A Novel Kalman Filter Latent State Estimator for GPS/INS Reference Point Acquisition

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Obtaining accurate, real-time position information is essential to realizing autonomous vehicle technology in everyday life. GPS currently does not meet the accuracy needs of autonomous vehicles, as its accuracy diminishes in urban environments (Duan and Wang, 2013). An inertial navigation system (INS) can provide more accurate position than GPS and is not adversely affected by environmental conditions (Rezaifard and Abbasi, 2017), but requires an accurate reference point (Yun et al., 2008). A Kalman filter (KF) can create an accurate position estimate from uncertain measurements. The objective of this engineering project was to create a software program that incorporated a KF that processed GPS measurements to create an accurate GPS reference point for an INS and determine whether a KF can provide a more accurate initial position estimate for an INS. The experimental program was compared against a control estimation method, which estimated position by taking a cumulative average of the incoming GPS data. The two methods were compared using different numbers of input measurements (n = 50, 125, 250, 500). The KF estimator showed a significant improvement in accuracy compared to the control method when 125 samples were used to estimate position. In the 50, 250, and 500-sample tests, there was no significant improvement in accuracy. The tests demonstrated that a KF is a promising method for generating an accurate INS reference point in a short amount of time, but the KF estimator prototyped in this study requires additional refinement to realize this potential.

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