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EPR-based material modelling of soils

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In the past few decades, as a result of the rapid developments in computational software and hardware, alternative computer aided pattern recognition approaches have been introduced to modelling many engineering problems, including constitutive modelling of materials. The main idea behind pattern recognition systems is that they learn adaptively from experience and extract various discriminants, each appropriate for its purpose. In this work an approach is presented for developing material models for soils based on evolutionary polynomial regression (EPR). EPR is a recently developed hybrid data mining technique that searches for structured mathematical equations (representing the behaviour of a system) using genetic algorithm and the least squares method. Stress–strain data from triaxial tests are used to train and develop EPR-based material models for soil. The developed models are compared with some of the well-known conventional material models and it is shown that EPR-based models can provide a better prediction for the behaviour of soils. The main benefits of using EPR-based material models are that it provides a unified approach to constitutive modelling of all materials (i.e. all aspects of material behaviour can be implemented within a unified environment of an EPR model); it does not require any arbitrary choice of constitutive (mathematical) models. In EPR-based material models there are no material parameters to be identified. As the model is trained directly from experimental data therefore, EPR-based material models are the shortest route from experimental research (data) to numerical modelling. Another advantage of EPR-based constitutive model is that as more experimental data become available, the quality of the EPR prediction can be improved by learning from the additional data, and therefore, the EPR model can become more effective and robust. The developed EPR-based material models can be incorporated in finite element (FE) analysis.