ANALYSIS OF THE REGENERATIVE BRAKING SYSTEM IN A PMSM MOTOR MODEL USING SIMULINK

Cahyaning Nur Karimah, S.Pd., M.T. *as a supervising lecturer*

Iskandar D'last Prince. R

Automotive Engineering Technology

Majoring of Engineering

ABSTRACT

Limited battery capacity is a major obstacle to increasing the range of electric motorcycles. This study investigates the energy efficiency of the Regenerative Braking System (RBS) as a technical solution for converting kinetic energy back into electrical energy. The research was conducted online using MATLAB R2024a Simulink simulations with a Permanent Magnet Synchronous Motor (PMSM) model. Variable tests were conducted for braking durations of 1, 2, and 3 seconds to observe the behavior of negative torque, angular velocity, and battery voltage recovery. Simulation results indicate that braking time is directly proportional to energy recovery efficiency. Power efficiency during 1-second braking was recorded at 15,10% (581,94 W), increased to 29,86% (1.195,74 W) at 2 seconds, and peaked at 3 seconds with 57,98% (2.391,48 W). The success of energy recovery is evidenced by the increase in the battery's final voltage compared to its initial state. It can be concluded that a longer braking duration provides more stable energy recovery, which significantly improves the overall efficiency of the electric vehicle.

Keywords*: Regenerative Braking, PMSM Motor, Simulink, Energy Efficiency, Electric Bicycle*