The 39th Symposium on Automation and Robotics in Construction (ISARC 2022)

Technical Program Schedule

VENUE

Universidad de los Andes – Mario Laserna Auditorium
Bogotá, Colombia
July 13th – 15th
2022

https://isarc2022.uniandes.edu.co/
## OVERALL PROGRAM

<table>
<thead>
<tr>
<th>Time*</th>
<th>Wednesday, July 13, 2022</th>
<th>Thursday, July 14, 2022</th>
<th>Friday, July 15, 2022</th>
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<tbody>
<tr>
<td>8:00</td>
<td>Registration</td>
<td>Registration</td>
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<tr>
<td>8:15</td>
<td>Opening Remarks &amp; External Keynote 1 (ML-B)</td>
<td>External Keynote 2 (ML-B)</td>
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<tr>
<td>8:45</td>
<td>Sponsor Keynote 1 (Autodesk) (ML-B)</td>
<td>Sponsor keynote 3 (Autodesk) (ML-B)</td>
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<tr>
<td>9:00</td>
<td>Technical Keynote 1 (ML-B)</td>
<td>IAARC Chapters &amp; Innovation Hubs (ML-B)</td>
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<tr>
<td>9:45</td>
<td>Session A1</td>
<td>Session B1</td>
<td>Session D1</td>
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<tr>
<td>10:00</td>
<td>Networking &amp; Coffee Break</td>
<td>Networking &amp; Coffee Break</td>
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<tr>
<td>11:00</td>
<td>Session A2</td>
<td>Session B2</td>
<td>Session D2</td>
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<tr>
<td>11:45</td>
<td>Session A3</td>
<td>Session B3</td>
<td>Session D3</td>
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<tr>
<td>12:00</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Session G1</td>
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<tr>
<td>12:15</td>
<td>IAARC BOD General Assembly 2022 (by invitation only) (ML 805B)</td>
<td>Registration</td>
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<tr>
<td>12:45</td>
<td>Networking &amp; Coffee Break</td>
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<tr>
<td>13:00</td>
<td>Session C1</td>
<td>Session C2</td>
<td>Session H1</td>
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<tr>
<td>13:15</td>
<td>Session C2</td>
<td>Session E1</td>
<td>Session G2</td>
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<tr>
<td>15:15</td>
<td>Welcome Reception (ML Building - 2nd Floor)</td>
<td>Technical keynote 2 &amp; Three Plenary Talks (ML-B)</td>
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<tr>
<td>15:45</td>
<td>Networking &amp; Coffee Break</td>
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<tr>
<td>16:00</td>
<td>Technical keynote 2 &amp; Three Plenary Talks (ML-B)</td>
<td>Technical Keynote 3 &amp; Three Plenary Talks (ML-B)</td>
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<tr>
<td>16:45</td>
<td>Networking &amp; Coffee Break</td>
<td>Networking &amp; Coffee Break</td>
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<tr>
<td>17:00</td>
<td>Sponsor Keynote 2 (Trimble) (ML-B)</td>
<td>Awards announcement (ML-B)</td>
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<td>17:15</td>
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<tr>
<td>17:30</td>
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<td>Customized event</td>
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</tbody>
</table>

### Legend - Conference Sessions

- **KP. Technical Keynote & Plenary Talks**
  - A. Sensing systems & data infrastructures
  - B. Information modelling techniques
  - C. Human factors & human-system collaboration
  - D. Robotic machines, devices, and end-effectors
  - E. Construction management techniques
  - F. Serv. and business applications / industry papers
  - G. Technology management and innovation
  - H. Applications in developing countries

### Notes

- **NOTE 1:** Dates and times are shown in the local timezone (Bogotá, Colombia)
- **NOTE 2:** Although not expected, some changes in the Technical Program Schedule could occur. Any changes will be communicated in due time.
- **NOTE 3:** The conference follows a hybrid format. Zoom link will be provided in due course.
**DETAILED PROGRAM**

