

33rd International Symposium on Automation and Robotics in Construction and Mining (ISARC 2016)

Auburn, Alabama, USA
18 - 21 July 2016

ISBN: 978-1-5108-2992-3

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© (2016) by International Association for Automation and Robotics in Construction (IAARC)
All rights reserved.

Printed by Curran Associates, Inc. (2017)

For permission requests, please contact
International Association for Automation and Robotics in Construction (IAARC)
at the address below.

International Association for Automation and Robotics in Construction (IAARC)
Slovak University of Technology in Bratislava
Faculty of Engineering
Radlinského 11
813 68 Bratislava
SK - Slovakia

Phone: +421 2 5927 4599

Fax: +421 2 5296 8811

secretariat@iaarc.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

TABLE OF CONTENTS

Analytical Hierarchy Process Decision Support System (AHP-DSS) for Trenchless Technology	1
<i>M. Salah, S. Samra, O. Hosny</i>	
Time-Cost Tradeoff Model for Multiple Asphalt Paving Projects Using Genetic Algorithms	10
<i>M. Salah, T. Zaki, O. Hosny</i>	
Fast and Robust 3D Terrain Surface Reconstruction of Construction Site Using Stereo Camera	18
<i>C. Sung, S. Lee, Y. Kwon, P. Kim</i>	
Sampling-based Floor Plan Analysis on BIMs	26
<i>C. Schlette, J. Robmann</i>	
Site Plan Development: Tower Crane Placement Based on Data Obtained from IFC File	33
<i>T. Funtik, J. Gasparik</i>	
Application of Self-location System Using a Floor of Random Dot Pattern to an Automatic Guided Vehicle	38
<i>Y. Fukase, H. Kanamori, H. Taga, K. Saito, E. Nagata</i>	
Automatic Surface Flatness Control using Terrestrial Laser Scanning Data and the 2D Continuous Wavelet Transform	45
<i>E. Valero, F. Bosche</i>	
Inspection Robot with Low Cost Perception Sensing	53
<i>H. Peel, G. Morgan, C. Peel, A. Cohn, R. Fuentes</i>	
How Can Lean, IPD and BIM Work Together?	60
<i>A. Fakhimi, J. Sardroud, S. Azhar</i>	
Direction Aware Bluetooth Low Energy Based Proximity Detection System for Construction Work Zone Safety	68
<i>J. Park, Y. Cho, S. Timalsina</i>	
Field Construction Management Application through Mobile BIM and Location Tracking Technology	74
<i>J. Park, Y. Cho, K. Kim</i>	
Adaptive Control of Bulldozer's Workflows	80
<i>A. Bulgakov, S. Emilianov, T. Bock, G. Tokmakov</i>	
Mathematical Representation of Haptic Robotic Realization for Artefacts Maintenance	87
<i>A. Bulgakov, A. Volkov, D. Sayfeddine</i>	
Innovative Assessment of Selected Properties of Industrial Floors	93
<i>T. Funtik, J. Erdelyi, M. Dubek, J. Gasparik</i>	
Automatic Reconstruction of As-built BIM from Laser Scanned Data of Precast Concrete Elements for Dimensional Quality Assessment	101
<i>Q. Wang, J. Cheng, H. Sohn</i>	
Active Control of a Pan-Tilt-Zoom Camera for Vision-Based Monitoring of Equipment in Construction and Surface Mining Jobsites	109
<i>E. Azar</i>	
A Face Recognition System for Automated Door Opening with parallel Health Status Validation Using the Kinect v2	117
<i>A. Ogawa, A. Mita, C. Georgoulas, T. Bock</i>	
Visual and 3D Mapping for Steel Bridge Inspection Using a Climbing Robot	125
<i>N. Pham, H. La, Q. Ha, S. Dang, A. Vo, Q. Dinh</i>	
Improving Construction Labor Productivity Using Automatic Rebar Tying Gun	133
<i>M. Safal, J. Cardenas, D. Leblanc, D. Rose, A. Shahi</i>	
Hybrid Simulation Modeling of Hoist Downpeak Operations in Construction Sites	138
<i>S. Xiang, M. Arashpour, R. Wakefield</i>	
Alternative Scheduling and Planning Processes for Hybrid Offsite Construction	146
<i>T. Salama, A. Salah, O. Moselhi</i>	
A Sequential Pattern Mining Approach to Extract Information from BIM Design Log Files	154
<i>S. Yarmohammadi, R. Pourabolghasem, A. Shirazi, B. Ashuri</i>	
Hbim and Fire Prevention in Historical Building Heritage Management	161
<i>G. Frosini, C. Biagini, P. Capone, V. Donato, T. Giusti</i>	
The Role of Automation in Right-time Construction Safety	169
<i>J. Teizer</i>	
First Person Virtual Reality for Evaluation and Learning of Construction Site Safety	177
<i>T. Hilfert, J. Teizer, M. Konig</i>	

