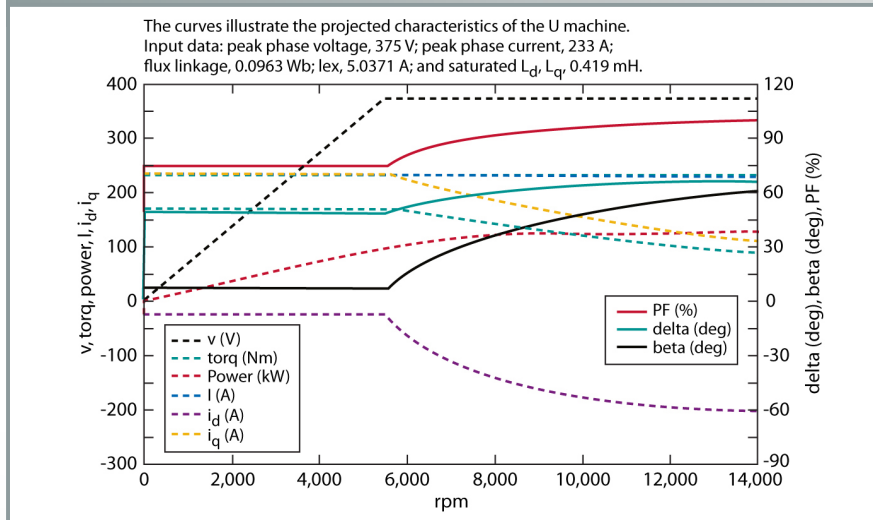


# Permanent-Magnet-Less Synchronous Reluctance Motors

UT-B IDs 200802068, 200702005, 200902227



## Technology Summary

A U-machine invented at ORNL offers a new motor design that eliminates the need for permanent magnets. This is an important cost-saving advance in electric motor technology. As hybrid and plug-in electric vehicles become increasingly popular, the demand for electric drive motors could soon reach multi-millions of units per year.

Currently, permanent magnet motors are the choice for hybrid, plug-in, and fuel-cell vehicle drives. However, raw materials for permanent magnets (e.g., rare earth elements) are subject to trends in supply and demand; eliminating these materials from electric motors and generators helps to control component costs.

This synchronous system has a stator core that generates a magnetic rotating field when sourced by an alternating current. It includes brushless adjustable field excitation for high starting torque, field weakening, and power factor improvement. The machine can operate at higher temperatures than conventional designs, and has lower cooling costs and less complexity. There are also zip-lock assembly features that increase power density and reduce cost.

In this invention, a patented, enclosed air gap is introduced between the stationary excitation core and the uncluttered rotor. A second gap in the stator core reduces the core loss caused by flux density that is non-uniformly distributed on the rotor. When in operation, the engine offers higher power density and higher efficiency, lowering the cost per kilowatt of use.

## Advantages

- Increase in peak motor speed for drive motors, with reductions in cost, weight, and motor volume
- Lower cost
- Temperature advantages
- Mutual beneficial influences among the motor, power electronics, and cooling of the drive system
- Enhanced performance (e.g. strong starting torque)

## Potential Applications

- Electric automotive propulsion
- Industrial motors and generators

## Patent

John S. Hsu, *Substantially Parallel Flux Uncluttered Rotor Machines (U-Machine)*, U.S. Patent Application 12/466,169, filed May 14, 2009.

John S. Hsu, *Permanent-Magnet-Less Machine Having An Enclosed Air Gap*, U.S. Patent Application 12/466,212, filed November 20, 2007.

John S. Hsu, *Permanent-Magnet-Less Synchronous Reluctance System*, U.S. Patent Application 12/274,895, filed November 20, 2007.

## Inventor Point of Contact

John S. Hsu  
Energy and Transportation Science Division  
Oak Ridge National Laboratory

## Licensing Contact

David L. Sims  
Technology Commercialization Manager,  
Building, Computational, and  
Transportation Sciences  
UT-Battelle, LLC  
Oak Ridge National Laboratory  
Office Phone: 865.241.3808  
E-mail: [simsdl@ornl.gov](mailto:simsdl@ornl.gov)

