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Self-Adversarial Training for enhanced robustness of neural network based inelastic constitutive descriptions

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This contribution presents a novel iterative training algorithm for recurrent neural networks (RNN) used as constitutive descriptions [1] to increase their robustness when feedback of their own prior output subjects them to perturbations in subsequent inputs. We propose to extend the unperturbed training dataset by generating adversarial examples on the basis of the neural network's current prediction errors. This method introduces new hyperparameters to the training, like the iteration length before reevaluating the errors and the fraction of adversarial examples contained in the dataset.

For this contribution, two datasets are obtained by Numerical Material Tests (NMT) [2] on Representative Volume Elements (RVE) considering two different sets of materials with elasto-plastic behavior. A set of hyperparameters for the Self-Adversarial Training, that results in high prediction robustness, is identified. The capabilities of the application of a neural network based constitutive description are evaluated for a numerical simulation on structural level.

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