BIM Applications of Rule-based Checking in Construction Site Layout Planning Tasks	185
<i>K. Schwabe, M. Konig, J. Teizer</i>	
Automated Equipment Recognition and Classification from Scattered Point Clouds for Construction Management Applications	193
<i>J. Chen, Y. Fang, Y. Cho</i>	
Real-time 3D Mobile Mapping for the Built Environment	200
<i>J. Chen, Y. Cho</i>	
Parametric Library Components for BIM-based Curtain Wall Design Automation Module	207
<i>B. Kim, S. Chin</i>	
A Framework for Developing an Estimation Model of Damages on Bridge Elements Using Big Data Analytics	213
<i>S. Lim, S. Chung, S. Chi, J. Song</i>	
Use of Ultra-Wideband Sensor Networks to Detect Safety Violations in Real Time	221
<i>J. Lucas, J. Burgett, A. Hoover, M. Gungor</i>	
Ergonomic Assessment of Residential Construction Tasks Using System Dynamics	228
<i>H. Abaeian, N. Inyang, O. Moselhi, M. Al-Hussein, M. El-Rich</i>	
Coupling Wireless Sensor Networks and Unmanned Aerial Vehicles in Bridge Health Monitoring Systems	236
<i>H. Moud, M. Gheisari</i>	
The Impact of Eco-Feedback on Energy Consumption Behavior: A Cross-Cultural Study	242
<i>J. Lin, N. Li, G. Ma, J. Zhou</i>	
Eye-Tracking Technology for Construction Safety: A Feasibility Study	249
<i>R. Pinheiro, N. Pradhananga, R. Jianu, W. Orabi</i>	
A Framework of Lift Virtual Prototyping (LVP) Approach for Crane Safety Planning	257
<i>Y. Fang, Y. Cho</i>	
Analytical Model and Data-driven Approach for Concrete Moisture Prediction	263
<i>K. Thiyagarajan, S. Kodagoda</i>	
Automated Classification of Detected Surface Damage from Point Clouds with Supervised Learning	271
<i>B. Guldur, J. Hajjar</i>	
Construction Progress Management and Interior Work Analysis Using Kinect 3D Image Sensors	277
<i>K. Ishida</i>	
Immersive Virtual Environments for Investigating Building Emergency Evacuation Behaviors: A Feasibility Study	285
<i>H. Zou, N. Li, L. Cao</i>	
Automated Construction of Masonry Buildings using Cable-Driven Parallel Robots	293
<i>T. Bruckmann, H. Mattern, A. Spengler, C. Reichert, A. Malkwitz, M. Konig</i>	
Integration of NDE Measurements and Current Practice In Bridge Deterioration Modeling	301
<i>M. Ahmed, O. Moselhi, A. Bhowmick</i>	
Discrete and Continuous Simulation Approach to Optimize the Productivity of Modular Construction Element	309
<i>M. Afifi, M. Al-Hussein, S. Abourizk, A. Fotough, A. Bouferguene</i>	
Automated Removal of Planar Clutter from 3D Point Clouds for Improving Industrial Object Recognition	315
<i>T. Czerniawski, M. Nahangi, S. Walbridge, C. Haas</i>	
Arbitrary 3D Object Extraction from Cluttered Laser Scans Using Local Features	323
<i>M. Nahangi, T. Czerniawski, C. Rausch, C. Haas</i>	
Applying the Concept of Selective Assembly to Modular Construction to Mitigate Impacts of Component Variability	330
<i>C. Rausch, M. Nahangi, M. Perreault, C. Haas, J. West</i>	
A Preliminary Study on Text Mining-Based Human Resource Allocation in a Construction Project	338
<i>S. Han, G. Lee</i>	
Incorporating BIM into Architectural Precast Concrete Fabrication	346
<i>J. Collins</i>	
Automated 3D Image-Based Section Loss Detection for Finite Element Model Updating	356
<i>N/A</i>	
Automation of Modular Assembly of Structural Frames for Buildings	364
<i>B. Raphael, K. Rao, K. Varghese</i>	
Suggestion of the Ground Stiffness Estimative Method with the Running Speed of a Plate Compactor	372
<i>T. Hashimoto, K. Fujino, K. Tateyama</i>	
Ambient Data Collection in Indoor Building Environments Using Mobile Robots	378
<i>B. Mantha, C. Menassa, V. Kamat</i>	

