Condition Monitoring of Wind Farms using Neural Network

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Abstract

Utilising additional variables, which are normally not measured by typical wind turbines, could bring significant improvements to condition monitoring and control of a wind turbine and farm. However, incorporating additional sensors to measure the variables could increase the cost significantly. As a solution, instead of equipping every turbine in the wind farm with an expensive sensor, which measures the variable that would improve condition monitoring or control of a wind turbine and farm, it is proposed that only one turbine be equipped with a sensor and the neighbouring turbines be equipped with an estimator that essentially replaces the sensor. Each estimator would then estimate what the sensor would measure. Each estimator is constructed using Neural Network (NN), and as a result, the cost could be significantly reduced. Note that the only turbine equipped with a sensor is used to train the NN. This work presents the results of a preliminary study to examine the feasibility of the proposed approach.

In order to train a NN, the weights need to be trained such that the error between the desired output and the actual output is minimised. This process requires that the NN compute the Error derivative of the Weights (EW); that is, it needs to calculate how the error changes as each weight is increased or decreased slightly. The back-propagation algorithm is the most common method for calculating the EW and is used for this study. The algorithm is implemented using the Neural Networks Toolbox Matlab/Simulink.

For simulations and data required to train the NN-based estimator, the Matlab/Simulink model of the Supergen (Sustainable Power Generation and Supply) Wind 5MW exemplar wind turbine, which has been employed by a number of researchers at various institutions and Universities over the last decade is used [1].

[1] Hur, S. Modelling and control of a wind turbine and farm, Energy 156 (2018) 360-370.

Keywords: *Wind farm, neural network, condition monitoring, estimation, maintenance*

Biography

SUNG-HO HUR received the B.Eng. degree in Electronics and Electrical Engineering (EEE) from the University of Glasgow, UK in 2004 and the Ph.D. degree in EEE from University of Strathclyde, UK in 2010 (from 2006 to 2010), respectively. He is an Assistant Professor within the School of Electronics Engineering at Kyungpook National University, South Korea. His research interests include control, condition monitoring and modelling, with particular interest in wind turbines and farms.