UNIVERSITY TRANSPORTATION CENTER

RESEARCH BRIEF

Advanced Energy Storage System for Electric Vehicle Charging Stations for Rural Communities in the Pacific Northwest

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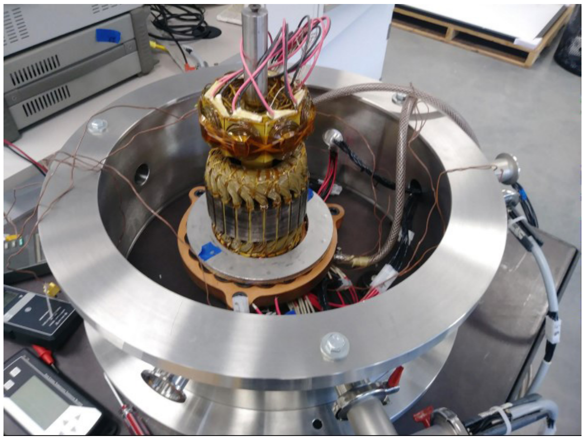
Background

The context for this project an improved system for charging electric vehicles (EV) in remote locations. We have an ongoing project with a public electrical utility to create a network of billable charging stations, some of them in remote locations without grid electrical power. Such remote charging stations need energy storage because remote energy sources, usually renewables, cannot instantly meet customer demand. Batteries are the incumbent technology, but flywheels are often better for harsh environments and for longevity. We created such a flywheel-based energy storage system for NASA to serve on the surface of the moon. We have promising performance observed in simulations and in building small scale, partial prototypes. We have captured energy from solar panels and fed it successfully into a mock electromechanical interface of our flywheel. We have designed and simulated a completely unprecedented form of a reluctance machine with a magnetically levitated, bearingless, and shaftless rotor. In simulation, it promises better efficiency and better energy storage per unit volume than conventional designs. We have created a modulation algorithm that shows excellent promise in driving the rotor to store energy on command. This project has the background to make this unique and promising machine a reality.



Research Project

In this project, we seek to build, modulate, control, and test the flywheel that we have designed. We will build a toroidal rotor for an "inside-out" field regulated reluctance motor-generator (FRRM) that has neither electrical connections nor physical shaft nor bearings. Everything is magnetically interfaced and magnetically supported. A superconducting Halbach Array supports the vertical axis rotor. An absolute encoder provides position and angle in the other five axes. A microcontroller converts this machine information and energy flow data into electrical voltage pulses applied to a stationary core of 24 windings located inside toroid of the rotor. These modulated pulses provide both field and armature functions through an innovative current modulation. Providing energy from an external source, such as a solar panel or electrical grid, causes our FRRM to accelerate. Our FRRM is fully reversible, yielding energy to the charging system when customer demand exceeds generation capacity. With no electrical or mechanical connections, but simply magnetic levitation, our FRRM has greater energy efficiency that conventional designs. It operates with a much wider temperature range than batteries. We have all of this performance proven in simulation. The project at hand will make that performance in hardware a reality.

ABOUT THE AUTHORS

The research team consisted of Herbert Hess of the University of Idaho.

ABOUT THE FUNDERS

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EXPECTED DATE OF COMPLETION

August 2022

FOR MORE INFORMATION

http://depts.washington.edu/pactrans/research/projects/advanced-energy-storage-system-for-electric-vehicle-charging-stations-for-rural-communities-in-the-pacific-northwest/