

Development and Validation of Wind Turbine Drivetrain Models

Clemson-GE Cooperation

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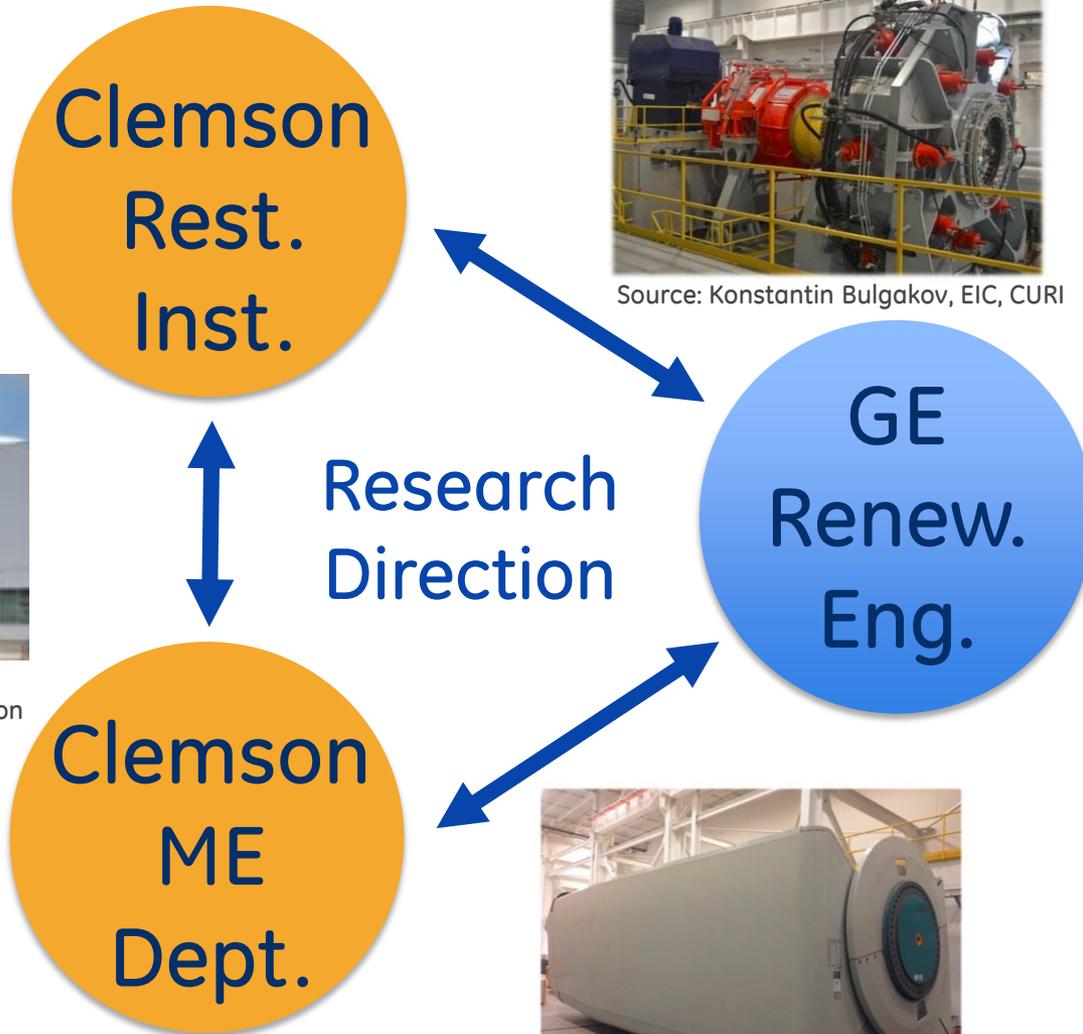
**2nd Annual International Workshop on Grid Simulator
Testing of Energy Systems and Wind Turbine Powertrains**

