optimization Algorithm for Enhancing Wi-Fi Fingerprint-Based Indoor Positioning	232
Jack C. P. Cheng and Kenneth Chun Ting Li	
Mapping Precast: Linking Global and Local Descriptions of Architectural Precast Concrete	241
Jeffrey Collins and Russell Gentry	
A Multi-LOD Model for Visualizing Building Information Models' Vagueness.....	248
Jimmy Abualdenien and André Borrmann	
Identifying Potential Innovative Technologies and Management Approaches for Design Standardization	256
Jin Ouk Choi, Young Hoon Kwak, Jennifer S. Shane, and Binit K. Shrestha	
Introducing Geometric Signatures of Architecture, Engineering, and Construction Objects and a New BIM Dataset	264
Jin Wu and Jiansong Zhang	

Automated BIM Model Generation Using Drawing Recognition and Line-Text Extraction	272
Juhee Rho, Hyun-Soo Lee, and Moonseo Park	
Ontology-Based Framework for Checking the Constructability of Concrete Volumetric Construction Submodules from BIM.....	279
Justin K. W. Yeoh and Runxing Jiao	
Cast-in-Place Reinforced Concrete Project Model Exchange Standards: Technology Challenges and Process Automation	286
Leonardo Garcia and Daniel Castro-Lacouture	
Exploiting Music and Dance Notation to Improve Visualization of Data in BIM.....	295
Marcel Broekmaat and Ioannis Brilakis	
Worksite Object Characterization for Automatically Updating Building Information Models	303
Max Ferguson, Seongwoon Jeong, and Kincho H. Law	
Schema for Automated Generation of CLT Framing and Panelization	312
Mehmet Sinan Bermek, Dennis Shelden, and Russell Gentry	
Automatic Generation of Path Networks for Evacuation Using Building Information Modeling.....	320
Meiqing Fu and Rui Liu	
Virtual Building Permitting Framework for the State of Florida: Data Collection and Analysis.....	328
Mouloud Messaoudi, Nawari O. Nawari, and Ravi Srinivasan	
A Technical Review on Developing BIM-Oriented Indoor Route Planning	336
Mun On Wong and Sanghoon Lee	
Blockchain Technologies in BIM Workflow Environment.....	343
Nawari O. Nawari and Shriraam Ravindran	
Automating Design Review with Artificial Intelligence and BIM: State of the Art and Research Framework.....	353
Rafael Sacks, Tanya Bloch, Meir Katz, and Raz Yosef	
Model Information Checking to Support Interoperable BIM Usage in Structural Analysis.....	361
Ran Ren and Jiansong Zhang	
Construction Site Path Planning Optimization through BIM.....	369
Siyuan Song and Eric Marks	

Georeferencing within IFC: A Novel Approach for Infrastructure Objects	377
Štefan Jaud, Andreas Donaubauer, and André Borrmann	
A Method to Provide Integrated Design through Systems-Level Automation	385
Steve Barg, Forest Flager, and Martin Fischer	
Leveraging Blockchain Technology in AEC Industry during Design Development Phase	393
Sulekha Singh and Baabak Ashuri	
Automated Item Matching and Pricing (IMP) for Wood Building Elements to Support BIM-Based Wood Construction Cost Estimation	402
Temitope Akanbi, Jiansong Zhang, and Yong-Cheol Lee	
Semantic Segmentation of Building Point Clouds Using Deep Learning: A Method for Creating Training Data Using BIM to Point Cloud Label Transfer	410
Thomas Czerniawski and Fernanda Leite	
BIM-Based Integrated Design Approach for Low Carbon Green Building Optimization and Sustainable Construction	417
Vincent J. L. Gan, Irene M. C. Lo, K. T. Tse, C. L. Wong, Jack C. P. Cheng, and C. M. Chan	
Designing a Database Schema for Supporting Visual Management of Variable Parameters in BIM Models	425
Wei-Liang Kuo, Han-Xiang Lee, and Shang-Hsien (Patrick) Hsieh	
Automated Mining of Construction Schedules for Easy and Quick Assembly of 4D BIM Simulations.....	432
Wilfredo Torres-Calderon, Yumo Chi, Fouad Amer, and Mani Golparvar-Fard	
Modeling 3D Spatial Constraints to Support Utility Compliance Checking	439
Xin Xu, Hubo Cai, and Kaiwen Chen	
A Bridge Information Modeling Framework for Model Interoperability	447
Yidong Qin, Rucheng Xiao, Yang Wang, and Kincho H. Law	
Scan2BrIM: IFC Model Generation of Concrete Bridges from Point Clouds	455
Yi-Pu Zhao and Patricio A. Vela	
Entity-Based MVD Concept Module Generation for Development of New BIM Data Exchange Standards	464
Yong-Cheol Lee, Pedram Ghannad, Moeid Shariatfar, Jiansong Zhang, and Jin-Kook Lee	
Holistic Clash Resolution Improvement Using Spatial Networks	473
Yuqing Hu, Daniel Castro-Lacouture, and Charles M. Eastman	

