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EDITORIAL
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Editorial: Understanding Human-Infrastructure Interactions: Context-Aware Structures and Interfaces

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Editorial on the Research Topic

Understanding Human-Infrastructure Interactions: Context-Aware Structures and Interfaces

It is our great pleasure to publish this research topic, contributing toward a broad and inclusive approach for the understanding of new interactions between humans and the built environment. This collection of journal papers is the result of an interdisciplinary call for papers that brings together a wide range of researchers interested in human-infrastructure interactions and interfaces. In this context, the various authors propose the scientific and engineering community to explore new opportunities enabled by interfaces and relationships. In this research topic, authors relate structures, humans, sensors, and performance with non-traditional paradigms: structures as sensors, humans as forces, or humans as interfaces.

The various disciplines include, but are not limited to: civil engineering, mechanical engineering, electrical and computer engineering, nuclear engineering, architectural engineering, computer science, structural engineering, data science, dance, and industrial engineering. Recognizing the diversity of the areas covered by the seven journal papers, the editors wanted to ensure that their contributions were evaluated and reviewed by experts aware of the proposed frontiers in the built environment and structural sensing. After the selection of topics and papers, the editors believe this research topic contributes with a firm first step toward new frontiers in the built environment and structural sensing with new human-infrastructure interactions and interfaces. The seven papers contributions are listed in the upcoming paragraphs.

Pan et al. introduces a new low-cost high-fidelity vibration sensing system to monitor pedestrians through their footstep-induced ambient structural vibrations in their paper titled "Collaboratively Adaptive Vibration Sensing System for High-fidelity Monitoring of Structural Responses Induced by Pedestrians." In particular, they present a hardware system with low-cost off-the-shelf vibration sensors that adapts hardware configuration (e.g., amplification gains) through a prediction method. This method employs both a heuristic model to adapt hardware based on local signal change and a collaborative model to adapt hardware based on global variance.

Poston et al. presents a framework to count the number of occupants in a building using structural dynamics sensor in their paper titled "A Framework for Occupancy Tracking in a Building via Structural Dynamics Sensing of Footstep Vibrations." Their framework first detects human footstep-generated signals, locate them, and then associate them to individuals to count and update occupancy over time in an online manner.

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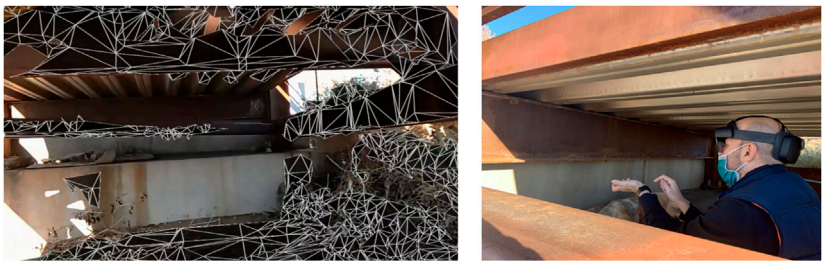

FIGURE 1 | Human-bridge abutment interface (AR capture by F. Moreu, photo by J. Xu).

Mascarenas et al. contribute to an exploration of Augmented Reality as a new tool for nuclear infrastructure applications in their paper "Augmented Reality for Enabling Smart Nuclear Infrastructure." This work summarizes a comprehensive AR solution that can be extrapolated to other types of infrastructure or other complex manufacturing environments. The solutions include cannister manipulation by enhanced glovebox operations using AR, as well as interfaces with sensing databases and localization means and methods that inform users on real-time, such as their interfacing bar code scanners to an augmented reality headset for agile auditing. It overlays the potential of AR as a new interface between humans and their environment that can enhance safety for humans.

Napolitano et al. propose access to Structural Health Monitoring (SHM) data in a new interface between data and humans in their paper "Combination of Image-Based Documentation and Augmented Reality for Structural Health Monitoring and Building Pathology." Specifically, they solve the challenge of accessing data by a new interface where humans can overlay datasets that are intuitive and applicable both on site and off site in the context of SHM.

Drira et al. introduces a physics-based data interpretation for tracking occupants using their footstep-induced floor vibrations in their paper titled "Model-Based Occupant Tracking Using Slab-Vibration Measurements." In particular, they present error-domain model falsification (EDMF) to track an occupant within an office environment. This approach enables deployment of sparse number of sensors in contexts of non-uniform complex structural configurations.

The paper "Monitoring Human Induced Floor Vibrations for Quantifying Dance Moves: A Study of Human–Structure Interaction" by Moreu et al. explains the use of sensors as a means to quantify the quality of human dances/moves. The evaluation of sensor data is used to sort and characterize human dance quality. By using low-cost sensors on a bridge, researchers demonstrated that the coordination of dancers can be measured and used as an objective ranking of different dances. The dancers were actively engaged in the fabrication and analysis of the data, emphasizing the participation of artists in the data collection and processing.

Xu and Moreu provided a general summary of AR advances in the civil engineering industry, where the significance of new research is outlined across the domains of construction (monitoring construction progress or assisting workers), Building information models (BIM), SHM and damage detection, underground facilities, and smart cities. In their work they identified current progress and technological ongoing efforts that will advance civil engineering interfaces in the near future. **Figure 1** shows the new frontier of human-infrastructure interfaces enabled by AR advances in the civil engineering industry.

The proposed collection contributes to advance the Frontiers in Built Environment and the area of Structural Sensing as a new opportunity for scholar knowledge and industrial transformation. The editors recommend readers to contact the various authors to learn more about the proposed discussed topics. We wanted to express our deep gratitude to the authors of the research and the reviewers for their time and efforts to ensure the seven journal papers are of high quality for Frontiers. We hope this research topic is explored further by the readers and yield to new collaborations, contributions, and frontiers in the future.

Thank you for your time and interest and enjoy the Research Topic.

Fernando Moreu, Hae Young Noh, Pei Zhang and David Mascarenas.

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AUTHOR CONTRIBUTIONS

FM, HN, PZ and DM contributed to this editorial equally by writing about the research topic, its contribution to the state of the art, and the review process for the papers submitted to the research topic.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.