North Charleston, SC

September 17-18, 2014



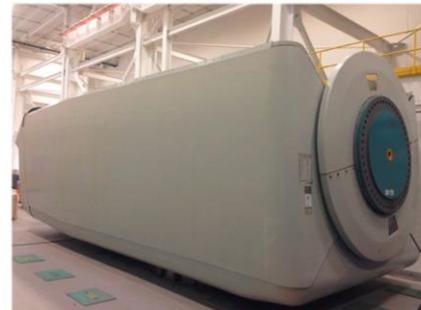
Research Cooperation



Source: Konstantin Bulgakov, EIC, CURI



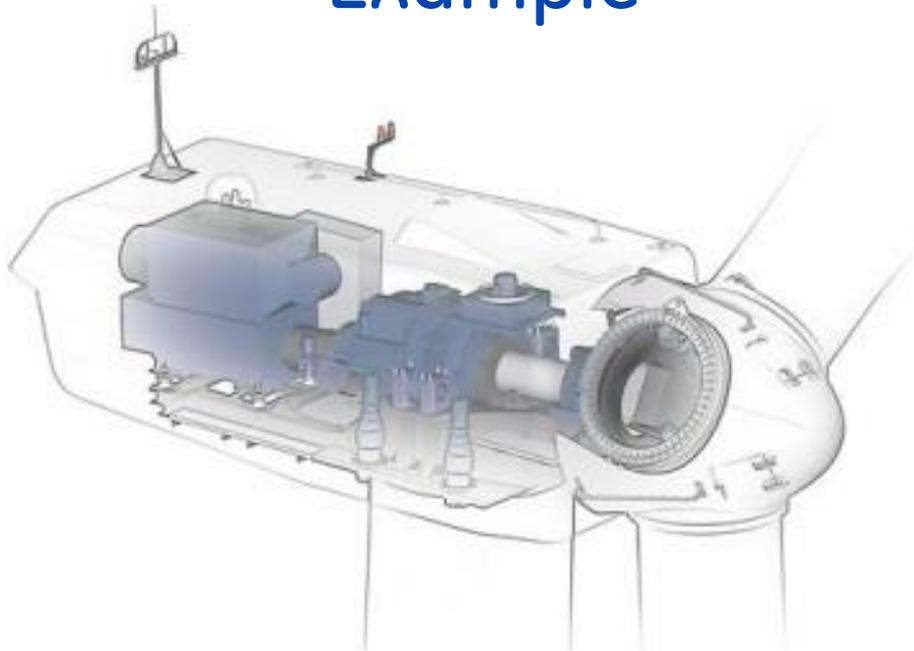
Source: CURI website
<http://www.clemson.edu/restoration>



