World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:12, No:05, 2018

Autonomous Flight Control for Multirotor by Alternative Input Output State Linearization with Nested Saturations

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Abstract : Multirotor is one of the most popular types of small unmanned aircraft systems and has already been used in many areas including transport, military, surveillance, and leisure. Together with its popularity, the needs for proper flight control is growing because in most applications it is required to conduct its missions autonomously, which is in many aspects based on autonomous flight control. There have been many studies about the flight control for multirotor, but there is still room for enhancements in terms of performance and efficiency. This paper presents an autonomous flight control method for multirotor based on alternative input output linearization coupled with nested saturations. With alternative choice of the output of the multirotor flight control system, we can reduce computational cost regarding Lie algebra, and the linearized system can be stabilized with the introduction of nested saturations with real poles of our own design. Stabilization of internal dynamics is also based on the nested saturations and accompanies the determination of part of desired states. In particular, outer control loops involving state variables which originally are not included in the output of the flight control system is naturally rendered through this internal dynamics stabilization. We can also observe that desired tilting angles are determined by error dynamics from outer loops. Simulation results show that in any tracking situations multirotor stabilizes itself with small time constants, preceded by tuning process for control parameters with relatively low degree of complexity. Future study includes control of piecewise linear behavior of multirotor with actuator saturations, and the optimal determination of desired states while tracking multiple waypoints.

Keywords : automatic flight control, input output linearization, multirotor, nested saturations
Conference Title : ICUAS 2018 : International Conference on Unmanned Aircraft Systems
Conference Location : Amsterdam, Netherlands
Conference Dates : May 10-11, 2018