**Wednesday July 13, 2022**

**Room ML-805B (ML Building - 8th Floor)**

**IAARC BOD General Assembly 2022** (by invitation only)

**Room Building 2nd Floor**

**Welcome Reception (all registered participants)**

**Thursday July 14, 2022**

**Session A1: Sensing systems & data infrastructures**

Session chair: Daniel Hall

ID 15: Towards BIM-based robot localization: a real-world case study

Huan Yin, Jia Min Liew, Wai Leong Lee, Marcelo H Ang Jr and Justin Ker-Wei Yeah

ID 22: Current State and Future Opportunities of Data Mining for Construction 4.0

Keyi Wu and Borja García de Soto

ID 29: The Use of Boston Dynamics SPOT in Support of LiDAR Scanning on Active Construction Sites

Eric Wetzel, Junshan Liu, Tom Leathem and A noop Sattineni

ID 32: Autonomous operation of a robot dog for point cloud data acquisition of scaffolds

Duho Chung, Sunwoong Paik, Juhyeon Kim and Hyungkwan Kim

ID 46: Cluster-based Deterioration Prediction of Composite Pavements with Incorporation of Flooding

Ishan Neema, Fatemeh Banani Ardecani and Omidreza Shoghli

**Session A2: Sensing systems & data infrastructures**

Session chair: Jose Guevara

ID 23: A framework for a comprehensive mobile data acquisition setting for the assessment of Urban Heat Island phenomenon.

Monica Pena Acosta, Faridaddin Vahdatikhaki, Joao Santos and Andre Doree

**Room ML-A**

**Session B1: Information modelling techniques**

Session chair: Mi Pan

ID 1: Innovative Model for Forecasting Trailer Usage for Prefabricated Exterior Wall Panels

Andrew Rener, Aslihan Karatas and Matthew Cole

ID 6: Automated Wall Detection in 2D CAD Drawings to Create Digital 3D Models

Chialing Wei, Mohit Gupta and Thomas Czerniawski

ID 7: IFC-based Information Extraction and Analysis of HVAC Objects to Support Building Energy Modeling

Hang Li and Jiansong Zhang

ID 16: Systematic Literature Review of Building Information Modelling and Green Building Certification Systems

Oludolapo Olanrewaju, W allese Enegbuma and Michael Donn

ID 18: Information Extraction from Text Documents for the Semantic Enrichment of Building Information Models of Bridges

Phillip Schönfelder, Tariq Al-Wesabi, Andreas Bach and Markus König

**Session B2: Information modelling techniques**

Session chair: Vicente Gonzalez

ID 49: Predicting construction productivity with machine learning approaches

Laura Florez-Perez, Zhiyuan Song and Jean C. Cortissoz

ID 51: Automated Checking of Scaffold Safety Regulations using Multi-Class 3D Segmentation

ID 19: BIM-Integration of Light Construction Equipment

Maximilian Schöberl, Sebastian Offinger, Theo Goldfuß, Stephan Kessler and Johannes Fottner

ID 21: Visualisation and graph-based storage of customised changes in early design phases

