Master's thesis proposal

Probabilistic Digital Twins: An Example for Geotechnical Construction

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Background

In recent years the Digital Twin (DT) approach showed potential for addressing current challenges confronting the Architecture, Engineering, Construction, Operations, and Management (AECOM) industries. Challenges in this field include the surge in the flow of project-related information, reduced productivity, unpredictability in terms of costs and schedules, and complexity attributed to structural fragmentation. Traditional DT approaches typically assume complete knowledge of the physical entity and its behavior. This assumption introduces significant limitations, as uncertainties prevalent in real-world scenarios cannot be represented. These uncertainties are especially large in geotechnical engineering, which is characterized by the inherent variability of soils and sparse data. The data is usually incomplete, of low quality and originates from multiple sources.

The probabilistic digital twin (PDT) framework emerged as a natural extension of traditional DT models and offers a robust mechanism for the AECOM industries to navigate the complexities of project-specific uncertainties.

Objectives & Methodology

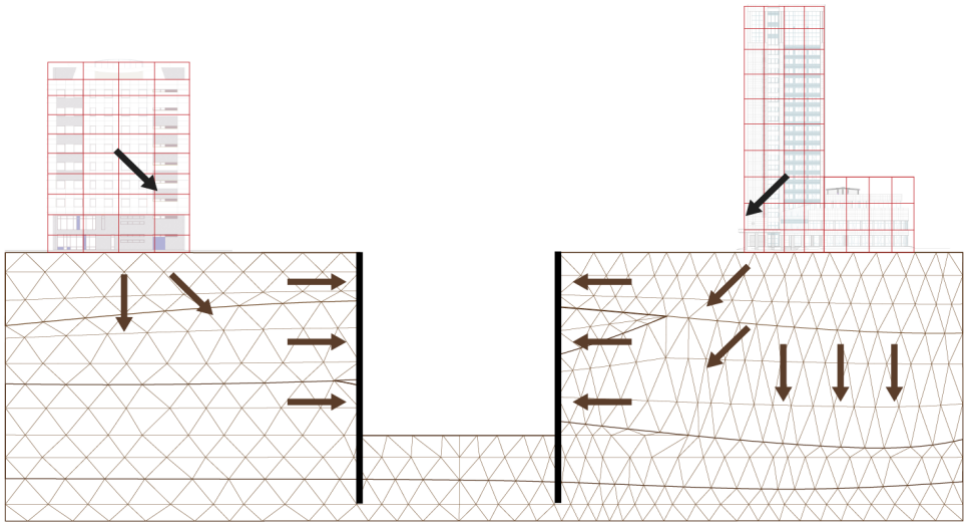

Figure 1. Sketch of excavation pit in urban environment

The scope of this master's thesis is to study the capability of the PDT with an example application from geotechnical engineering. Specifically, the design of an excavation pit in an urban environment with adjacent buildings is considered (see Figure 1).

For this goal the following steps are planned: First, a familiarization step with the (PDT) framework is required. Afterwards, a python code

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is provided to create a probabilistic stratification model from borehole or CPT soundings. Next, potential approaches of incorporating the probabilistic stratification in a reliability-based design and assessment using the SOFiSTiK software is studied. Depending on the project progress, in the end the aspect of model updating for measured settlements can be considered.

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Knowledge Requirements

- basic probability theory knowledge
- basic background in geotechnical engineering
- basic command of python
- first experience with FEA analysis in SOFiSTiK or similar software

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If you are interested in this project, don't hesitate to email Dafydd with your transcript of records and possible starting date.