BIM TWIN

Optimal Construction Management
& Production Control

Newsletter

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 958398.

About

BIM2TWIN aims to build a Digital Building Twin (DBT) platform for construction management that implements lean principles to reduce operational waste of all kinds, shortening schedules, reducing costs, enhancing quality and safety and reducing carbon footprint.

For more information, please look at our project website: **www.bim2twin.eu**.

This is the third issue of the BIM2TWIN project newsletter. It provides a summary of the Scientific Papers published recently in the context of the project's results and information on upcoming events and initiatives not solely of BIM2TWIN but also of members of the Tech4EU Construction Cluster of which BIM2TWIN recently became part of.

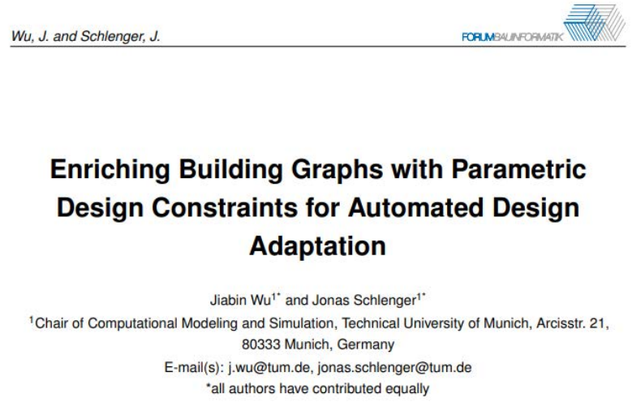
Last scientific publications

Enriching Building Graphs with Parametric Design Constraints for Automated Design Adaptation (2023)

Authors: Jiabin Wu and Jonas Schlenger

University: Technical University of Munich, Germany

Building designing is an iterative process of developing design concepts while fulfilling various requirements. Design parameters, dependencies, and constraints are embedded in the BIMbased design environment to support automated design adaptation techniques. However, only a small part of design constraints is explicitly represented in the digital models as design and engineering knowledge, and most studies focus on constraints on single object levels. To address this issue, this paper presents a workflow for enriching building knowledge graphs with design-oriented constraints. This research aims to extract constraints through embedded design parameters automatically. Data retrieval queries and analyses for model constraints are accomplished based on the extracted RDF graph that represents the intended building topology. Maintaining the users' design intent and obeying the consistency constraints, **the graph-based approach dynamically computes the range of design parameters potentially associated with the requirement constraint fulfillment**. Due to the graph structure, cascading effects of element displacements can be considered on various levels of adjacency.


Wu, J. and Schlenger, J. FORUMBAUINFORMATIK

Enriching Building Graphs with Parametric Design Constraints for Automated Design Adaptation

Jiabin Wu[1*] and Jonas Schlenger[1*]
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E-mail(s): j.wu@tum.de, jonas.schlenger@tum.de
*all authors have contributed equally

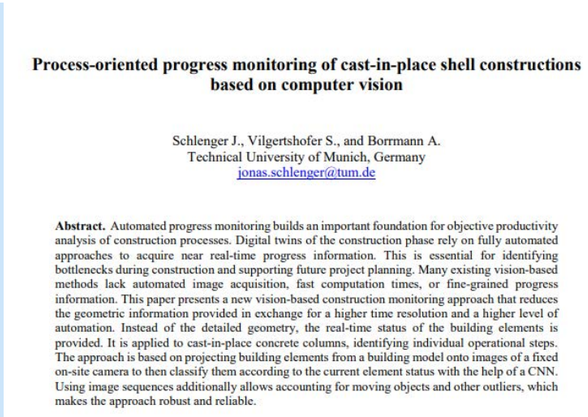
Last scientific publications

Process-oriented progress monitoring of cast-in-place shell constructions based on computer vision (2023)

Authors: Schlenger J., Vilgertshofer S., and Borrmann A.