**Networking & Coffee Break**
<table>
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<tr>
<th>ID</th>
<th>Title</th>
<th>Authors</th>
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<tr>
<td>71</td>
<td>A Systematic Classification and Evaluation of Automated Progress Monitoring Technologies in Construction</td>
<td>Jeehoon Kim, Juhyeon Kim, Nahye Koo and Hyoungkwan Kim</td>
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<tr>
<td>72</td>
<td>Conceptual Modeling of Lifecycle Digital Twin Architecture for Bridges</td>
<td>Daniel Napps, Ato Zahedi, Markus König and Frank Petzold</td>
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<td>82</td>
<td>Reducing spatial error in mobile laser scanning by real-time uncertainty visualization and human-machine interaction</td>
<td>Varun Kumar Reja, Megha S Pradeep and Kashy Varghese</td>
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<td>83</td>
<td>Towards the development of a digital twin for subsoil monitoring and stability against overturning of a mobile drilling rig</td>
<td>Maciej Trzciak, Chris Burgoyne and Ioannis Brilakis</td>
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<td>87</td>
<td>Toward Automation in Crack Detection and Measurements: Benchmarking of CNN-based Algorithms</td>
<td>Donghoon Ji, Yelda Turkan and Paolo Calvi</td>
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<td>11</td>
<td>The Neural Basis of Risk Attitude in Decision-Making Under Risk: fNIRS investigation of the Simulated Electrical Construction Task</td>
<td>Shiva Pooladavand, Deha Ay and Sogand Hasanazade</td>
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<td>Toward Personalized Safety Training: Automating the Classification of Construction Workers’ Cognitive Failures</td>
<td>Kyeongsuk. Lee, Yugandhar Shinde, Sogand Hasanazade and Behzad Esmaeelli</td>
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<td>27</td>
<td>iVisit-Collaborate: Online Multiuser Virtual Site Visits Using 360-Degree Panoramas and Virtual Humans</td>
<td>Ricardo Eiris and Masoud Gheisari</td>
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<td>36</td>
<td>Vulnerability Assessment of Construction Equipment: An Example for an Autonomous Site Monitoring System</td>
<td>Muammer Semih Sorkor, Xinghui Xu, Samuel A. Prieto and Borja Garcia de Soto</td>
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<td>40</td>
<td>Fire Evacuation and Management Model Based on Building Information Modeling and Virtual Reality</td>
<td>Ren-Hao Gao, Kun-Chi Wang, Xiang-Hao Lai and Wei-Hsiang Hung</td>
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<td>Evaluation of Construction Site Layout Using Virtual Reality Linked with 3D CAD and Body Tracking</td>
<td>Hidetoshi Tsuda and Kosei Ishida</td>
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<tr>
<td>56</td>
<td>Automated Recognition of Hand Gestures for Crane Rigging using Data Gloves in Virtual Reality</td>
<td>Aparna Harichandran and Jochen Teizer</td>
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<td>64</td>
<td>A Knowledge Graph for Automated Construction Workers’ Safety Violation Identification</td>
<td>Yifan Zhu and Xiaowei Luo</td>
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<td>78</td>
<td>Highway Workers and Wearable Technologies: Perception and Preferences</td>
<td>Sepehr Sabeti, Omidreza Shaghili, Nichole Morris and Hamed Tobkhi</td>
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<td>Integrated Sensor-Based Interface for Human-Robot Collaboration in Construction</td>
<td>Xiaowei Luo</td>
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**July 14 | 12:45 pm - 2:00 pm | Campus Main Cafeteria**

**Room ML-A**

**Session B3: Information modelling techniques**

Session chair: Vineet Kamat

- ID 63: ColombiaClass: proposal for a BIM Classification System for public buildings in Colombia  
  Maria Del Pilar Revuelta Mendoza, Nelly Paola Garcia Lopez and Luis Arturo Salazar Fica
- ID 68: Towards Automated Pipelines for Processing Load Test Data on a HS Railway Bridge in Spain using a Digital Twin  
  Carlos Ramonell and Rolando Chacon
- ID 86: Potentials of 5D BIM with Blockchain-enabled Smart Contracts for Expediting Cash Flow in Construction Projects  
  Jong Han Yoon and Pardis Pishdad-Bozorgi

