

ABSTRAK

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Judul : ANALISIS KARAKTERISTIK TORSI DAN KECEPATAN PADA MOTOR SERVO AC DENGAN EKSITASI MEDAN PERMANEN MENGGUNAKAN METODE FIELD-ORIENTED CONTROL (FOC)

Penelitian ini menganalisis karakteristik torsi dan kecepatan pada motor servo AC dengan eksitasi medan permanen (PMSM) menggunakan kontrol Field-Oriented Control (FOC) berbasis Space Vector PWM (SVPWM). Tujuannya adalah mengevaluasi respons sistem terhadap variasi kecepatan (1000–4000 RPM) dan beban (0,1–0,3 Nm). Simulasi dilakukan di MATLAB/Simulink, sedangkan validasi eksperimen menggunakan trainer Lucas-Nuelle 300 W. Hasil menunjukkan sistem mampu mencapai kecepatan referensi tanpa overshoot, waktu naik 0,5–1,2 detik, dan error torsi mendekati nol. Arus Id terkendali ≈ 0 , sesuai strategi Maximum Torque per Ampere (MTPA), sementara Iq meningkat proporsional terhadap torsi. Respons torsi transien muncul selama akselerasi dan stabil setelah mencapai kecepatan target. Pada pengujian beban, kecepatan aktual tetap konstan di 2000 RPM dengan torsi steady-state sesuai nilai beban. Arus tiga fasa yang dihasilkan berbentuk sinusoidal dan seimbang, mencerminkan kualitas kontrol inverter dan efektivitas SVPWM. Keselarasan hasil simulasi dan eksperimen membuktikan validitas model serta keandalan sistem kontrol. Penelitian ini mendukung optimalisasi kontrol motor presisi berbasis FOC dan SVPWM.

Kata kunci: *Field-Oriented Control, PMSM, motor servo AC, SVPWM, torsi elektromagnetik*

ABSTRACT

Name : Zainur Rofiq

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Title : ANALYSIS OF TORQUE AND SPEED CHARACTERISTICS OF AN AC SERVO MOTOR WITH PERMANENT FIELD EXCITATION USING THE FIELD ORIENTED CONTROL (FOC) METHOD

This study analyzes the torque and speed characteristics of a permanent magnet synchronous motor (PMSM) using Field-Oriented Control (FOC) with Space Vector PWM (SVPWM). The goal is to evaluate system responses under varying speeds (1000–4000 RPM) and mechanical loads (0.1–0.3 Nm). Simulations were conducted in MATLAB/Simulink and validated through experiments using a 300 W Lucas-Nuelle trainer. Results show the system achieved reference speed without overshoot, with rise times between 0.5–1.2 seconds and near-zero steady-state error. The direct-axis current (I_d) was maintained around zero, following the Maximum Torque per Ampere (MTPA) principle, while the quadrature-axis current (I_q) increased with torque demands. During load tests, the actual speed remained stable at 2000 RPM with steady-state torque matching the applied loads. The resulting three-phase currents were sinusoidal and balanced, indicating effective inverter control and SVPWM performance. The consistency between simulation and experimental results confirms the model's validity and control system reliability. This research supports the optimization of precise motor control using FOC integrated with SVPWM.

Keywords: *Field-Oriented Control, PMSM, AC servo motor, SVPWM, electromagnetic torque*