

Regenerative Braking Control of Electric Vehicles Using PI and Sliding Mode Controllers using Xcos

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Abstract

Regenerative braking has become an important feature in modern electric vehicles (EVs). Unlike conventional braking systems that waste kinetic energy in the form of heat, regenerative braking systems convert a portion of this energy into electrical energy and store it back in the battery. This project aims to design and simulate a regenerative braking system for an electric vehicle using Scilab/Xcos and evaluate the performance of different control strategies.

The proposed model includes vehicle dynamics, a DC motor model, battery charging through regenerative braking, and controller-based duty cycle regulation. Two control techniques, namely the Proportional-Integral (PI) controller and Sliding Mode Controller (SMC), are implemented and compared. The primary objective is to analyze their ability to regulate braking current and maximize energy recovery during vehicle deceleration.

Simulation results indicate that both controllers successfully achieve regenerative braking and battery charging. However, the Sliding Mode Controller provides better current tracking and improved energy recovery compared to the conventional PI controller. The study demonstrates that advanced control techniques can significantly enhance the efficiency of regenerative braking systems and contribute to improved energy utilization in electric vehicles.

This project provides practical exposure to control system design, electric vehicle modeling, and renewable energy recovery techniques using the Scilab/Xcos simulation environment.

1. References

1. Energy-Regenerative Braking Control of Electric Vehicles Using Three-Phase BLDC Motors, Research Paper, 2014.

Link: [Energy-Regenerative Braking Control of Electric Vehicles Using Three-Phase Brushless Direct-Current Motors](#)