**Room ML-B**

**Session C1: Human factors & human-system collaboration**

Session chair: Alessandro Carbonari

  Shiva Pooladavand, Deha Ay and Sogand Hasanazade
- ID 12: Toward Personalized Safety Training: Automating the Classification of Construction Workers’ Cognitive Failures  
  Kyeongsuk. Lee, Yugandhar Shinde, Sogand Hasanazade and Behzad Esmaeelli
- ID 27: iVisit-Collaborate: Online Multiuser Virtual Site Visits Using 360-Degree Panoramas and Virtual Humans  
  Ricardo Eiris and Masoud Gheisari
- ID 36: Vulnerability Assessment of Construction Equipment: An Example for an Autonomous Site Monitoring System  
  Muammer Semih Sorkor, Xinghui Xu, Samuel A. Prieto and Borja Garcia de Soto
- ID 40: Fire Evacuation and Management Model Based on Building Information Modeling and Virtual Reality  
  Ren-Hao Gao, Kun-Chi Wang, Xiang-Hao Lai and Wei-Hsiang Hung

**July 14 | 3:15 pm - 3:30 pm | ML Building 2nd Floor**

**Networking & Coffee Break**

**July 14 | 3:30 pm - 4:45 pm**

**Room ML-B**

**Session C2: Human factors & human-system collaboration**

Session chair: Zoubir Laffaj

- ID 54: Evaluation of Construction Site Layout Using Virtual Reality Linked with 3D CAD and Body Tracking  
  Hidetoshi Tsuda and Kosei Ishida
- ID 60: Automated Recognition of Hand Gestures for Crane Rigging using Data Gloves in Virtual Reality  
  Aparna Harichandran and Jochen Teizer
- ID 64: A Knowledge Graph for Automated Construction Workers’ Safety Violation Identification  
  Yifan Zhu and Xiaowei Luo
- ID 78: Highway Workers and Wearable Technologies: Perception and Preferences  
  Sepehr Sabeti, Omidreza Shaghili, Nichole Morris and Hamed Tobkhi
- ID 94: Integrated Sensor-Based Interface for Human-Robot Collaboration in Construction  
  Xiaowei Luo

**Room ML-A**

**Session E1: Construction management techniques**

Session chair: Zoubir Laffaj

- ID 14: YAKE-Guided LDA approach for automatic classification of construction safety reports  
  Hrishikesh Gadekar and Nikhil Bugalia
- ID 48: Construction Progress Monitoring and Reporting using Digital Images and Computer Vision Techniques – A Review  
  Dana Shamsollahi, Osama Moselhi and Khasheyar Kharasani
- ID 75: BIM, Twin and Between: a Conceptual Engineering Approach to Formalize Digital Twins in Construction  
  Fabiano Correa
- ID 98: Inspection Data Exchange and Visualization for Building Maintenance using AR-enabled BIM  
  Rauno Heikkilä, Tanja Kolli and Teppo Rauhala

**Room ML-B**

**Session C2: Human factors & human-system collaboration**

Session chair: Zoubir Laffaj

- ID 54: Evaluation of Construction Site Layout Using Virtual Reality Linked with 3D CAD and Body Tracking  
  Hidetoshi Tsuda and Kosei Ishida
- ID 60: Automated Recognition of Hand Gestures for Crane Rigging using Data Gloves in Virtual Reality  
  Aparna Harichandran and Jochen Teizer
- ID 64: A Knowledge Graph for Automated Construction Workers’ Safety Violation Identification  
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  Sepehr Sabeti, Omidreza Shaghili, Nichole Morris and Hamed Tobkhi
- ID 94: Integrated Sensor-Based Interface for Human-Robot Collaboration in Construction  
  Xiaowei Luo
July 14 | 4:45 pm - 5:00 pm | ML Building 2nd Floor

Networking & Coffee Break

July 14 | 5:00 pm - 6:30 pm | Room ML-B

Technical Keynote & Plenary Talks (KP)

Session chair: Daniel Castro

Keynote:
ID 4: Using BIM and LCA to evaluate material circularity: Contributions to building design improvements

  Haibo Feng, Qian Chen, Borja Garcia de Soto and Mehrdad Arashpour

Plenary talks:
ID 55: Insights into automation of construction process using parallel-kinematic manipulators

