

INTISARI

PENERAPAN KENDALI *ATTITUDE* MENGGUNAKAN *CASCADE SLIDING MODE CONTROL* PADA *BRUSHLESS MINI QUADCOPTER* BERBASIS STM32F401RCTX

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Quadcopter merupakan salah satu jenis UAV (*Unmanned Aerial Vehicle*) yang banyak digunakan dalam berbagai bidang karena potensinya di berbagai bidang. Namun, menjaga kestabilan atau *attitude* pada *mini quadcopter* bukanlah hal yang mudah, mengingat karakteristik sistem yang bersifat nonlinier dan sensitif terhadap gangguan eksternal. Mengatasi permasalahan ini, penelitian ini menerapkan metode *Cascaded Sliding Mode Control* (CSMC) dalam struktur sebagai solusi kendali nonlinier yang *robust*. Sistem kendali dirancang dalam dua lapis, yaitu *outer loop* untuk mengatur sudut orientasi dan *inner loop* untuk mengatur kecepatan sudut, lalu diimplementasikan pada mikrokontroler STM32F401RCTx.

Pengujian dilakukan secara eksperimental dalam ruangan tertutup menggunakan *test bed* untuk mengamati respons sistem dalam kondisi tanpa gangguan dan saat diberi gangguan eksternal. Hasil yang diperoleh menunjukkan bahwa sistem mampu mengatur *attitude* secara stabil, dengan waktu naik cepat, *overshoot* terbatas, serta kestabilan sudut yang tetap terjaga meskipun terdapat gangguan. Oleh karena itu, metode CSMC terbukti efektif dalam mengendalikan *attitude* pada *mini quadcopter* berbasis STM32

Kata kunci: *Quadcopter, Attitude, Cascade Sliding Mode Control, Sistem Nonlinier, STM32.*

ABSTRACT

IMPLEMENTATION OF ATTITUDE CONTROL USING CASCADE SLIDING MODE CONTROL ON A BRUSHLESS MINI QUADCOPTER BASED ON STM32F401RCTX

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A quadcopter is a type of UAV (Unmanned Aerial Vehicle) that is widely utilized across various fields due to its versatility. However, maintaining the stability or attitude of a mini quadcopter is a challenging task, primarily because of its nonlinear system characteristics and sensitivity to external disturbances. To address this issue, this study implements a Cascaded Sliding Mode Control (CSMC) method as a robust nonlinear control solution. The control system is designed in a two-layer structure: an outer loop that regulates the orientation angles, and an inner loop that controls the angular velocities. This system is implemented on an STM32F401RCTx microcontroller.

Experimental tests were conducted in an indoor environment using a test bed to observe the system's response under both undisturbed conditions and external disturbances. The results demonstrate that the system is capable of maintaining stable attitude control, exhibiting fast rise times, limited overshoot, and consistent angle stability even in the presence of disturbances. Therefore, the CSMC method proves to be an effective solution for attitude control of STM32-based mini quadcopters.

Keywords: Quadcopter, Attitude, Cascade Sliding Mode Control, Nonlinear System, STM32.