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# Multi-step wind variability prediction based on deep learning neural network

**Sayahnya Roy**
Laboratoire Océanologie et Géosciences, CNRS UMR8187, Univ. Littoral Cote d'Opale, Univ. Lille, IRD, Wimereux, France (sayahnya1110@gmail.com)

Wind energy is widely used in renewable energy systems but the randomness and the intermittence of the wind make its accurate prediction difficult. This study develops an advanced and reliable model for multi-step wind variability prediction using long short-term memory (LSTM) network based on deep learning neural network (DLNN). A 20 Hz Ultrasonic anemometer was positioned in northern France (LOG site) to measure the random wind variability for the duration of thirty-four days. Real-time turbulence kinetic energy is computed from the measured wind velocity components, and multi-resolution features of wind velocity and turbulent kinetic energy are used as input for the prediction model. These multi-resolution features of wind variability are extracted using one-dimensional discrete wavelet transformation. The proposed DLNN is framed to implement multi-step prediction ranging from 10 min to 48 h. For velocity prediction, the root mean square error, mean absolute error and mean absolute percentage error are 0.047 m/s, 0.19 m/s, and 11.3% respectively. These error values indicate a good reliability of the proposed DLNN for predicting wind variability. We found that the present model performs well for mid-long-term (6-24h) wind velocity prediction. The model is also good for the long-term (24-48h) turbulence kinetic energy prediction.