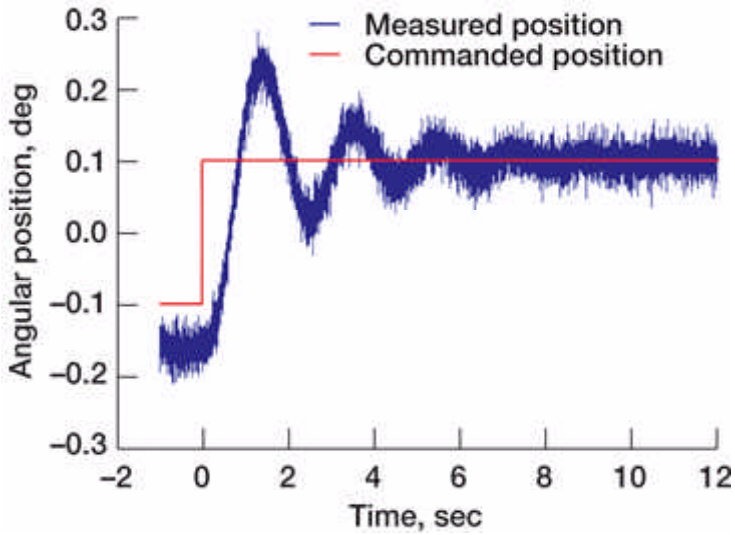
Flywheel Single-Axis Integrated Momentum and Power Control System Demonstrated

On July 10, 2003, the NASA Glenn Research Center flywheel team experimentally demonstrated a two-flywheel-module system that simultaneously provided attitude control in a single axis and regulated power. The test was conducted using the D1 flywheel module and the high-speed shaft (HSS) in the High Energy Flywheel Facility (HEFF). Both of these flywheel modules consist of a magnetically levitated rotor with an integral motor/generator, a vacuum housing, and mechanical touchdown bearings. Energy is stored kinetically in the rotor. The motor/generator allows energy to be added to or withdrawn from the rotor, and magnetic bearings and a vacuum enclosure are used to minimize losses.

D1 and HSS flywheels on air table.

The modules are both located on a common table that is mounted on an air bearing, allowing the table to rotate (see the photograph). When a command is issued to move the table to a new angle, the attitude control system commands opposite torques on each module, resulting in a net torque on the air table. The table moves, and the position is fed back to the controller. We were only able to move the air table through an angle of ±0.1° because of cable drag in our test setup (see the following graph). This is functionally

similar to a momentum control system on a satellite. In addition to providing attitude control, the system simultaneously provides energy storage and electrical bus regulation. The bus voltage was regulated at 125 V during charge and discharge. Charge-discharge and discharge-charge transitions were demonstrated by changing the amount of power that the power supply provided. In a satellite system, this would be the equivalent of changing the amount of energy that the solar array provides to the spacecraft.



Air table tracking-angle command.

Glenn contacts: Jim Soeder, 216-433-5328, Jim.Soeder@nasa.gov; Kerry McLallin, 216-433-5389, Kerry.L.cLallin@nasa.gov; and Ralph Jansen, 216-433-6038, Ralph.Jansen@nasa.gov
Author: James F. Soeder
Headquarters program office: OAT
Programs/Projects: Aerospace Flywheel Technology, Energetics