University: Technical University of Munich, Germany

Automated progress monitoring builds an important foundation for objective productivity analysis of construction processes. Digital twins of the construction phase rely on fully automated approaches to acquire near real-time progress information. This is essential for identifying bottlenecks during construction and supporting future project planning. Many existing vision-based methods lack automated image acquisition, fast computation times, or fine-grained progress information. This paper presents a **new vision-based construction monitoring approach** that reduces the geometric information provided in exchange for a higher time resolution and a higher level of automation. Instead of the detailed geometry, the real-time status of the building elements is provided. It is applied to cast-in-place concrete columns, identifying individual operational steps. The approach is based on **projecting building elements from a building model onto images of a fixed on-site camera to then classify them according to the current element status with the help of a CNN**. Using image sequences additionally allows accounting for moving objects and other outliers, which makes the approach robust and reliable.



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Schlenger J., Vilgertshofer S., and Borrmann A.
Technical University of Munich, Germany
jonas.schlenger@tum.de

Abstract. Automated progress monitoring builds an important foundation for objective productivity analysis of construction processes. Digital twins of the construction phase rely on fully automated approaches to acquire near real-time progress information. This is essential for identifying bottlenecks during construction and supporting future project planning. Many existing vision-based methods lack automated image acquisition, fast computation times, or fine-grained progress information. This paper presents a new vision-based construction monitoring approach that reduces the geometric information provided in exchange for a higher time resolution and a higher level of automation. Instead of the detailed geometry, the real-time status of the building elements is provided. It is applied to cast-in-place concrete columns, identifying individual operational steps. The approach is based on projecting building elements from a building model onto images of a fixed on-site camera to then classify them according to the current element status with the help of a CNN. Using image sequences additionally allows accounting for moving objects and other outliers, which makes the approach robust and reliable.

Ontologies in Digital Twin. Methodology, lessons learned and practical approach (2023)

Authors: Agnieszka Mikołajczyk, Raúl García-Castro, Rahul Tomar, Rehan Khan, Wojciech Teclaw, Bruno Fies, Jonas Schlenger

University: Technical University of Munich, Germany; Centre Scientifique et Technique du Bâtiment, Marne-la-Vallée, France; SINTEF, Trondheim, Norway; DigitalTwin Technology GmbH, Koln, Germany; Universidad Politécnica de Madrid, Madrid, Spain; ASM Research Solution Strategy, Kutno, Poland

This article is a result of j**oint workshop which took place during Sustainable Places 2022** conference in Niece, France, and was coorganized by the **Building Digital Twin Association (BDTA)** and six EU-funded projects that have developed a **construction-phase digital-twin data model**, and their ontological representation, which is capable of capturing all data requirements for the digital representation of building and/or infrastructure construction sites. Four of the EUfunded projects participating in the event contribute to this Open Letter which aims to highlight the relevance of ontology in the digital twin environment, and the approach by the different EU-funded projects. All four LC-008-EEB funded projects contributing to this article (BIMprove, COGITO, ASHVIN and BIM2TWIN), agreed on joining forces for **raising awareness around Digital Building Twins and its impact in the construction industry**. Their primary aim is to share knowledge, experiences and research outcomes with other stakeholders and communities around the EU and beyond, via online communication like webinars, newsletters, social media channels and scientific or technical articles. This initiative aims at delivering the wide range of digital tools for the construction sector needed on the European market and to raise awareness about the benefits coming from their use.

