UNIVERSITI TEKNOLOGI MARA

CONTROL DESIGN VIA PRESCRIBED PERFORMANCE FUNCTIONS FOR FLIGHT MANAGEMENT

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ABSTRACT

Flight attitude management for Unmanned Aerial Vehicles (UAV) have some difficulty in automatic control. The problem is driven by the nonlinear and uncertain nature of UAV dynamics. Controllers form the core of most of our modern technology. They allow us to achieve accurate responses from many systems simply by reference to a given signal, and automatically adjusting for any interference. The most widely used controller in industry today are the so called Proportional, Integral, Derivative controller, or PID. A simple controller featuring little parameters to tune while still achieving great performance. This performance however is only achievable provided proper tuning of the controller. A fairly recent development in controller theory is the so called Prescribed Performance Controller. First proposed by Bechlioulis and Rovithakis, the PPC is capable of achieving quick and accurate responses through the use of a performance function that defines boundary limits for error evolution. While individually these PID and PPC controllers have great performance potential, this study proposes that combining the two, forming a new hybrid PPCPID controller can achieve even better. Even further, greater benefits could be achieved through the implementation of additional control enhancement modules that addresses key control issues. These modules include the anti-windup module that directly compensate the integral windup issue common to PID controllers and the fuzzy logic gain scheduling module that allow dynamic tuning of the controller based on the dynamic response of the system. To demonstrate the performance of the proposed controller, a DC motor system was used to emulate a common application of these type of controllers. Two test cases were proposed, the first implementing a simple reference signal defined with a simple step function and the second case a more dynamic reference with a sine wave. For each case the performance of all aforementioned controllers were compared. The proposed controllers were able to achieve comparable if not better performance compared to their standalone counterparts, but further improvements can still be achieved.

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