Extended Kalman Filter Based Fuzzy Decentralized Trajectory Tracking Control of Quadrotor Unmanned Aerial Vehicles

Abstract—It is not suitable for the only use of GPS or INS for the measured velocity and position of outdoor QUAV. In this report, the nonlinear mathematical model of sensors including GPS and INS is first established. Its linearized model around the GPS signal is constructed for the discrete version of extended Kalman filter (EKF). Compared performances between GPS and INS, and GPS-aided INS confirm the effectiveness of the estimated signal through GPS-aided INS. Subsequently, the EKF-based fuzzy decentralized path tracking control (FDPTC) is applied for the path tracking of an outdoor QUAV. Finally, the compared experiments of circular path confirm the effectiveness and robustness of the proposed method.

Fuzzy Decentralized Sliding-Mode Controller (FDSMC) Design

The proposed control does not need the mathematical dynamic model of QUAV, it only needs its input/output data to construct the fuzzy rule table. After that, three factors and the coefficients of sliding surface for each subsystem are tuned to obtain the satisfactory control performance.

Experimental setup

![Figure 4](image)

(a) Photograph

![Figure 5](image)

(b) Block diagram

Experimental results

Figure 6. 2D trajectory

Figure 7. 3D trajectory

(b) Response of FDSMC without EKF

Conclusion

The experimental results in Figs 6 and 8 demonstrate that using EKF-based FDCMC beats the FDSMC only using of GPS and INS. It’s also confirm the effectiveness and robustness of the proposed method.

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