Geophysical Research Abstracts
Vol. 21, EGU2019-5130, 2019
EGU General Assembly 2019

A portable fiber optic gyroscope based on giant single mode fiber coil for seismology rotation sensing

Yulin Li, Yuwen Cao, Dong He, Yangjun Wu, Fangyuan Chen, Chao Peng, and Zhengbin Li

State Key Laboratory of Advanced Optical Communication Systems and Networks, School of Electronics Engineering and Computer Science, Peking University, Beijing, China (liyulin@pku.edu.cn)

In this contribution, we presented a giant interferometric fiber optic gyroscope (IFOG) for rotational seismic motion monitoring, in which a 30-km long single mode fiber coil with an average diameter of 38.5 cm is utilized, providing an enclosed area of 2888 m^2. The single mode fiber was chosen for its low optical attenuation to suppress the shot noise, as well as high cost efficiency. The thermal phase noise, introduced by the fluctuation of the refractive index of the fiber due to the atomics' thermal motion, increases with the fiber length and plays as the most dominant noise in giant IFOGs. The high order eigen frequency modulation is demonstrated to suppress the thermal phase noise, which results in an angular random walk of $1.2 \times 10^{-5}\,^{\circ}/\sqrt{\mathrm{h}}$ and a bias instability of $4.2 \times 10^{-5}\,^{\circ}/\mathrm{h}$ that exceeds the performance of conventional depolarized IFOGs. Even so, the residual thermal phase noise still exists and contributes to the high-frequency noise in giant IFOGs limiting the detection bandwidth. The self noise is detected as 3.5 $\mathrm{nrad}/\mathrm{s}/\sqrt{\mathrm{Hz}}$ at low frequencies and 5.2 $\mathrm{nrad}/\mathrm{s}/\sqrt{\mathrm{Hz}}$ at 100 Hz in the 30 km giant IFOG. With the high sensitivity and the diameter less than half a meter, this giant IFOG is suitable for seismology rotation sensing both in station and field scenario. This attempt achieves a higher sensitivity in the wide concerned detection bandwidth, showing the ability and potential of giant IFOGs to detect weak seismic rotation signals. The analysis and suppression of thermal phase noise would also help to the design and realization of giant IFOGs for seismology rotation sensing.