FSAE EV Motor Controller - Team Motor Doktors

Abstract

This project is the third in line of the electrical engineering senior design teams working on the UAH FSAE electric vehicle. This is an international competition where university teams compete in racing their EVs in specific engineering challenges. Success within this competition depends on a team's ability to solve complex engineering problems, develop a vehicle design that adheres to strict constraints, communication between team members, and detailed organization of everything relating to the project. Our main goal this semester was to variably control the motors RPM using an accelerator pedal position sensor (APPS). This is a major step in the right direction for simulating a "driving" environment allowing for user control over the motor; previous teams only had achieved an on/off state for the motor with a minimum RPM of 0 and max of 800 with no variation.

In order to achieve this, our team spent time understanding the EMRAX 228 motor, the Cascadia PM100DX motor inverter, and the TPS280DP position sensor used for the APPS as selected by previous teams. An additional requirement for the scope of this project was to determine a suitable Vehicle Control Unit (VCU) that would act as the hub for all connections and communication between components (not implemented in this project scope). The VCU275 uses the CAN SAE J1939 protocol for communication between the inverter and itself.

For successful implementation of the APPS providing variable motor control, we started by understanding how the PM100DX controls motor speed, as outlined in its documentation. This is done via a linear function between the APPS values of COST_HI and ACCEL_MAX. To successfully control speed, the APPS must first be connected to the VCU (this was initially simulated using a Nucleo STM32 767ZI board while waiting for the selected VCU275 to arrive). The APPS was connected to the 5V output on the STM32 767ZI board, which is important because the APPS requires a 5V regulated supply in order to produce a 0–5V output on Channel 1. Next, the output from Channel 1 was connected to analog output 1 (AO1), which was then routed to an ADC pin (D13) on the STM32 board. The resulting digital output was connected to AIN1 on the PM100DX inverter, providing the input for accelerator pedal position. Implementing the system in this way demonstrated successful control of the motor's RPM, allowing the user to vary the RPM from 0 to 800. Future teams will be able to take this testing method and apply it with the VCU by fully integrating it into the overall system.