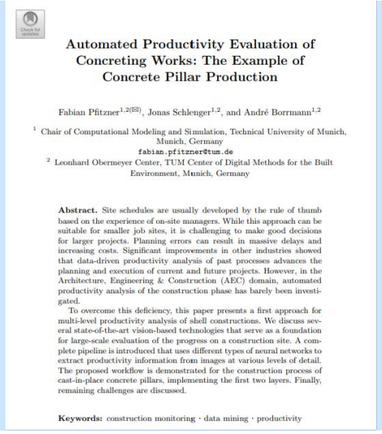
Last scientific publications

Automated Productivity Evaluation of Concreting Works: The Example of Concrete Pillar Production (2024)

Authors: Fabian Pfitzner, Jonas Schlenger and André Borrmann

University: Technical University of Munich, Germany

Site schedules are usually developed by the rule of thumb based on the experience of on-site managers. While this approach can be suitable for smaller job sites, it is challenging to make good decisions for larger projects. Planning errors can result in massive delays and increasing costs. Significant improvements in other industries showed that data-driven productivity analysis of past processes advances the planning and execution of current and future projects. However, in the Architecture, Engineering & Construction (AEC) domain, **automated productivity analysis of the construction phase has barely been investigated**. To overcome this deficiency, this paper presents a **first approach for multi-level productivity analysis of shell constructions**. We discuss several state-of-the-art vision-based technologies that serve as a foundation for large-scale evaluation of the progress on a construction site. A complete pipeline is introduced that uses different types of neural networks to extract productivity information from images at various levels of detail. The proposed workflow is demonstrated for **the construction process of cast-in-place concrete pillars**, implementing the first two layers. Finally, remaining challenges are discussed.



Automated Productivity Evaluation of Concreting Works: The Example of Concrete Pillar Production

Fabian Pfitzner[1,2(✉)], Jonas Schlenger[1,2], and André Borrmann[1,2]

[1] Chair of Computational Modeling and Simulation, Technical University of Munich, Munich, Germany
fabian.pfitzner@tum.de
[2] Leonhard Obermeyer Center, TUM Center of Digital Methods for the Built Environment, Munich, Germany

Abstract. Site schedules are usually developed by the rule of thumb based on the experience of on-site managers. While this approach can be suitable for smaller job sites, it is challenging to make good decisions for larger projects. Planning errors can result in massive delays and increasing costs. Significant improvements in other industries showed that data-driven productivity analysis of past processes advances the planning and execution of current and future projects. However, in the Architecture, Engineering & Construction (AEC) domain, automated productivity analysis of the construction phase has barely been investigated.

To overcome this deficiency, this paper presents a first approach for multi-level productivity analysis of shell constructions. We discuss several state-of-the-art vision-based technologies that serve as a foundation for large-scale evaluation of the progress on a construction site. A complete pipeline is introduced that uses different types of neural networks to extract productivity information from images at various levels of detail. The proposed workflow is demonstrated for the construction process of cast-in-place concrete pillars, implementing the first two layers. Finally, remaining challenges are discussed.

Keywords: construction monitoring · data mining · productivity

Matching design-intent planar, curved, and linear structural instances in point clouds (2024)

Authors: Zhiqi Hu, Ioannis Brilakis

University: Technical University of Department of Engineering, University of Cambridge, UK

The lack of timely progress monitoring and quality control contributes to cost-escalation, lowering of productivity, and broadly poor project performance. This paper **addressed the challenge of high-precision structural instance segmentation** from point clouds by leveraging as-designed IFC models in Scan-vs-BIM contexts. We proposed an **automatic method** to segment the entire points corresponding to the as-designed instance. The workflow contains: 1) Instance descriptor generation; 2) PROSAC-based shape detection; 3) DBSCAN-based cluster optimization. The method matches design-intent planar, curved, and linear structural instances in complex scenarios including: **1) the as-built point cloud is noisy with high occlusions and clutter; 2) deviations between as-built instances and as-designed models in terms of position, orientation, and scale; 3) both Manhattan-World and non-Manhattan-World instances**. The experimental results from five diverse real-world datasets showed excellent performance with mPrecision 0.962, mRecall 0.934, and mIoU 0.914. Benchmarking against state-of-the-art methods showed that the proposed method outperforms all existing ones.

