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Residual intensity modulation in resonator fiber optic gyro with sinusoidal wave phase modulation

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Key words: Resonator fiber optic gyro, Phase modulation, Residual intensity modulation

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Motivation

- When the phase modulator is driven by a voltage phase modulation signal, the residual intensity modulation (RIM) effect will be induced, which affects the performance of the resonator fiber optic gyro (R-FOG).
- We analyze in detail how the RIM effect affects an R-FOG with the sinusoidal wave phase modulation technique.

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Features of our method

- Using the Bessel function and the method of optic field overlapping, the expression for the demodulation curve under the RIM effect is obtained.
- The demodulation characteristics with different RIM coefficients and modulation frequencies are discussed.
- The zero deviation induced by the RIM effect is analyzed.
- The expression for the RIM-induced error is presented by studying the zero deviation for two counter propagating beams.
- How the RIM-induced error varies with the RIM coefficient and modulation frequency is discussed.

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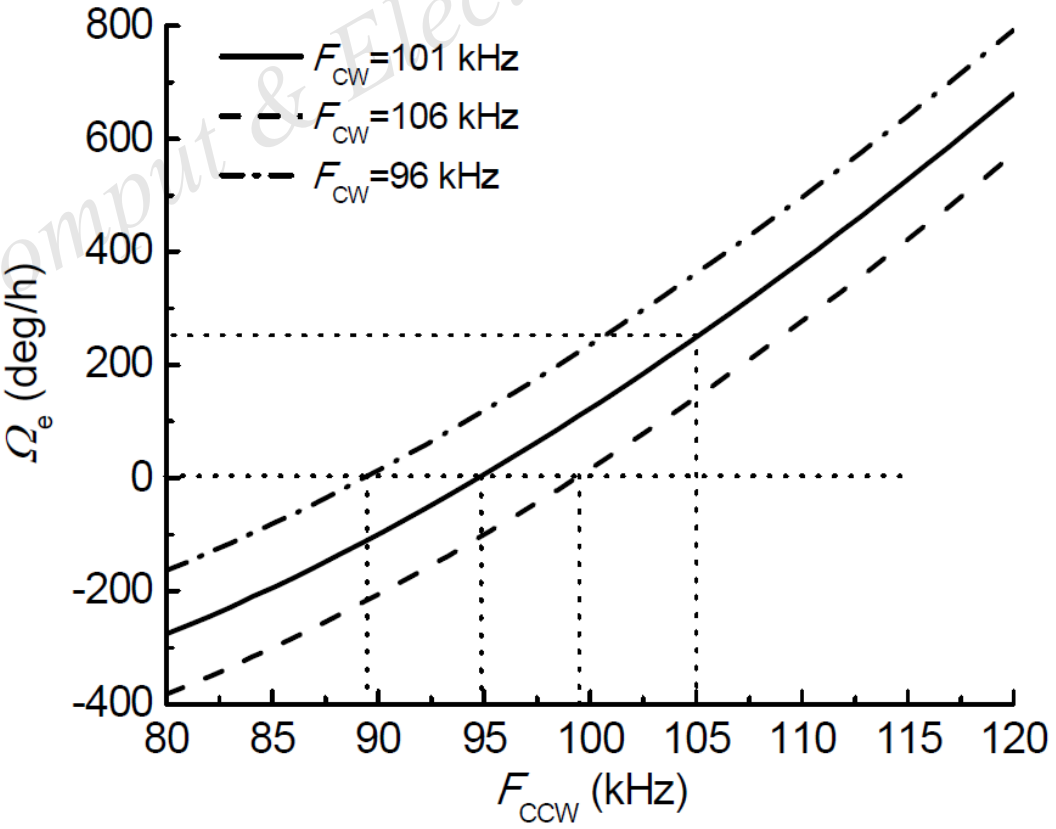
Major results

We calculated the gyro system error due to the RIM effect as a function of the modulation frequencies F_{CCW} and F_{CW}. There exist optimum values for the modulation frequencies that lead to a zero RIM-induced error. However, in practical situations, the chosen modulation frequency is generally different from its optimum value to suppress the RIM error. Taking F_{CW}=101 kHz as an example, when F_{CCW} deviates from its optimum value by about 10.2 kHz, the error would be about 253.4 deg/h, which should be counted for a medium accuracy R-FOG.



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Conclusions

- A zero deviation is induced by the RIM effect on the demodulation curve, and this zero deviation varies with the RIM coefficient and modulation frequency.
- The RIM-induced error varies with the RIM coefficient and modulation frequency.
- There exist optimum values for the RIM coefficient and modulation frequency to totally eliminate the RIM-induced error, and a large system error is induced even if there exists a very small deviation of these two critical parameters from their optimum values.
- The RIM-induced error should be considered when designing and evaluating an R-FOG system.

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