Interactive Multiple Model Filter for Inertial Sensor Drift Correction in GPS-Denied Target Drone Waypoint Flights

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Target drones are smaller versions of military aircraft used to test air defense mechanisms and provide aid for manned aircraft during missions. One of the biggest threats to target drones is signal jamming and cyber hijacking. Tools like laser rangefinders, ground beacons, and occupancy-grid mappers have been used to supplement a GPS navigation system, but these solutions are not viable for target drones. Use of an inertial navigation system (INS) for navigation in GPS-denied areas has been suggested, but raw INS data is rather inaccurate due to drift error and sensor bias, especially in bodies experiencing large magnitudes of acceleration.

This project aimed to test and evaluate the accuracy of applying smoothing filters (Kalman filter, Extended Kalman Filter, and Unscented Kalman Filter) to the INS data using an Interactive Multiple Model (IMM). The IMM works by establishing *x*, *y*, and *z* drift rates from a series of acceleration and velocity inputs over time. These measurements were compared against the flight plan to identify and eliminate noisy and biased measurements in a process involving Bayesian statistics. The IMM is adaptive, as each estimation model is assigned a probability based on relative confidence that the filter would produce an accurate result. Data was collected with an INS on board a DJI Mavic Pro drone, which was flown according to pre-planned flight paths. Comparing the calculated trajectories using the INS data and a copy run through the IMM showed that using the IMM provided a displacement error reduction of about 75%.

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