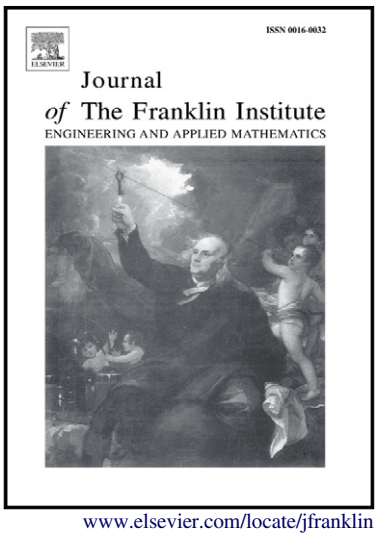

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Abstract
Gyro simulation is an important process of inertial navigation theory research, with the major difficulty being the stochastic error modeling. One commonly used stochastic model for a fiber optic gyro (FOG), is a Gaussian white (GW) noise plus a first order Markov process. The model parameters are usually obtained by using time series analysis methods or Allan variance method through FOG static experiment. However, in a real life situation, a FOG may not be used. In this paper, a simulation method is proposed for estimating the stochastic errors of FOG. When using this method, the model parameters are set based on performance indicators, which are chosen as the angle random walk (ARW) and bias stability. During the research, the ARW and bias stability indicators of the GW noise and the first order Markov process are analyzed separately. Their analytical expressions are derived to reveal the relation between the model parameters and performance indicators. In order to verify the theory, a large number of simulations were carried out. The results show that the statistical performance indicators of the simulated signals are consistent with the theory. Furthermore, a simulation of a VG951 FOG is designed in this research. The Allan variance curve of the simulated signal is in agreement with the real one.

Keywords
Fiber Optic Gyro, Stochastic Model, Performance Indicator, Parameter Identification, Gyro Simulation

I. Introduction

FOG is a kind of optical gyros and its principle is based on the Sagnac effect [1]. It can provide accurate angular velocity information partially because of its insensitivity to vibration, shock and acceleration. FOGs are widely used in inertial navigation systems (INSs), which are applied in many fields such as aviation, spaceflight and navigation [2].

When verifying a new INS theory or program, numerical simulation is always the initial step [3]. An INS is a dead-reckoning system, as a result, the position, the velocity and the attitude errors produced by gyros' errors spread over time [4]. Therefore, the simulation quality of a FOG based INS mainly depends on the fidelity of FOG simulation. A FOG signal includes the nominal value and errors. In the INS simulation process, the nominal value of the FOG signal can be derived from the vehicle trajectory, which is easy to get. The simulation of FOG's errors needs error modeling and parameters identification [5], which is relatively difficult. So the simulation of FOG errors is the key process.