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Matching design-intent planar, curved, and linear structural instances in point clouds

Zhiqi Hu *, Ioannis Brilakis

Department of Engineering, University of Cambridge, Cambridge, UK

ARTICLE INFO

Keywords:
Digital twins
Building information modelling (BIM)
Object detection
Instance segmentation
Scan-vs-BIM
IFC model
Point clouds
Structural objects
Design intent (DI)

ABSTRACT

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News

TECH4EU CONSTRUCTION CLUSTER

BIM2TWIN joined the **Tech4EUconstruction Cluste**r! An initiative created by the Horizon Europe projects BEEYONDERS, HumanTech, and RoBétArmé.

The Cluster is **open to other EU-funded projects such as BIM2TWIN working on AI and Robotics in Construction, and willing to collaborate on different aspects**, such as joint promotional and dissemination activities, mutual exchange of projects' expertise and technical innovations, and co-creation of workshops and events. Funded by the European Commission, the **cluster members aim to develop and demonstrate new technologies to digitalise further and automatise the European construction sector**, targeting to increase its safety and attractivity for workers. Finally, the cluster seeks to stimulate the EU's sovereignty in the industry, decreasing the need for technological imports.

BIM2TWIN WEBINAR SERIES

1st of March - 1st of April 2024
Online

BIM2TWIN Webinar Series is composed of 5 online webinars that will run from the 1st of March until the 1st of April. The series **offers technical and specific insights** into the project's different work packages dealing with the Digital Building Twin platform, its applications and its testing on specific demonstration sites where physical building renovation or construction is happening.

To register to the webinars, visit our website page: **bim2twin.eu/webinar**

Each webinar will last approximately 40 minutes.

PROMOTING CIRCULARITY IN CONSTRUCTION

28th of February 2024, 13:00-14:30 CET
Online

The Horizon Project RECONMATIC organized a clustering event titled "Promoting Circularity in Construction" that will be hosted on the BUILD UP platform on February 28, 2024, from 13:00 to 14:30 CET.

In this clustering event, sustainability experts and key stakeholders in construction, IT, automation, business and communication disciplines will be brought together to provide an overview of the European priorities for the Twin Transition in the sector and identify collaboration opportunities between five research initiatives with similar goals.

Namely, the representatives of the projects Beeyonders, CircularB COST Action, Reincarnate, RobetArme, REDOL and Valrec will join their counterparts in the RECONMATIC project, in a discussion panel that will pave the path to independent collaboration workshops on specific research topics.

This clustering event will contribute to narrowing the gap between the research community and industry stakeholders who are invited to share their hurdles and experiences in implementing circularity along various construction life cycle stages. Given the high potential social impact of the project on European society, this event is open to the general public.

For more info and registration visit the webpage: **RECONMATIC Clustering Event: Promoting Circularity in Constructio**

News

EUROPEAN ROBOTIC FORUM (ERF)

13 -15 Mar 2024, 16:30-17:50
Palacongressi Rimini, Italy

The Horizon Project BEEYONDERS will newly participate in the AI and Robotics in construction workshop that will be held at the European Robotics Forum, this year held in Rimini (Italy) from 13th to 15th of March 2024. The ERF is the main hub for keeping up to date with the leading experts, both industrial and academics, in the field of robotics, and it is specifically designed to encourage interaction between end-users, researchers, technology producers with the ultimate goal of improving industrial competitiveness, fostering scientific progress, stimulating networking between stakeholders in the field, and identifying new impactful application scenarios for robotics.

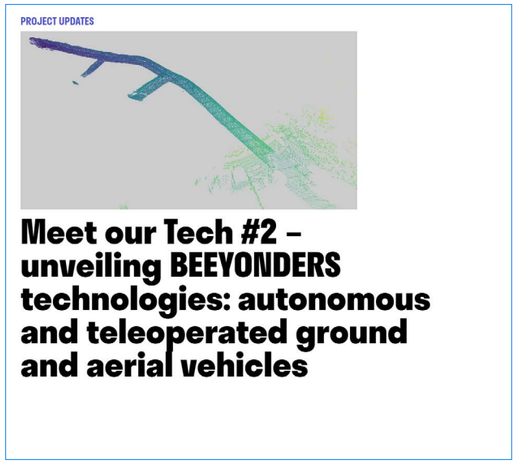
BEEYONDERS, together with its sister projects HUMANTECH and Robetarme, will host a workshop on AI and Robotics in construction. Based on their research and development activities, they will share what they have learned about AI and robotics technologies, which are necessary for introducing automation in construction sites. They will mainly focus on sharing advances in robot vision, navigation, control and human-robot collaboration. In addition, they will share insights from the first user-evaluation developed in HumanTech and hold a panel discussion on challenges and lessons learned within their projects.