Fast Terminal Sliding Mode Control for Gantry Cranes	386
<i>A. Singh, V. Hoang, Q. Ha</i>	
A Framework for Optimizing Lap Splice Positions within Concrete Elements to Minimize Cutting Waste of Steel Bars	392
<i>Z. Nadoushani, A. Hammad, A. Akbarnezhad</i>	
Factors influencing BIM Adoption in Small and Medium Sized Construction Organizations	399
<i>Y. Hong, S. Sepasgozar, A. Ahmadian, A. Akbarnezhad</i>	
Simulation of HVAC Local Control Based on Occupants Locations and Preferences	408
<i>Z. Liu, S. Salimi, A. Hammad</i>	
Industrial Timber House Building – Levels of Automation	415
<i>D. Popovic, M. Winroth</i>	
Research on Improving Work Efficiency of Unmanned Construction	422
<i>M. Moteki, N. Akihiko, S. Yuta, H. Mishima, K. Fujino</i>	
Operation Analysis of Hydraulic Excavator with Different Operation System	430
<i>A. Nishiyama, M. Moteki, K. Fujino, T. Hashimoto</i>	
Derivation of the Factors Influencing the Network Performance of Serverless Smart Exit Sign Systems based on Wireless Sensor Networks	438
<i>H. Kim, G. Lee, J. Cho</i>	
A Multi-Objective Mixed Integer Programming Model for Minimising Obtrusive Effects and Installation Costs of Night-time Lighting on Construction Sites	446
<i>A. Hammad, A. Akbarnezhad, D. Rey</i>	
A Realisation of a Construction Scale Robotic System for 3D Printing of Complex Formwork	455
<i>J. Gardiner, S. Janssen, N. Kirchner</i>	
Joint Segmentation and Recognition of Worker Actions using Semi-Markov Models	461
<i>J. Yang, Z. Shi, Z. Wu</i>	
A Suggestion for Improvement of IFC Data in Energy Performance Index (EPI) based on Open BIM	467
<i>J. Choi, I. Kim, M. Kim, J. Ryu</i>	
Emissions Modelling of Earthmoving Equipment	475
<i>K. Barati, X. Shen</i>	
Monitoring Apparent pH Value in Geopolymer Concrete Using Glass Electrode	483
<i>J. Dang, X. Shen, A. Castel, J. Aldred</i>	
Optimum Driving Pattern for Minimizing Fuel Consumption of On-road Vehicles	490
<i>J. Klein, X. Shen, K. Barati</i>	
Reduced-order Models for Supporting Energy Audits of Buildings	497
<i>M. Benedettelli, A. Carbonari, B. Naticchia, M. Vaccarini</i>	
Human State Estimation System Implemented in an Office Deployable Getaway Based on Multiple Bio Information	505
<i>S. Nakaso, J. Guttler, A. Mita, T. Bock</i>	
A Cloud-based BIM Platform for Information Collaboration	513
<i>L. Ma, R. Sacks</i>	
Real-time Schedule Control	521
<i>S. Isaac</i>	
Human-Robot Collaboration for Creative and Integrated Design and Fabrication Processes	526
<i>S. Sharif, T. Gentry, L. Sweet</i>	
Optimizing the Trajectory of the Painting Robot	534
<i>M. Bruzl, V. Usmanov, P. Svoboda, R. Sulc</i>	
A Point Cloud-Vision Hybrid Approach for 3D Location Tracking of Mobile Construction Assets	541
<i>Y. Fang, J. Chen, Y. Cho, P. Zhang</i>	
Investigating Safety Passage Planning for System Shoring Supports with BIM	548
<i>R. Zhuang, S. Hung, Y. Shiau, K. Liu, C. Liu</i>	
Development of House Selling System for Construction Industries	553
<i>R. Zhuang, Y. Chiu, Y. Shiau, C. Guo</i>	
Dynamic Space Conflict Modeling for Construction Operations	559
<i>A. Saeedfar, L. Song, S. Gore</i>	
Audio Signal Processing for Activity Recognition of Construction Heavy Equipment	566
<i>C.-F. Cheng, A. Rashidi, M. Davenport, D. Anderson</i>	
An Automated GIS based Piezoelectric Potential Assessment: PE Calculator©	574
<i>S. Toroghi, M. Li, B. Ashuri</i>	
Low Cost Augmented Reality Framework for Construction Applications	581
<i>S. Kodeboyina, K. Varghese</i>	
Entity Matching Across Stereo Cameras for Tracking Construction Workers	590
<i>Y.-J. Lee, M.-W. Park, I. Brilakis</i>	

