



## 四旋翼飞行器的非线性PID姿态控制

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## Attitude control of quadrotor aircraft via nonlinear PID

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摘要

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**摘要** 针对四旋翼飞行器的非线性姿态运动动力学模型,设计了一种新的几乎全局稳定的非线性PID (Proportional Integral Derivative) 姿态控制器.该控制器由一个线性PID的控制部分和一个惯性力矩补偿部分组成,可以抑制常值干扰和幅值有界且能量有界的干扰.数字仿真验证了该控制器对干扰的抑制作用.在搭建的姿态控制实验平台上进行了定点姿态跟踪控制实验.实验结果显示俯仰角和滚转角的误差均小于1°,验证了该控制器对小角度控制的有效性和对未建模动态的鲁棒性.

**关键词:** 姿态控制 非线性比例积分微分 四旋翼飞行器

**Abstract:** Based on the nonlinear attitude dynamic and kinematic model of a quadrotor aircraft, an almost globally stabilizing nonlinear proportional integral derivative(PID) attitude controller was developed. The proposed controller consists of a linear PID feedback and a compensation of inertia torques, and can reject the external disturbances consisting of not only a constant term but also a bounded and square-integrable term. Simulation results show the effectiveness on disturbances rejection. Experiments of set-point attitude control were conducted on the constructed attitude control platform. Experimental results illustrate that the pitch and roll angular errors are both smaller than one degree, which verifies the effectiveness of the proposed controller on small angle maneuvers and the robustness against unmodeled dynamics.

**Keywords:** attitude control nonlinear proportional integral derivative quadrotor aircraft

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