

Surrogate modeling for mechanized tunneling simulations with uncertain data

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Abstract

Computational reliability assessment in mechanized tunneling requires sufficiently realistic numerical models accounting for the uncertainty of geotechnical and process parameters. For real-time prognoses, surrogate models are in general inevitable to substitute expensive complex numerical simulations. In this paper, different strategies for surrogate modeling in mechanized tunneling simulations are presented. The focus is on surrogate models for reliability analyses with polymorphic uncertain data described by e.g. stochastic numbers, p-boxes, fuzzy stochastic numbers, fuzzy numbers as well as intervals resulting in imprecise probabilities. Beside surrogate models based on Proper Orthogonal Decomposition Method (POD) and Artificial Neural Networks (ANN), a hybrid surrogate model, i.e. a combination of POD and ANN, is presented. Thereby, uncertain time varying surface settlements of several monitoring points are predicted by recurrent neural networks. Based on that, spatially varying surface settlements are evaluated using POD. Utilizing this surrogate model helps to reduce the computation time, when limit states at multiple surface positions are required.

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