DSCC Paper

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Optimal Control of an In-Wheel Motor Electric Ground Vehicle While Considering Traffic Models

Introduction

A large focus in many areas of society today is energy conservation and optimization. We now have the option of buying LED instead of incandescent light bulbs, many buildings are equipped with super-efficient windows, and governments across the globe are offering more and more incentives to industries and citizens for maintaining energy efficiency. Some of the most significant effort in energy saving, however, has been put into the area of industrial and personal transportation. The large majority of vehicles still run on fossil fuels, but an increasing amount of effort has been put into developing and optimizing alternative energy sources such as electric, natural gas, and even solar power. One of the more promising solutions for ground vehicles seems to be electric power, as many car manufacturers offer at least hybrid electric, if not a variety of pure electric vehicle options. The task at hand, therefore, is to not only investigate how to increase the capacity of batteries, but make the vehicle’s use of the battery the most efficient it can be. [Maybe insert a source on battery capacity/discharge research].

Ways to accomplish optimizing the energy stored in a vehicle’s battery include increasing the efficiency of energy transfer to the wheels, investing in efficient mechanical components, or also implementing regenerative braking or various momentum-storing devices [citation]. These solutions can offer significant energy savings, but possibly one of the largest sources of waste comes from inefficient or reckless driving styles. To help approach this problem, some form of autonomous driving needs to be implemented to either completely control the vehicle, or at least provide some feedback to the driver so they may choose a more optimal path or speed if they wish. While autonomous driving is still noticeably in its infancy, applying optimal control techniques to vehicle and traffic models can be used to see if such a project is even worth pursuing. Previous research has been conducted on such a topic, and savings of up to 20% have been documented by optimizing the motor torques of an electric ground vehicle (EGV) over a given terrain profile [citation].

EGV Model

An EGV with four BLDC in-wheel motors is considered in this study