  Maike Klöckner, Mathias Haage, Helena Eriksson, Henrik Malm, Klas Nilsson, Anders Robertsson and Ronny Andersson

ID 77: Predictive Maintenance Optimization Framework for Pavement Management

  Amit Kumar and Omidreza Shoghli

ID 65: Weakly supervised pseudo label generation for construction vehicle segmentation

  Wei-Chih Chern, Vijayan Asari, Tam Nguyen and Hongjo Kim

July 14 | 6:30 pm - 7:00 pm | Room ML-B

Sponsor Keynote 2 - Construsoft

July 14 | 7:00 pm - 9:00 pm |

BOD Dinner (by invitation only)

Friday July 15, 2022

July 15 | 8:00 am - 8:30 am | ML Building 2nd Floor

Registration

July 15 | 8:30 am - 9:00 am | Room ML-B

External Keynote 2 - Mani Golparvar Fard

July 15 | 9:00 am - 10:00 am | Room ML-B

Sponsor Keynote 3 - Autodesk + Mcad

July 15 | 9:30 am - 10:00 am | Room ML-B

IAARC Chapters & Innovation Hubs

Session chair: Thomas Linner

July 15 | 10:00 am - 11:15 am

Room ML-B

Session D1: Robotic machines, devices, and end-effectors

Session chair: Chen Feng

ID 13: Requirements analysis of additive manufacturing for concrete printing – A systematic review

  Patricia Peralta Abadia and Kay Smarsly

ID 17: Safety Risk Assessment of Drones on Construction Sites using 4D Simulation

  Zixian Zhu, Idris Jeelani and Masoud Gheisari

ID 35: Progress Estimation of an Excavation Pit

  Axel Vierling, Tobias Groll, Dennis Meckel, Kristina Heim, Daniel Walter, Lukas Scheidhauer, Karsten Körkemeyer and Karsten Berns


Room ML-A

Session F1: Services and business applications / industry & short papers

Session chair: Ming Shan Ng

ID 24: Comparison of 3D Data Acquisition Techniques: Considerations for Low-budget Contractors

  Eyob Mengiste, Samuel A. Prieto and Borja García de Soto

ID 30: Mud Dauber: Prototype of the Mobile Gantry Architecture

  Peter Staritz, Josiah McClurg, Caleb Miller, Moriah Schlenker and Shane Wozniak

ID 47: Model driven method for crack detection in robotic inspection

  Erika Pellegrino and Tania Stathaki

ID 56: A Case Study: Conception of digitalizing prefabrication processes in the construction industry
July 15 | 11:00 am - 11:30 am | ML Building 2nd Floor

Networking & Coffee Break

July 15 | 11:30 am - 12:45 pm

Room ML-B
Session D2: Robotic machines, devices, and end-effectors (D)
Session chair: Wen Pan

ID 44: Reinforcement learning with construction robots: A review of research areas, challenges and opportunities
Xinghui Xu and Borja Garcia de Soto

ID 45: Constrained Control Scheme for the Manipulation of Heavy Pre-fabricated Elements with Lightweight Robotic Arm
Michele Ambrosino, Fabian Boucher, Pierre Mengeot and Emanuele Garone

ID 50: Importance of a 5G Network for Construction Sites: Limitation of WLAN in 3D Sensing Applications
Hyung Joo Lee, Ajith Krishnan, Sigrid Brell-Cokcan, Janina Knüßmann, Maximilian Brochhaus, Robert H. Schmitt, Johannes J. Emontsbotz and Johannes Sieger

ID 70: Path Generation for Foam Additive Manufacturing of Large Parts with a Cable-Driven Parallel Robot
Elodie Paquet, Marceau Metillon, Kevin Subrin, Benoît Furet and Stéphane Caro

ID 76: Automated material selection based on detected construction progress
Tyler Stephens, Austin McClymonds, Robert Leicht and Alan Wagner

