ANALYSIS OF *DUAL INVERTER* WITH DIRECT TORQUE CONTROL (DTC) AND HYSTERESIS BAND PULSE WIDTH MODULATION (HBPWM) IN INDUCTION MOTOR CONTROL

By : Fadilah Apriliya Sari
Student Identity Number : 04221054
Supervisor : Andhika Giyantara, S.T., M.T.
Co-supervisor : Riza Hadi Saputra, S.T.,M.T.

ABSTRACT

Three-phase induction motors are widely used in industry due to their simple construction and high reliability, yet exhibit limitations including high starting current and sensitivity to load variations. Conventional Direct Torque Control (DTC) provides fast dynamic response but still suffers from high torque ripple and non-constant switching frequency. This study designs and analyzes a DTC controller based on Hysteresis Band Pulse Width Modulation (DTC-HBPWM) with a PI controller in single and *Dual Inverter* open-end winding configurations, compared against the V/F method through MATLAB/Simulink simulation with load variations of 0–26.71 Nm (the rated load). Within the normal operating range (0–25 Nm), DTC-HBPWM *Dual Inverter* achieved the best performance with Torque Pulsation (T_{pp}) consistently maintained at 0.305–0.357 Nm, representing up to a 95.07% reduction compared to V/F *Single Inverter*. Rotor speed was maintained at 150 rad/s with a maximum Steady-State Error (SSE) of 0.014%, compared to V/F which reached an SSE of 18.886%. Mechanical power fluctuation decreased by up to 96.0%, and minimum torque remained positive, completely eliminating instantaneous torque reversal. Conversely, *Dual Inverter* under the V/F method produced higher T_{pp} than *Single Inverter*, proving that *Dual Inverter* advantages are only realized with appropriate closed-loop control. At the rated load of 26.71 Nm, both DTC-HBPWM configurations experienced loss of control due to integrator windup caused by *DC-Link* voltage limitations, indicating that the system is recommended for operation only up to 25 Nm without further PI controller parameter adjustment.

Keywords: Induction Motor, Direct Torque Control (DTC), Hysteresis Band Pulse Width Modulation (HBPWM), *Dual Inverter*, Open-End Winding, Torque Ripple, PI Controller.