Longitudinal Dynamics Modeling of an Electric Go-Kart and Analysis of Regenerative Braking under Various Braking Profiles using MATLAB Simulink

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Abstract

Regenerative braking plays a crucial role in optimizing energy efficiency in electric vehicles (EVs), yet its performance is significantly influenced by driving behavior. This study investigates the impact of various braking profiles on regenerative braking effectiveness, with a focus on battery State of Charge (SOC) recovery. As a proof of concept, a control-oriented, first-principles mathematical model of an electric go-kart was developed in MATLAB Simulink using real prototype parameters to simulate longitudinal vehicle dynamics under different throttle, coasting, and braking conditions. In this setup, the vehicle employs a simple Regenerative Braking System using a direct current motor, which is activated when the throttle pedal is released and operates with a constant Back Electromotive Force (EMF) resistance. This mechanism can slow down the vehicle, but a friction brake is still required for a complete stop. Open-loop simulation results show that full-throttle driving achieves a maximum speed of 13.7 m/s, resulting in a 1.16% SOC depletion. During coasting, when regenerative braking is active, a 0.05% SOC gain was recorded over 100 seconds. For braking applications, the highest energy recovery (+0.030% SOC) occurred with a strategy involving 4 seconds of coasting followed

Detailed information

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