July 15 | 12:45 pm - 2:00 pm | Campus Main Cafeteria
Lunch

July 15 | 2:00 pm - 3:15 pm

Room ML-B
Session D3: Robotic machines, devices, and end-effectors
Session chair: Rongbo Hu

ID 83: Solution Kits for automated and robotic façade upgrading
Kepa Iturralde, Thomas Bock, Philip Zimmermann, Renzo G. Bazan Santos, Samant Das, Wenlan Shen, Mahrk Malik, Steven Miao, Agi Hidi and Juncheng Shen

ID 84: Concept of a Robot Assisted On-Site Deconstruction Approach for Reusing Concrete Walls
Hyung Joo Lee, Christoph Heuer and Sigrid Brell-Cokcan

Nihar Gonsalves, Mohamad Khalid, Abiola Akinniyi, Omobolanle Ogunseiju and Abiola Akanmu

ID 92: Industry Perspectives of the Potential of Wearable Robot for Pipe Installation Work

Room ML-A
Session F2: Services and business applications / industry & short papers
Session chair: Cynthia Brosegue

ID 43: Stag hunt game-based approach for cooperative UAVs
Lanh Van Nguyen, Ignacio Torres Herrera, Trung Hoang Le, Duong Manh Phung, Ricardo Patricia Aguilera and Quang Phuc Ha

ID 62: On the Bar Installation Order for the Automated Fabrication of Rebar Cages
Mahdi Momeni, Johan Relefors, Lars Pettersson, Alessandro Vittorio Papadopoulos and Thomas Nolte

ID 73: A Taxonomy for Connected Autonomous Plant
Cormac Browne, Ross Walker, Tim Embleby, Muneer Akhtar, Amer Essa, Anette Pass, Simon Smith and Alex Wright

ID 81: Digital Commissioning Processes for the Oil and Gas Sector
Daniel Luiz de Mattos Nascimento, Alessandra Brancher Roeder, Diego Calvetti, Alexander Chavez Lopez, Fernando Rodrigues Gonzalez and Flavio Araujo

ID 88: Overview of the State-of-Practice of BIM in the AEC Industry in the United States
Hala Nassereddine, Makram Bou Hatoum and Awadh Hanna

ID 95: 5G Wireless Communication for Autonomous Excavation
Rauna Heikkilä, Matti Immonen, Heikki Keränen, Olli Linnamäki, Esa Piri and Tanja Kolli

ID 5: The Use of Drones in the Construction Industry: Applications and Implementation
Makram Bou Hatoum and Hala Nassereddine

ID 8: Intelligent BIM-based spatial conflict simulators: A comparison with commercial 4D tools
Leonardo Messi, Borja Garcia de Soto, Alessandro Carbonari and Berardo Naticchia

ID 9: BIM-assisted, automated processes for commissioning in building services engineering
Ralf Becker, Christoph Blut, Christoph Emunds, Jérôme Frisch, Dirk Heidemann, Tristan Kinnen, Alexander Lenz, Michael Möller, Nicolas Pauen, Tobias Retting, Dominik Schlütter, Matthias Wenthe, Jörg Blankenbach, Günter Bleimann-Gather, Johannes Fütterer, Jörg Jungedeitinger and Christoph van TREECK

ID 10: Blockchain-supported design tool on building element scale
ID 97: Development of Framework for Highway Lawn Condition Monitoring using UAV Images
Nihar Gonsalves, Mohamad Khalid, Abiola Akinniyi and Abiola Akanmu
Goran Sibenik, Marijana Sreckovic, Thomas Preindl, Martin Kjäer and Wolfgang Kastner

ID 26: Digital Transformation in Asset Management – A Case of BIM Adoption in New Zealand Local government
Yeseul Kim, Seongyong Kim, Yosuke Yajima, Javier Irizarry and Yong K. Cho
John Jiang, Theuns Henning and Yang Zou

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