Title: Conceptual Evaluation, Modeling and Analysis of a Flywheel Energy Storage System

Duration: 2010-2012

Sponsor: Lawrence Livermore National Laboratory

Contributing Faculty: James Hoburg (PI), Marija Ilic

Contributing Students: Kevin Bachovchin

Description: This project supported the design and testing of LLNL's flywheel-based electromechanical battery (EMB) for use in power system applications. Specifically this project involved the modelling and design of passive magnetic bearings for flywheels. Magnetic bearings can be used in flywheels instead of conventional mechanical bearings in order to reduce frictional energy losses. Passive magnetic bearings are much less expensive than active magnetic bearings, which use sensors and feedback control systems. However a significant challenge with passive magnetic bearings results from Earnshaw's Theorem, which states the impossibility of stably levitating a rotor in all directions using only permanent magnets. A Halbach array stabilizer, which induces currents in stabilization coils in order to overcome this instability, was designed and modelled. Using electromagnetic theory, the magnetic fields, forces, and stability of the system were analyzed. The total magnetic bearing system, consisting of permanent magnets and the Halbach array stabilizer, was shown to be stable in all directions.