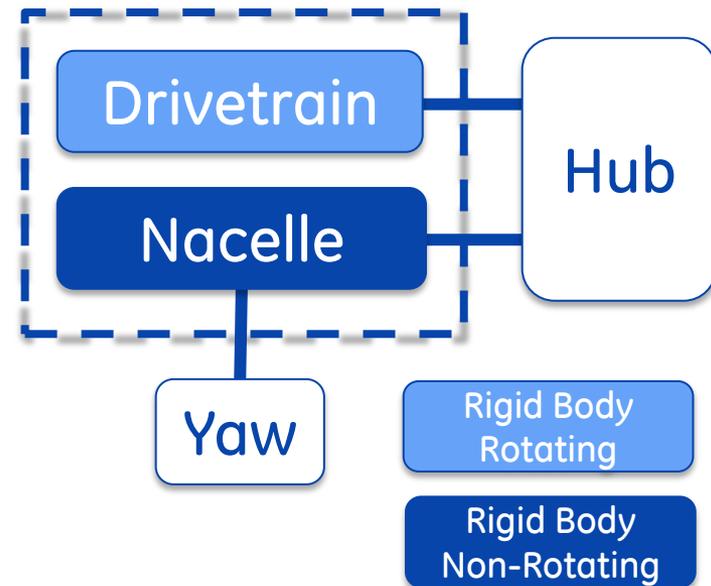
Source: Konstantin Bulgakov, EIC, CURI

Motivation

Drivetrain Example



Drivetrain Model Example



Find model fidelity that captures design drivers as designs evolve



Research Plan

2014

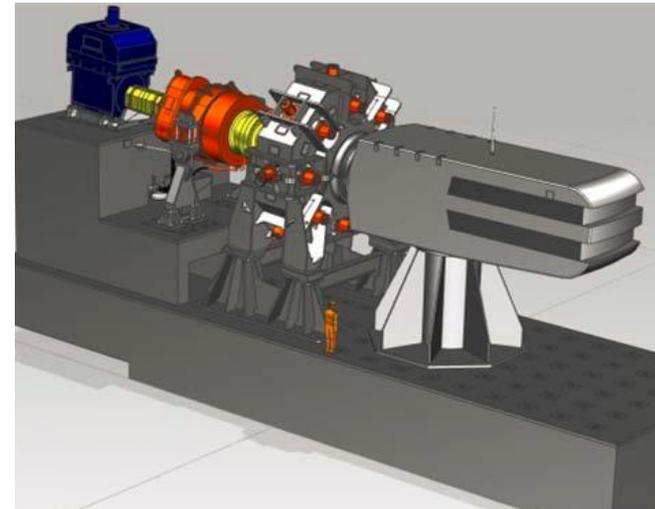
2015

2016

2017

Dev. &
Val. EFDM

Dev. &
Val. HFDM



Source: Konstantin Bulgakov, EIC, CURl

Apply EFDM & HFDM to
WT Controls Dev.

Dev.: Development

Val.: Validation

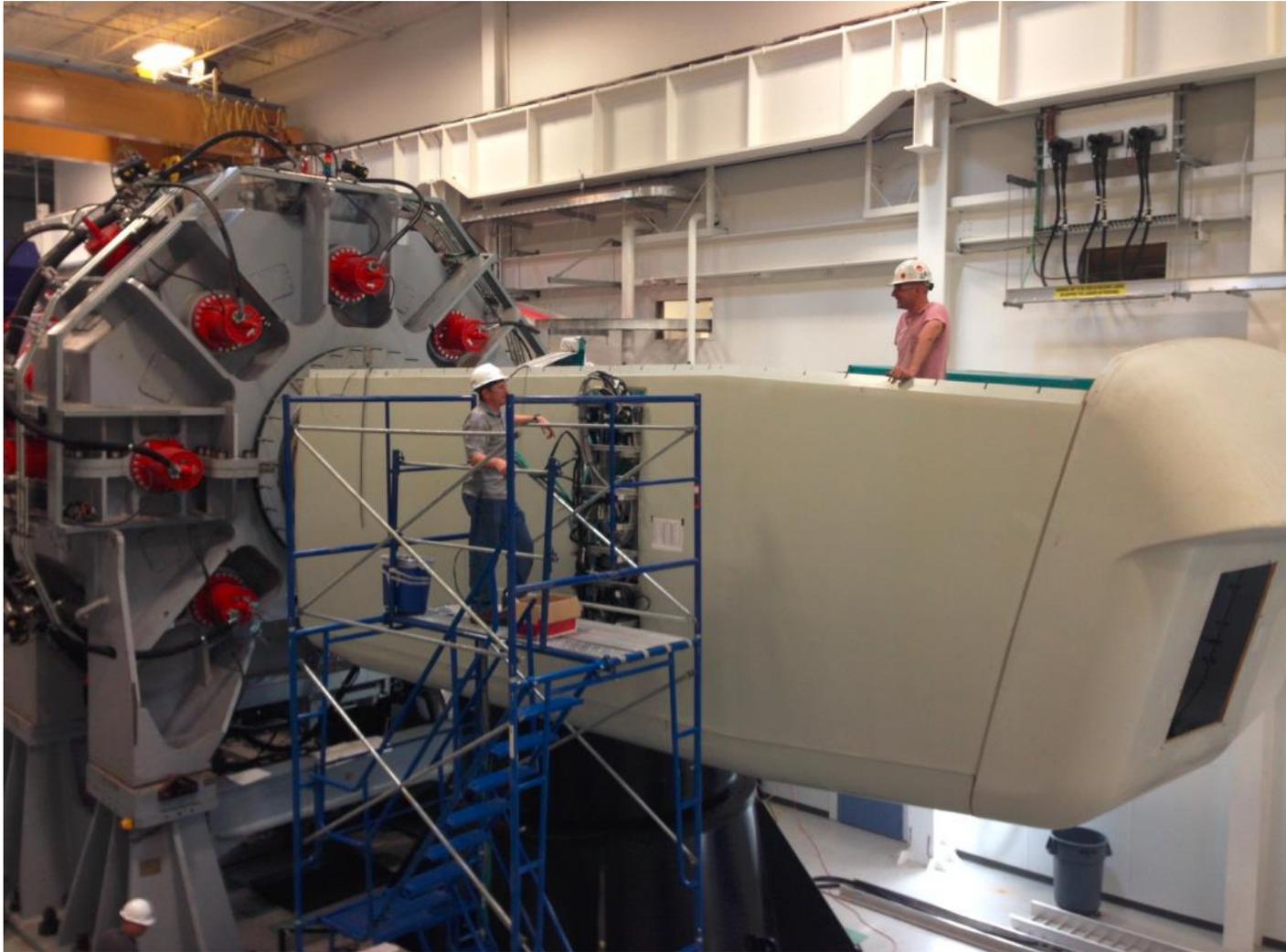
EFDM: Enhanced-fidelity drivetrain model

