

Advanced Power Electronics

Flux Enhancement and Weakening of High-Strength Undiffused Brushless Motor

Background

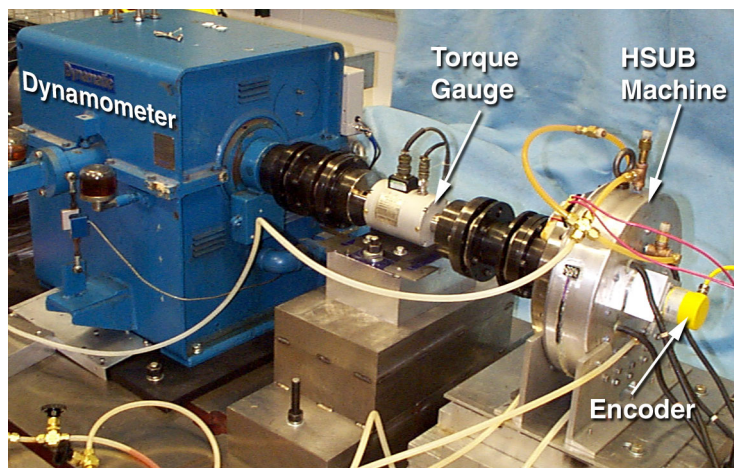
Under the direction of the U.S. Department of Energy's FreedomCAR and Vehicle Technologies Program, Oak Ridge National Laboratory (ORNL) is conducting transportation power electronics and electric machinery research and development.

The permanent magnet motor has a high power density, but its field weakening requirement adds cost to the inverter. In order to reduce the size and raise the power density of an electric vehicle drive motor, the motor starting torque must be enhanced and the motor speed range must be increased. These

enhancements are not feasible because of the limitations of a fixed supply voltage and a fixed permanent magnet flux. The high-strength undiffused brushless (HSUB) motor invented at ORNL can increase the power density of permanent magnet motors and lower the inverter cost by incorporating unique field enhancement and weakening capabilities.

The Technology

The HSUB motor uses permanent magnets to produce a magnetic flux in the air gap and to prevent the diffusion (leakage) of flux between the poles. The fixed permanent magnetic

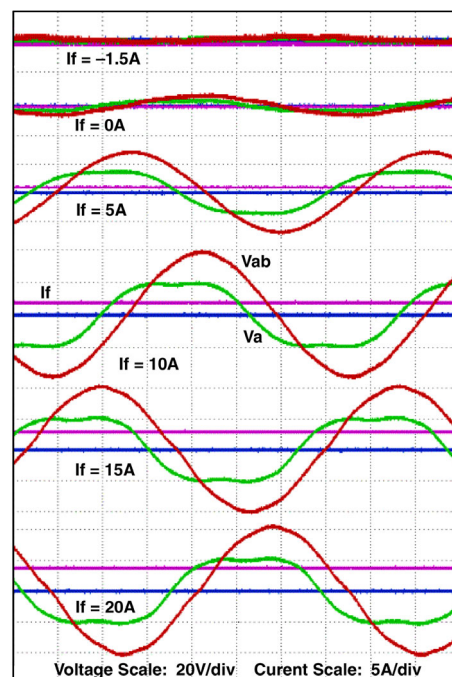


Dynamometer test setup for HSUB motor.



Less dependence on foreign oil, and eventual transition to an emissions-free, petroleum-free vehicle

Fully controllable back emf ensures a high constant power-speed ratio



vehicle systems

fuels & lubricants

engines & emission control

field can be either enhanced or weakened through a brushless, stationary, controllable dc field winding incorporated into the motor. Consequently, starting torque is increased when the field is enhanced. When the field is reduced, a high constant power-speed ratio is achieved through field weakening. The prototype motor being tested is providing results consistent with design expectations.

Benefits

- Increased power density
- Significant cost reductions
- Reduced drive system size
- Power versus speed performance for hybrid and fuel cell vehicles that is equivalent to conventional drivetrains

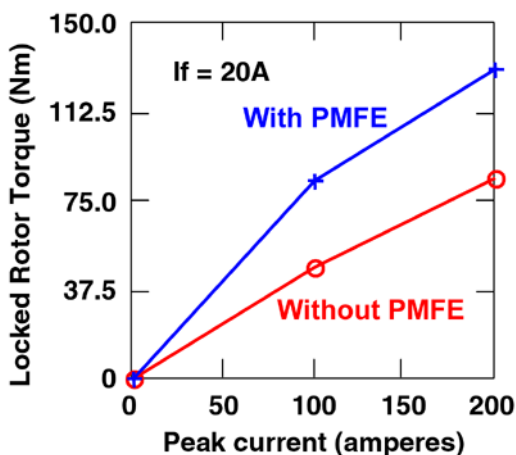
Where Can I Find More Information?

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Commercialization

A major corporation is forming a cooperative research and development agreement (CRADA) with ORNL for the possible commercialization of the HSUB motor.



The HSUB motor increases starting torque with permanent magnet flux enhancement (PMFE).

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



U.S. Department of Energy

Energy Efficiency and Renewable Energy

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