Energy Cycling and Efficiency Improvement for Electrical Propulsion Systems with Hybrid Energy Storage

System Concept
- Prime mover/Generator sets
- Induction machine and drive
- Electrical propulsion system
  - Propeller characteristics
  - Ship dynamics
- Hybrid energy storage system (HESS): mitigate the power and thrust fluctuations in the electric drive system
  - Battery
  - Ultracapacitor
  - Flywheel

General information
- Sponsor: ONR/NEEC

Activities/Accomplishments:
- Dynamic modeling and model-based analysis
- System level optimization and case studies analysis
- Control algorithm development for components (e.g. induction machine, DC/DC converter)
- Model predictive control to improve system overall efficiency and reliability
- Hardware test-bed development and real-time control

System characteristics and technical challenges
- Ship propulsion system:
  - Large scale and high power rating
  - Multi-frequency and large load fluctuation magnitude
  - Significant environment influence
- HESS control and optimization