Analysis of Accuracy Factor for 3D Reconstruction using 2D Image Obtained from Unmanned Aerial Vehicle (UAV)	598
<i>H. Ko, S. Kwon, S. Chung, D. Moon, J. Park, J. Seo, S. Kang</i>	
Target-Free Automatic Registration of Point Clouds	605
<i>P. Kim, Y. Cho, J. Chen</i>	
Resource Allocation Methodology of Virtual Desktop Infrastructure in Cloud Computing BIM: Focusing Korean Small and Medium Sized Architectural Design Firm	612
<i>K. Lee, S. Kwon, J. Shin, D. Kim, D. Moon, S. Lee</i>	
Using Simulation Applications for Sustainable Design and Construction	620
<i>H. Khoshnevis, N. Khairdoost</i>	
3D Grid Size Optimization of Automatic Space Analysis for Plant Facility Using Point Cloud Data	627
<i>G. Choi, S. Kwon, D. Kim, D. Moon, S. Jung, S. Lee, H. Ko</i>	
KBim Code-based Applications for the Representation, Definition and Evaluation of Building Permit Rules	635
<i>S. Park, J.-K. Lee</i>	
Optimizing Surveillance Camera Placement in Buildings Using BIM	643
<i>A. Albahri, A. Hammad</i>	
Integration of BIM and FEA in Automation of Building and Bridge Engineering Design	648
<i>F. Fedorikl, T. Makkonen, R. Heikkila</i>	
Challenges and Opportunities for Implementation of Laser Scanners in Building Construction	654
<i>S. Sepasgozar, C. Wang, S. Shirowzhan</i>	
Design and Simulation of a Fuzzy Supervisory Control System Integrated in a Small Public Building	663
<i>A. Carbonari, S. Meschini, M. Benedetelli</i>	
Auto-layout of Lighting Objects to Support Lighting Design in the Early Phase of Design	671
<i>H. Kim, J. Huang, Y.-S. Hwang, J.-K. Lee</i>	
Automated Layout Planning of Climbing Formwork System Using Genetic Algorithm	679
<i>M. Kim, T. Kim, H. Lim, H. Cho, K.-I. Kang</i>	
An Extended Ambient Intelligence Implementation for Enhanced Human-Space Interaction	686
<i>A. Cheng, H. Bier</i>	
Evaluation of Lifting Efficiency of Double-Cage Construction Lift in Supertall Building Construction	694
<i>W. Kim, D. Lee, T. Kim, S. Kim, H.-K. Jung, H. Cho, K.-I. Kang</i>	
Robotic Application of Foam Concrete Onto Bare Wall Elements	702
<i>E. Lublasser, J. Bruninghaus, A. Vollpracht, L. Hildebrand, S. Brell-Cokcan</i>	
Development of a Fast and Effective Solution for On-site Building Envelope Installation	710
<i>W. Pan, T. Bock, T. Linner, K. Iturralde</i>	
Accuracy Assessment for 5 Commercial RTK-GNSS Systems Using a New Roadlaying Automation Test Center Calibration Track	716
<i>R. Heikkila, M. Vermeer, T. Makkonen, P. Tyni, M. Mikkonen</i>	
A Case Study: Projecting Images for Designing Interior Panels Using Parametric Modeling Tool	721
<i>H. kim, J. Huang, J.-K. Lee</i>	
SeeBridge Information Delivery Manual (IDM) for Next Generation Bridge Inspection	728
<i>R. Sacks, A. Kedar, A. Borrmann, L. Ma, D. Singer, U. Kattel</i>	
Development of the Scenario-based Evaluation of Indoor Circulation using BIM-enabled Parameters	736
<i>J. Shin, J.-K. Lee, J. Huang</i>	
Applying Systems Modeling Approaches to Building Construction	744
<i>F. Valdes, R. Gentry, C. Eastman, S. Forrest</i>	
Robot-Oriented Design for Production in the Context of Building Information Modeling	752
<i>F. Correa</i>	
State of Art on Site Space Modeling in Construction Projects	760
<i>S. Gore, A. Saeedfar, L. Song</i>	
Interoperability with IFC in the Automated Rebar Fabrication	769
<i>A. Maciel, F. Correa</i>	
Data-Processing Model for Vertical Zoning Based on Construction Lift Operation Records for High-rise Building	777
<i>J. Shin, S. Kwon, D. Kim, D. Moon, S. Chung, G. Choi, K. Lee</i>	
Automatic Crane-Related Workflow Control for Nuclear Plant Outages through Computer Vision and Simulation	784
<i>C. Zhang, P. Tang, A. Yilmaz, N. Cooke, V. Buchanan, A. Chasey, R. Boring, S. Germain, T. Vaughn, S. Jones</i>	
Decision Support System for Material Selection Based on Supplier Rating	792
<i>A. Akanmu, B. Asfari</i>	
An Adaptive Automated Monitoring of Construction Activities using Swarm Nodes	800
<i>A. Akanmu, J. Zhang</i>	

