Dynamics and Control of a Tilt-Motor Quadrotor

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The paper presents a dynamical model and a control loop structure for an unmanned aerial vehicle (UAV) with four tilt-motors. The advantage of the considered quadrotor design over the standard models is full controllability because of additional servomotors, which allow tilting the four motors responsible for the thrust force. The mathematical model describes the dynamics of a complex system consisting of the UAV body and the four rotors. The system's center of mass dynamics is influenced by the gravity force, the aerodynamic drag force, and the thrust force generated by the rotating propellers. The rotational dynamics of the UAV's body is modeled with the account of the aerodynamic torque, gyroscopic torques, and the thrust force torques. The attitude of the system is described with the use of quaternions. The proposed control algorithm allows to independently control position and attitude of the UAV. The considered model also takes into account the sensor's signal errors, which are processed by the Extended Kalman Filter. Numerical simulations are carried out to endorse the correctness of the model and the control algorithms.

Keywords: *UAV, dynamics, control, tilt-rotors, maneuverability*

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