HFDM: High-fidelity drivetrain model

WT: Wind turbine



Upcoming Test – 1.6-MW Nacelle



Source: Konstantin Bulgakov, EIC, CURI

Synergy with Other Research

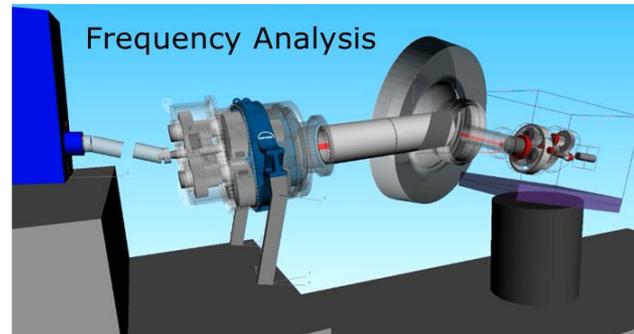
Clemson's Energy Innovation Center



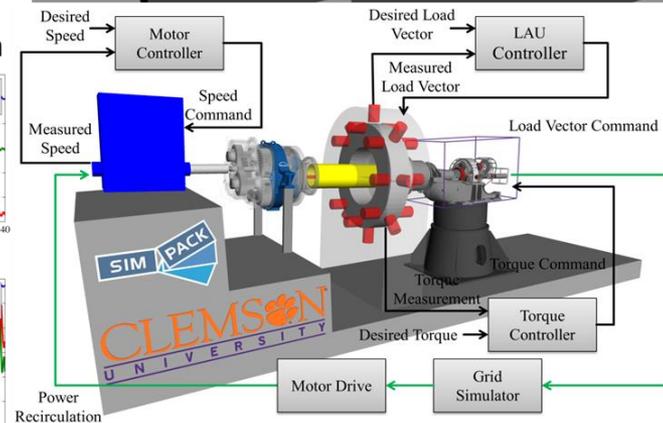
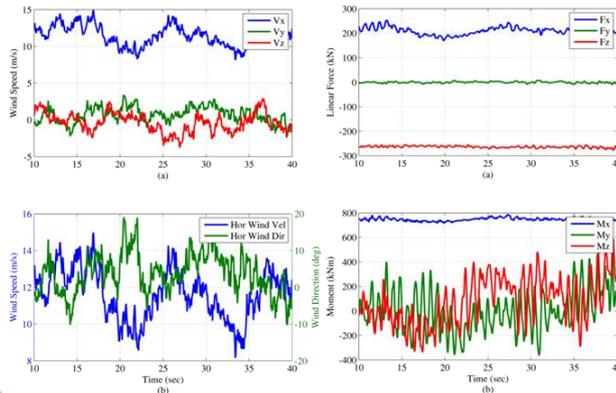
Dynamic Simulation Time and Frequency Domain

System level Dynamic Simulation

- Multi-body dynamics
- Control systems
- Electrical/power systems
- Real-time execution
- Wind load simulation
- Test profile development and evaluation
- Third party tool integration



Wind and Main Shaft Load Simulation



Time Domain Simulation



Source: Content from this slide from Dr. Ryan Schkoda, EIC, CURl



Summary

- Research starting
- Planned for 3-4 years
- Focus on drivetrain model development with application to controls
- Validation using drivetrain-in-the-loop 7.5-MW test bench & field data
- Open to extend cooperation

