World Academy of Science, Engineering and Technology
International Journal of Electrical and Computer Engineering
Vol:12, No:11, 2018

Distributed Optical Fiber Vibration Sensing Using Phase Generated Carrier Demodulation Algorithm

Authors : Zhihua Yu, Qi Zhang, Mingyu Zhang, Haolong Dai

Abstract : Distributed fiber-optic vibration sensors are gaining extensive attention, for the advantages of high sensitivity, accurate location, light weight, large-scale monitoring, good concealment, and etc. In this paper, a novel optical fiber distributed vibration sensing system is proposed, which is based on self-interference of Rayleigh backscattering with phase generated carrier (PGC) demodulation algorithm. Pulsed lights are sent into the sensing fiber and the Rayleigh backscattering light from a certain position along the sensing fiber would interfere through an unbalanced Michelson Interferometry (MI) to generate the interference light. An improved PGC demodulation algorithm is carried out to recover the phase information of the interference signal, which carries the sensing information. Three vibration events were applied simultaneously to different positions over 2000m sensing fiber and demodulated correctly. Experiments show that the spatial resolution of is 10 m, and the noise level of the Φ-OTDR system is about 10-3 rad/√Hz, and the signal to noise ratio (SNR) is about 30.34dB. This vibration measurement scheme can be applied at surface, seabed or downhole for vibration measurements or distributed acoustic sensing (DAS).

Keywords : fiber optics sensors, Michelson interferometry, MI, phase-sensitive optical time domain reflectometry, Φ-OTDR, phase generated carrier, PGC
Conference Title : ICOFS 2018 : International Conference on Optical Fibre Sensors
Conference Location : Dubai, United Arab Emirates
Conference Dates : November 19-20, 2018