INTISARI

KONTROL GERAK *ROLL* DAN *PITCH* MENGGUNAKAN *EXPONENTIAL MOVING AVERAGE* DAN REGULATOR OPTIMAL PADA *MINI QUADCOPTER* BERBASIS STM32F401

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Penelitian ini mengkaji kontrol gerak *roll* dan *pitch* pada *mini quadcopter* berbasis STM32F401 menggunakan metode *Exponential Moving Average* (EMA) sebagai filter dan regulator optimal sebagai pengendali. Mini quadcopter memiliki enam derajat kebebasan, sehingga sulit untuk dikendalikan secara stabil. Algoritma EMA dirancang dengan menggunakan sensor MPU6050 untuk mengurangi *noise* pada data, sementara regulator optimal diterapkan untuk mencapai kestabilan posisi *roll* dan *pitch*. Pemodelan *state space* dari *mini quadcopter* berhasil menggambarkan dinamika sistem, termasuk sudut dan kecepatan sudut *roll* dan *pitch*. Pemodelan ini divalidasi melalui perbandingan respons *open loop* antara model nonlinier dan linier. Simulasi model linierisasi menggunakan MATLAB menunjukkan bahwa regulator optimal mampu menstabilkan sudut *roll* dan *pitch* pada titik equilibrium dengan respon yang cepat dan tanpa *overshoot* yang signifikan. Pada implementasi *mini quadcopter* berbasis STM32F401, sensor MPU6050 berhasil mendeteksi perubahan posisi sudut, dan sinyal kontrol memberikan koreksi serta perlawanan terhadap perubahan posisi sudut untuk mengembalikan *mini quadcopter* ke titik equilibrium. Namun, masih terdapat osilasi dan *noise* saat kontroler berupaya menjaga kestabilan posisi sudut *mini quadcopter*.

Kata kunci : *Mini Quadcopter,* Regulator Optimal, EMA, *Roll, Pitch*

ABSTRACT

ROLL AND PITCH MOTION CONTROL USING EXPONENTIAL MOVING AVERAGE AND OPTIMAL REGULATOR ON A MINI QUADCOPTER BASED ON STM32F401

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This study examines the roll and pitch motion control of a mini quadcopter based on STM32F401 using the Exponential Moving Average (EMA) method as a filter and an optimal regulator as the controller. The mini quadcopter has six degrees of freedom, making it difficult to achieve stable control. Using the MPU6050 sensor, the EMA algorithm is designed to reduce noise in the data, while the optimal regulator is applied to achieve stability in roll and pitch positions. The state-space modeling of the mini quadcopter successfully represents the system's dynamics, including roll and pitch angles and angular velocities. This modeling is validated through a comparison of the open-loop response between nonlinear and linear models. Simulations of the linearized model using MATLAB demonstrate that the optimal regulator effectively stabilizes the roll and pitch angles at the equilibrium point with a fast response and no significant overshoot. In the implementation of the STM32F401-based mini quadcopter, the MPU6050 sensor successfully detects changes in angular position, and the control signal provides corrections and counteractions to restore the mini quadcopter to its equilibrium position. However, oscillations and noise are still present as the controller attempts to maintain stability in the quadcopter's angular position.

Keyword : Mini Quadcopter, Optimal Regulator, EMA, Roll, Pitch