Novel Photonic Vibration Sensor for In-situ Data Acquisition

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Abstract

Micatu, Inc. introduces a novel, Photonic Vibration Sensor (PHOVIS) for high performance, *in-situ* data acquisition. PHOVIS has applications, including in use as a Condition Monitoring System (CMS), for real time predictive failure analysis.

PHOVIS provides a direct optical interferometric signal measurement of vibrational displacement and frequency, in contrast to conventionally available vibration sensors. Measurement of vibrational displacement amplitudes at high resolution (sub-micron) is possible in both time series and FFT frequency data (< to 10 kHz) necessary for precise characterization of CMS signatures for wind turbines and industrial machinery. In addition, with PHOVIS there is no noise due to mechanical transfer function, thereby providing for a wide dynamic range (0.01g to 10g) and unprecedented sensitivity and accuracy, while it is also capable of measuring transients.

PHOVIS features the novel use of monolithic, solid optical components, providing a simple package and detection method in which there are no electronic components or electrical power in the sensor head making the photonic vibration sensor impervious to Radio-Frequency (RF) and Electromagnetic Interference (EMI).

Tests of PHOVIS were conducted at the National Renewable Energy Laboratory (NREL) as part of the Gearbox Reliability Collaborative (GRC) project analyzing generator disengagements to simulate grid disconnections. For these experiments, dynamometer speed decreased linearly while the drivetrain torque oscillated as it was being damped. PHOVIS installed on the gearbox monitored these events, providing real-time amplitude and spectra data, with precise (+/-1%) characterization of all transients and harmonics of the frequency signature within the sensor bandwidth.