High Bandwidth Wide Operating Range PMSM Controller Platform for EV/HEVs
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**Objective:**
- Design PMSM driving controller for electric vehicles with high energy efficiency and wide operating range
- Develop platform that will allow for testing of novel motor control strategies that maximize advantages of SiC inverter technology

**Technical Approach:**
- Complete motor drive system simulated using Matlab/Simulink
- State of the art motor control design utilizing detailed motor characterization data for precise maximum torque per amp control
- Additional high speed mode, where flux is reduced to obtain the maximum torque at speeds above the rated base speed
- SiC inverter enables switching frequencies over 50khz providing high bandwidth control for increased precision and stability
- Latest TI DSP(TMS320F28377) based controller designed for control algorithm implementation
- Motor characterization data was utilized to create direct and quadrature inductance look-up tables that capture variations over entire motor operating range allowing for precise and efficient torque control

**Accomplishments:**
- Good speed tracking performance with acceleration, deceleration and load torque sudden transition
- Compact design for 1st generation DSP controller board to increase system power density

**Next Steps:**
- Improve Matlab/Simulink model for current controller design and verify performance on DSP controller board
- Design generation II controller board with all necessary peripherals and drive the traction motor in the EV dynamometer test bench
- Develop new control algorithms to maximize the benefits of SiC devices

**Potential Impact:**
- Improved energy efficiency boosting mileage range for electric vehicles
- Platform will allow for improved controller designs based on SiC technology enabling EVs/HEVs with better efficiency, maneuverability, reliability and safety.

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**Fig.1** Surface fitting results used for controller design.

**Fig.2** PMSM drive speed response over a wide speed range.

**Fig.3** Electric Vehicle dynamometer test bench.