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Dual-polarization fiber optic gyroscope with improved sensitivity for seismologic rotation sensing

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In the dual-polarization interferometric fiber optic gyroscope (IFOG) scheme, a relative intensity noise (RIN) reduction method with excellent sensitivity is proposed for seismologic rotation sensing. The main characteristics concerned about IFOG utilized for seismologic rotation sensing is portability, detection sensitivity and environmental adaptability. While good portability is the advantage of IFOG over ring laser gyroscope (RLG) and well environmental adaptability is more an engineering task, detection sensitivity is most crucial in improving the performance of IFOG itself. With conventional 'minimal scheme' IFOG, RIN is one of the main factors limiting the detection sensitivity, where with a 2 km polarization maintaining (PM) fiber optic sensing coil, the sensitivity is around 2.4×10^{-7} $\mathrm{rads}^{-1}\mathrm{Hz}^{-1/2}$ (achieved with our equipment). A new dual-polarization IFOG scheme, with two polarizations working in the PM fiber coil, can almost perfectly reduce RIN without a redundant long fiber delay coil. The outputs of two polarizations work independently as two IFOGs and contain similar RIN with opposite signs, therefore, a compensated output with removal of RIN can reach a detection sensitivity of 7.5×10^{-8} $\mathrm{rads}^{-1}\mathrm{Hz}^{-1/2}$. One of the two major advantages of the dual-polarization IFOG scheme is the saving of a redundant delay coil, and RIN reduction is achieved within one sensing coil in dual-polarization IFOG scheme. The other one is better detection sensitivity is obtained by changing the optical structure scheme with the same fiber coil. With larger fiber coil configurations and comprehensive signal processing efforts, the potential to achieve ultra-sensitivity with dual-polarization IFOG scheme is expected, and better sensitivity for seismologic rotation sensing can be achieved.