Wind turbine site-specific load estimation using artificial neural networks calibrated by means of high-fidelity load simulations

Previous studies have suggested the use of reduced-order models calibrated by means of high-fidelity load simulations as means for computationally inexpensive wind turbine load assessments; the so far best performing surrogate modelling approach in terms of balance between accuracy and computational cost has been the polynomial chaos expansion (PCE). Regarding the growing interest in advanced machine learning applications, the potential of using Artificial Neural-Network (ANN) based surrogate models for improved simplified load assessment is investigated in this study. Different ANN model architectures have been evaluated and compared to other types of surrogate models (PCE and quadratic response surface). The results show that a feedforward neural network with two hidden layers and 11 neurons per layer, trained with the Levenberg Marquardt backpropagation algorithm is able to estimate blade root flapwise damage-equivalent loads (DEL) more accurately and faster than a PCE trained on the same data set. Further research will focus on further model improvements by applying different training techniques, as well as expanding the work with more load components.