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High sensitivity dual-polarization fiber optic gyroscope for seismology rotation sensing

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In recent years, interferometric fiber optic gyroscopes (IFOGs) have received increasing attention in the field of seismologic rotation research because of its high sensitivity and portability. One of the most effective ways to increase the signal-to-noise ratio (SNR) of the interference signal is to increase the sensitive area of the fiber coil in the IFOG. However, the diameter of the fiber coil is limited by the practical application, and the effective fiber length is limited by the fiber attenuation due to the shot-noise. The dual-polarization IFOG scheme is also an effective way to increase the SNR of the interference signal, which differs from the conventional "minimum configuration" of operating with only one polarization of the fiber, but operates simultaneously with two orthogonal polarizations and compensates the common mode noise. On the other hand, the effect of cross-coupling between the two polarizations is significantly exposed in the dual-polarization IFOG, which destroys the otherwise perfect interference contrast and prevents conventional square-wave modulation method from working properly in an open-loop configuration. Therefore, a square-wave modulation method specifically for the dual-polarization IFOG with a high SNR while suppressing polarization cross-coupling noise is proposed. Experiments have shown that in a dual-polarization IFOG with a polarization maintaining fiber coil of length 10 km and a diameter of 374 mm, a detection sensitivity of 10 $\mathrm{nrad/s/\sqrt{Hz}}$ is obtained with the proposed modulation method, which is applicable for seismology rotation sensing.