# ECE 590 I
# POWER & ENERGY SYSTEMS SEMINAR

## Monday, September 27, 2021, 3:00 – 3:50 p.m., ECEB 5070

**Zoom Meeting ID: 826 3892 4416**
**Password: seminar_21**
https://illinois.zoom.us/j/82638924416?pwd=ckh3R2lJcGVnMDZ2RS9LWmd6SytJUT09

## Modeling of Rotor Flux Barriers in a Brushless Doubly-Fed Reluctance Machine

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A brushless doubly-fed reluctance machine requires partially-rated power converter, reduced maintenance, and operates without permanent magnets making it an attractive option for many applications such electrified propulsion and wind energy conversion system. However, BDFRMs have inherently poor torque density and high torque ripple. Since the flux modulation in a BDFRM is carried out by the rotor, the rotor structure plays an important role in torque production. We have proposed an analytical approach to model the effect of the rotor flux barriers on the mean and ripple torque. The method shows that the instantaneous torque is highly sensitive to the location of these flux-barriers. A rotor with two flux barriers per pole is used to illustrate the effectiveness of the proposed approach. Finally, the proposed modeling framework is used to optimize the rotor geometry to achieve a maximize mean torque with lower ripple. The estimated torque profile for the optimized rotor is verified using finite element analysis (FEA) of the machine.

## BESS Operational Flexibility Impacts in Grids with Integrated Renewable Resources

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The deepening penetrations of renewable energy resources (RERs) into power grids pose major challenges to the grids' ability to accommodate the resulting variable and uncertain net loads, that is, to provide grid operational flexibility (GOF). These challenges intensify as ambitious RER penetration targets are accompanied by accelerated retirements of conventional controllable generation resources. A major consequence of this rapid transition towards emission reduction is an increase in renewable energy curtailments to avoid overgeneration events, reserves scarcity and insufficient ramping capability to meet future net load changes. Energy storage resources (ESRs) provide effective means to avoid renewable energy curtailment and, in the specific case of battery energy storage systems (BESSs), can provide fast response and ramp rates. Furthermore, the advancements and decreasing prices of battery technology have increased the interest in their utility-scale deployment to provide the energy and ancillary services required to accommodate deepening penetrations of RERs. However, large-scale battery deployment and the assessment of their grid contributions and economic operations are topics that need further investigation. We present a simulation approach in which we model ESR market participation through the submission of bids derived from the solution of an ESR bidding problem (EBP). The proposed EBP is based on stochastic optimization and relies on price forecasts to determine bids that maximize expected ESR profits. We apply the proposed EBP to model BESS market participants with the explicit representation of battery degradation costs as variable operational costs and assess BESS profits, operations, and contributions towards operational flexibility.