Idiosyncratic algorithm for IMU drift prevention for personal position sensor

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Abstract

Non-GPS tracking systems often use fused information from sensors such as gyros and accelerometer, either stand-alone or as parts of Inertial Measurement Units (IMUs), to estimate changes in the users heading. Since gyros measure rate of rotation, they require, among other mathematical processing, that their signals be numerically integrated to produce the desired heading information. The numeric integration has a tendency to cause errors due to drift. Drift is produced when small, near-constant deviations from the correct signal are integrated with respect to time. The highly undesirable result of drift is that the error of the computed heading increases continuously and without bound. One can conceptually view drift as being comprised of two components: a slowly changing, near-DC component, called bias instability, and a high-frequency noise component with an average of zero (called Angle Random Walk ARW). The high-frequency component creates only relatively small errors in the computation of heading from the gyros rate of turn measurements, since its average is about zero. In the context of this paper, we are therefore concerned only with the near-DC component of drift. Gyros are also sensitive to changes in temperature, and certain gyros are sensitive to linear accelerations. In our application, these two effects also produce errors that can be treated as having near-DC, slow changing components, as drift does. Our proposed drift reduction method counteracts all near-DC errors regardless of whether they are caused by the physical phenomena of drift, temperature sensitivity, or sensitivity to accelerations. For that reason, throughout this paper we lump all three of these near-DC error sources together and call them collectively drift before constructing a heuristic model to reduce error based on idiosyncratic behavior.

I. Introduction

Of a complete cycle of military simulation and training, one of the key subject matters is to help trainers and trainees to record training scenarios for after action review

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