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Real-time Vibration Sensing in Renewable Energy Wind Turbine Blades Using a Polarization Based Optical Fibre Device

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Energy is essential for achieving sustainable growth among developing countries within Africa. Wind is regarded as one of the most promising types of renewable energy source capable of lowering the effects of greenhouse gases. Vibration monitoring and analysis is essential in the design of wind turbines due to the partially elastic structural property of the blades and because they are required to function in harsh and unsteady environments. This work presents a novel technique for accurately measuring vibrational frequencies as well as monitoring the plane of vibrations in renewable energy wind turbine blades, based on a polarimetric optical fibre sensor. The proposed technique further involves an offline, fast Fourier transform (FFT) digital signal processing (DSP) analysis. We successfully show operation for vibrations from 57-117 Hz. A fibre sensing system capable of measuring vibrational frequencies in one plane was first demonstrated. Frequencies of 56.7 Hz, 84.8 Hz and 90.3 Hz were accurately measured within 99.2 % of the actual value. Thereafter, simultaneous sensing in two orthogonal planes at 99.4 Hz and 116.5 Hz was experimentally achieved.

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