A Particle Swarm Optimization Approach for Training Artificial Neural Networks with Uncertain Data

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Abstract

Artificial neural networks are powerful tools to learn functional relationships between data. They are widely used in engineering applications. An overview of neural network approaches in structural analysis considering imprecision and variability is published in Graf et al. (2011). In Graf et al. (2010), recurrent neural networks for fuzzy data have been introduced to map uncertain structural processes with deterministic network parameters. Extensions for trainable fuzzy network parameters are presented in Freitag et al. (2011). In these previous works, modified backpropagation algorithms are used for network training. Here, a new training strategy based on swarm intelligence is developed. Using particle swarm optimization (PSO), special network structures with dependent parameters can be created. Additionally, all parameters of recurrent neural networks can be modified during the learning process. Accounting for uncertainty in measurements, a PSO approach using interval and fuzzy numbers is presented. Applications are focused on the description of time-dependent material behavior with recurrent neural networks for uncertain data within the interval and fuzzy finite element method, see e.g. Muhanna et al. (2007).

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