A Process-Driven Representation Schema for Masonry Wall Assemblies	806
<i>A. Cavieres, R. Gentry, C. Eastman</i>	
LCA of a Designed Single-family Housing in Atlanta Under Two Different Energy Usage Systems	814
<i>Y. Shi, T. Feng</i>	
Challenges of Migrating from Desktop-based BIM in Construction	824
<i>S. Sepasgozar, A. Costin, C. Wang</i>	
Data-Driven Scene Parsing Method for Construction Site Monitoring	832
<i>H. Kim, K. Kim</i>	
Large Scale 3D Printing of Complex Geometric Shapes in Construction	836
<i>J. Teizer, A. Blickle, T. King, O. Leitzbach, D. Guenther</i>	
Sensing Workers Gait Abnormality for Safety Hazard Identification	844
<i>K. Yang, C. Ahn, M. Vuran, H. Kim</i>	
Integrating Crane Information Models in BIM for Checking the Compliance of Lifting Plan Requirements	852
<i>J. Yeoh, J. Wong, L. Peng</i>	
Handheld Simultaneous Localization and Mapping Devices for 3D Scanning	860
<i>M. Froehlich, S. Azhar</i>	
The Study on the Integrated Control System for Curtain Wall Building Cleaning Robot	869
<i>M. Gil, S. Kim, Y. Lee, S. Lee, C. Han</i>	
Development of a Sensor System for Detecting Window Contamination for the Building Maintenance Robot System	875
<i>Y. Lee, S. Kim, J. Lee, M. Kang, D. Sun, C. Han</i>	
Development of BIM-based Real-time Evacuation and Rescue System for Complex Buildings	881
<i>M.-Y. Cheng, K.-C. Chiu, Y.-M. Hsieh, I.-T. Yang, J.-S. Chou</i>	
Modeling the Permanent Deformation Behavior of Asphalt Mixtures Using a Novel Hybrid Computational Intelligence	890
<i>M.-Y. Cheng, D. Prayogo</i>	
The Development of a BIM-enabled Inspection Management System for Maintenance Diagnoses of Oil and Gas Plants	896
<i>H. Chi, J. Wang, J. Chai, X. Wang</i>	
A Framework for Establishing Early Warning System for Working in Hot Environments	904
<i>W. Yi, J. Zhu, X. Liu, X. Wang, A. Chan</i>	
An Integrated INS-GPS-Raspberry Pi System Using the Time-Sphere Model for Real-Time Identification of Struckby-Equipment Hazard	910
<i>J. Wang, S. Du, S. Razavi</i>	
Applications of Supernumerary Robotic Limbs to Construction Works: Case Studies	918
<i>W. Seo, C.-Y. Shin, J. Choi, D. Hong, C. Han</i>	
Technical Term Similarity Model for Natural Language Based Data Retrieval in Civil Infrastructure Projects	924
<i>T. Le, H. Jeong</i>	
Consolidated Exchange Models for Implementing Precast Concrete Model View Definition	931
<i>K. Afsari, C. Eastman</i>	
A Model for Real-Time Control of Industrial Robots	939
<i>F. Shahmiri, J. Ficca</i>	
Cloud-based BIM Data Transmission: Current Status and Challenges	946
<i>K. Afsari, C. Eastman, D. Shelden</i>	
Development of a Modular and Integrated Productmanufacturing-installation System Kit for the Automation of the Refurbishment Process in the Research Project BERTIM	953
<i>K. Iturralde, T. Linner, T. Bock</i>	
Lean-based Diagnosis and Improvement for Offsite Construction Factory Manufacturing Facilities	961
<i>Y. Zhang, G. Fan, Z. Lei, S. Han, C. Raimondi, M. Al-Hussein, A. Bouferguene</i>	
Author Index	