Simulation and Process Modeling

Optimal Construction Facilities Location Selection for Linear Infrastructure Projects	482
Amr G. Mansour, Mohamed S. Eid, and Emad E. Elbeltagi	
Use of Simulation Software and Passive Design Strategies for School Design.....	491
Chang-Ray Chen and Frida Cobar	
A Simulation Framework for Technology Adoption Decision Making in Construction Management: A Composite Model	499
Chukwuma Nnaji, Ifeanyi Okpala, and Sungjin Kim	
Conceptual Quantitative Model to Group Risks in Fast-Track Construction Projects	507
Claudia Garrido Martins, Susan M. Bogus, and Vanessa Valentin	
A Hybrid Simulation Approach for Understanding the Social Contagion Effect of Safety Violations within the Construction Crew.....	514
Huakang Liang and Ken-Yu Lin	
A Network-Based Methodology for Quantitative Knowledge Gap Identification in Construction Simulation and Modeling Research.....	522
Ibrahim S. Abotaleb and Islam H. El-adaway	
Proposing a Multi-Staged Calibration Methodology for System Dynamics Construction Management Models	530
Ibrahim S. Abotaleb and Islam H. El-adaway	
Multi-Agent Based Model for Studying Electric Grid Transition to Distributed Energy Resources	538
Islam El-adaway, Charles Sims, Mohamed Eid, and Yinan Liu	
Nuclear Power Plant Disaster Site Simulation Using Rigid Body Physics	546
Jingdao Chen, Kinam Kim, Yong K. Cho, Joo Sung Lee, Byeol Kim, Yong Han Ahn, and Junsuk Kang	
Three-Tiered Simulation Framework for Modeling Bridge Girders Fabrication Processes in a Steel Fabrication Shop	553
Ming Lu, Monjurul Hasan, and Arash Mohsenijam	
Multi-Objective Simultaneous Optimization for Linear Projects Scheduling	561
Mohamed S. Eid, Emad E. Elbeltagi, and Islam H. El-Adaway	
Integrating Fuzzy Agent-Based Modeling and Multi-Criteria Decision-Making for Analyzing Construction Crew Performance	569
Nebiyu Siraj Kedir, Mohammad Raoufi, and Aminah Robinson Fayek	

Effect of Improving Cost Estimating Accuracy in Competitive Bidding	577
Sadegh Asgari	
Path-Float Based Approach to Optimizing Time-Cost Tradeoff in Project Planning and Scheduling	585
Sasan Nasiri and Ming Lu	
Analysis of Lighting Occupancy Sensor Installation in Building Renovation Using Agent-Based Modeling of Occupant Behavior.....	593
Seddigheh Norouziasl, Amirhosein Jafari, and Chao Wang	
Dynamic Agent-Based Simulation of Information Transfer in Collaborative Project Network	602
Shaochong Gao, Xinyi Song, and Ronggui Ding	
Performance Indicators for the Claim Management Process of Construction Projects	611
Wonkyoung Seo and Youngcheol Kang	
A Cost Model to Evaluate the Economic Performance of Contour Crafting	618
Xun Zhang, Ian Flood, Yuanxin Zhang, Hashem Izadi Moud, and Mohsen Hatami	
Enhance the Simulation of Architecture and Engineering Design Process: A Data-Driven Based Approach	626
Yu Hou, Lucio Soibelman, and Yan Jin	
Evaluation of Reshuffling Efforts to Comply with Installation Sequences of Prefabricated Interior Wall Panels from Bunks Delivered On Site.....	635
Yujin Lee, Martin Fischer, and Jung In Kim	