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SIMULATION AND OPTIMIZATION FOR DIGITAL FABRICATION OF SUSTAINABLE CONCRETE STRUCTURES

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ABSTRACT

Reducing the environmental impact of concrete construction requires advances in both material composition and structural design. Digital fabrication in general, and three-dimensional concrete printing (3DCP) in particular, offer opportunities to realize material-saving geometries while reducing reliance on bespoke formworks. Achieving sustainable construction, however, depends on integrating material selection and structural performance with the constraints of fabrication and assembly.

This Invited Session will explore how simulation and optimization can support this integration, from printable cementitious materials and deposition processes to complete structural systems. Attention will be given to linking the evolving properties and stability of concrete during printing with the performance of the completed structure, and to incorporating printability and buildability constraints into design. Contributions addressing low-carbon and recycled materials, as well as approaches toward carbon-negative construction, are welcome.

The session aims to bring together researchers in computational mechanics, structural optimization, materials engineering and digital fabrication. Through numerical methods, experiments and applications, it will examine how validated models can guide design and process decisions and help translate optimized geometries into feasible, resource-efficient concrete structures.

Possible topics may include, but are not limited to, the following themes:

- IGA and FEA simulation for 3DCP;
- Material design for printable cementitious composites;
- Structural optimization of concrete structures incorporating fabrication constraints;
- Experimental validation of process and structural models;
- Printability, buildability and stability during fabrication;
- Form finding and assembly of segmented printed structures;
- Monitoring and controlling digital fabrication processes and 3D printing;
- Low-carbon and carbon-negative construction approaches.