Prediction of unsupported excavations behaviour with machine learning techniques

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ABSTRACT

Artificial intelligence and machine learning algorithms have known an increasing interest from the research community, triggering new applications and services in many domains. In geotechnical engineering, for instance, neural networks have been used to benefit from information gained at a given site in order to extract relevant constitutive soil information from field measurements [1].

In this paper, we evaluate predictive supervised machine learning systems in the context of simple unsupported excavations in a dry homogeneous soil, considering the following three steps:

- Creation of an artificial database of several thousands of simplified 2D cases with an existing finite element software (ZSWalls [2], part of the ZSOIL software suite), with varying input parameters (excavation depth, wall length and stiffness, soil strength and stiffness) and related output variables (wall stability, maximal deflection and bending moment, and maximal soils settlement behind the wall).

- Training of machine learning algorithms based on neural networks and deep learning in order to find a set of plausible output variables for any given set of input parameters.

- Evaluation of the system performance in terms of prediction quality by comparing the set of output variables with a finite element analysis of the same case.

The resulting model can predict accurately if an unsupported excavation is stable. Settlements, wall deflections and maximum bending moments can also be predicted with small relative errors (less than 5%).

Conclusions are drawn and open the door to the creation of a tool capable of predicting the behaviour of an excavation support (slurry or sheet-pile wall, with anchors or struts) without calculating it with conventional engineering software (finite element method), but rather using existing data (knowledge) from existing cases, and find the optimal design (in terms of costs or construction duration) for a given set of data (stratigraphy, groundwater table, excavation's depth).

REFERENCES

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