Numerical simulation of a 3D concrete printing process under polymorphic uncertainty

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Abstract

Proper models of uncertainty are required for realistic analyses. While stochastic approaches usually depend on a large experimental data basis, interval or fuzzy uncertainty models can be used to take a lack of knowledge or a very limit data basis into account. A combination of such basic uncertainty models yields a polymorphic uncertainty approach, for example a fuzzy probability-based random variable describing a material parameter; see Beer et al. (2013).

Temporal varying material and process parameters are usually described by random processes (RP), which are characterized by an auto-correlation structure. Material parameter interdependencies can be taken into account using cross-correlated random processes; see Vořechovský (2008). In this contribution the only vaguely known auto- and cross-correlation parameters are described by intervals leading to an interval probability-based RP description of material parameters.

During the past few years, additive manufacturing techniques for concrete have gained extensive attention, especially extrusion-based 3D concrete printing (3DCP). Most of the research is based on experimental studies or even trial-and-error tests. Numerical 3DCP models can advance the understanding of the influencing factors on the printed structure. Using an efficient pseudo-density algorithm on a pre-defined mesh, an extrusion based 3DCP can be simulated to study the variation of different material (Wolfs, R.J.M., 2018) and process parameters.

References

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