To know more about the event visit the webpage: **AI and Robotics in Construction Workshop at the European Robotics Forum (ERF) 2024 - Beeyonders**

MEET OUR TECH

The Horizon Project BEEYONDERS recently published the second episode of its “Meet our Tech” initiative, providing news on one of its technologies, namely Autonomous and Teleoperated Ground and Aerial Vehicles.

For more information look at the webpage: **Meet our Tech #2 - unveiling BEEYONDERS technologies: autonomous and teleoperated ground and aerial vehicles - Beeyonders.**



Keep in touch

Are you interested in knowing more about BIM2TWIN technologies?
Are you a professional in the construction industry interested in collaborating with BIM2TWIN partners?

Contact us to share your feedback and ideas on this page.

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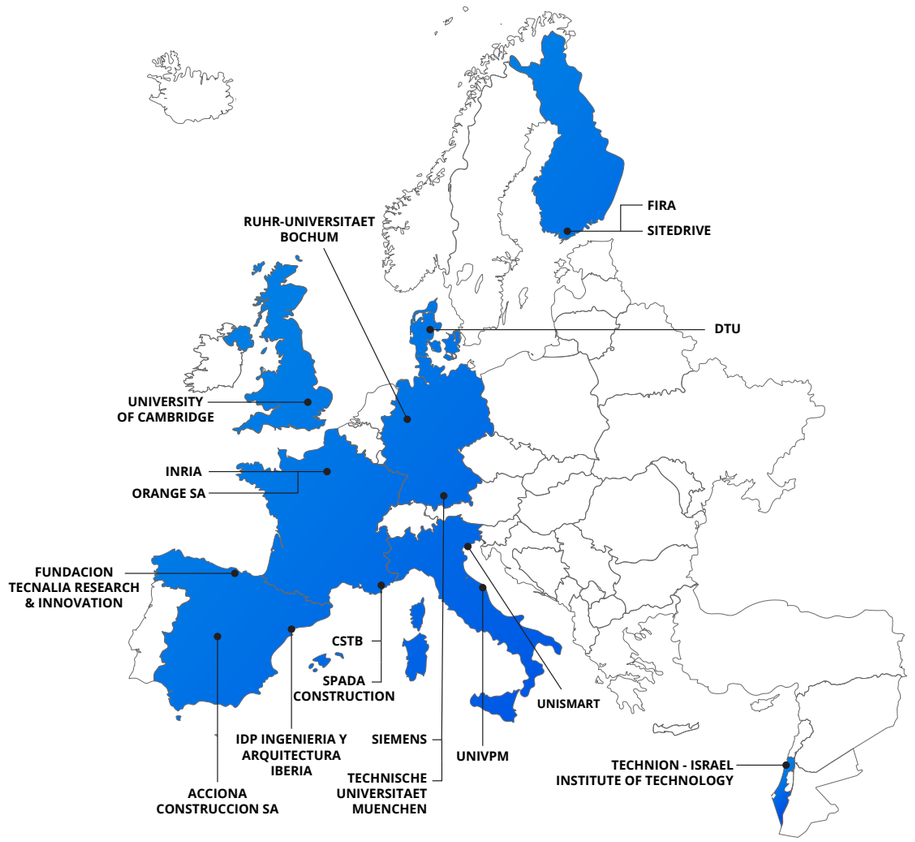

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