Test and Analysis Results for Two Synergy Power Corp. Wind Turbines

Participants:

Windward Engineering

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by

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Description of Project

- ADAMS validation
- Field testing of Synergy turbines
  - S-20000 (6.2 m dia.)
  - S-50000 (10.3 m dia.)
  - SL (12.8 m dia.)
- Designing with ADAMS

Test Site

- Located near Spanish Fork, UT 50 miles south of Salt Lake City.
- Canyon winds
- Typical wind schedule:
  - Near ideal for prototype testing
  - Synergy turbines optimized for lower wind regimes

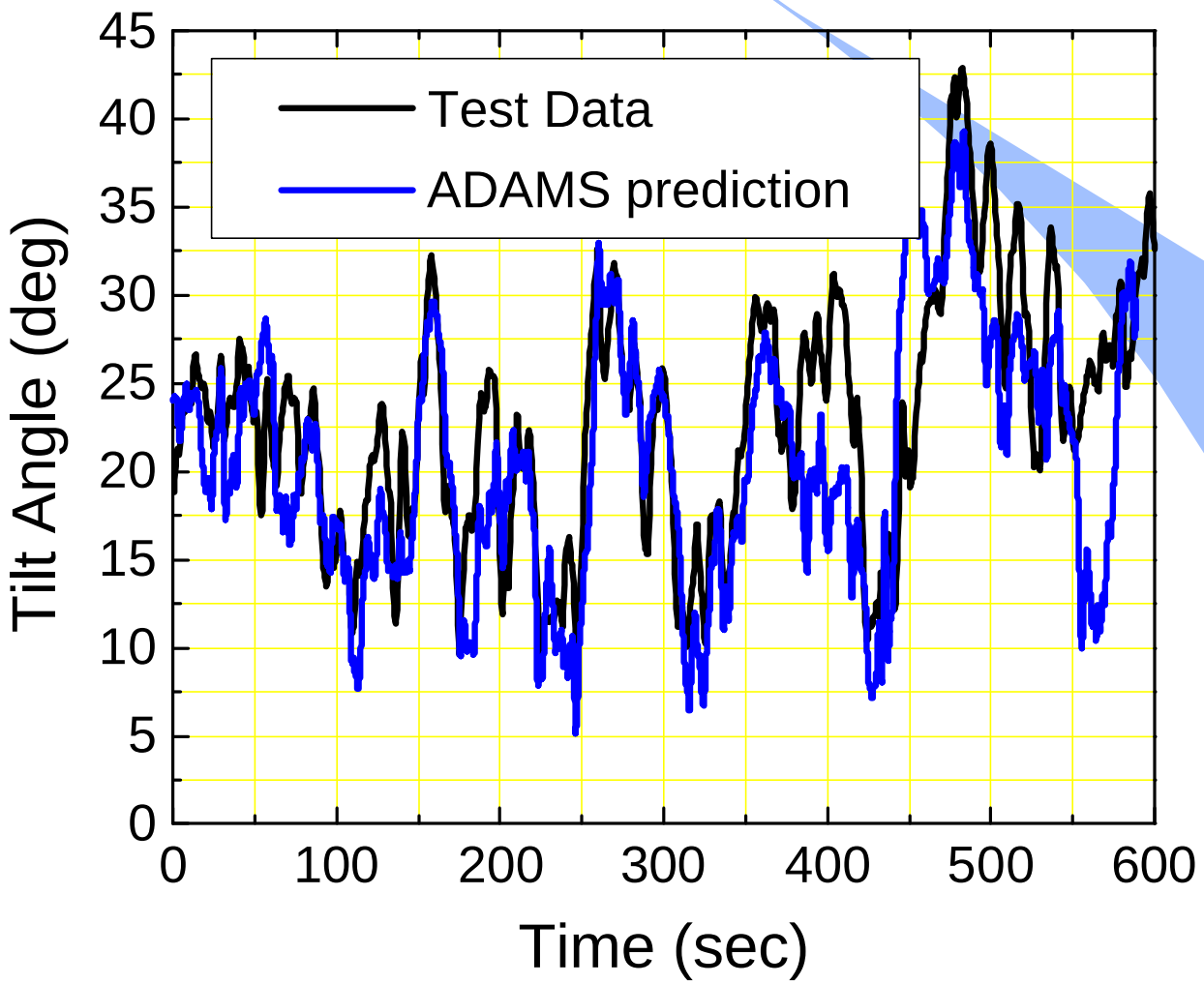
Synergy SL turbine

- 3 bladed 12.8 m dia.
- Free tilt (passive power regulation)
- Utility connected (constant rpm)
- Designed for low wind regimes (class 2)
- 30 kW rated power
- Fixed pitch

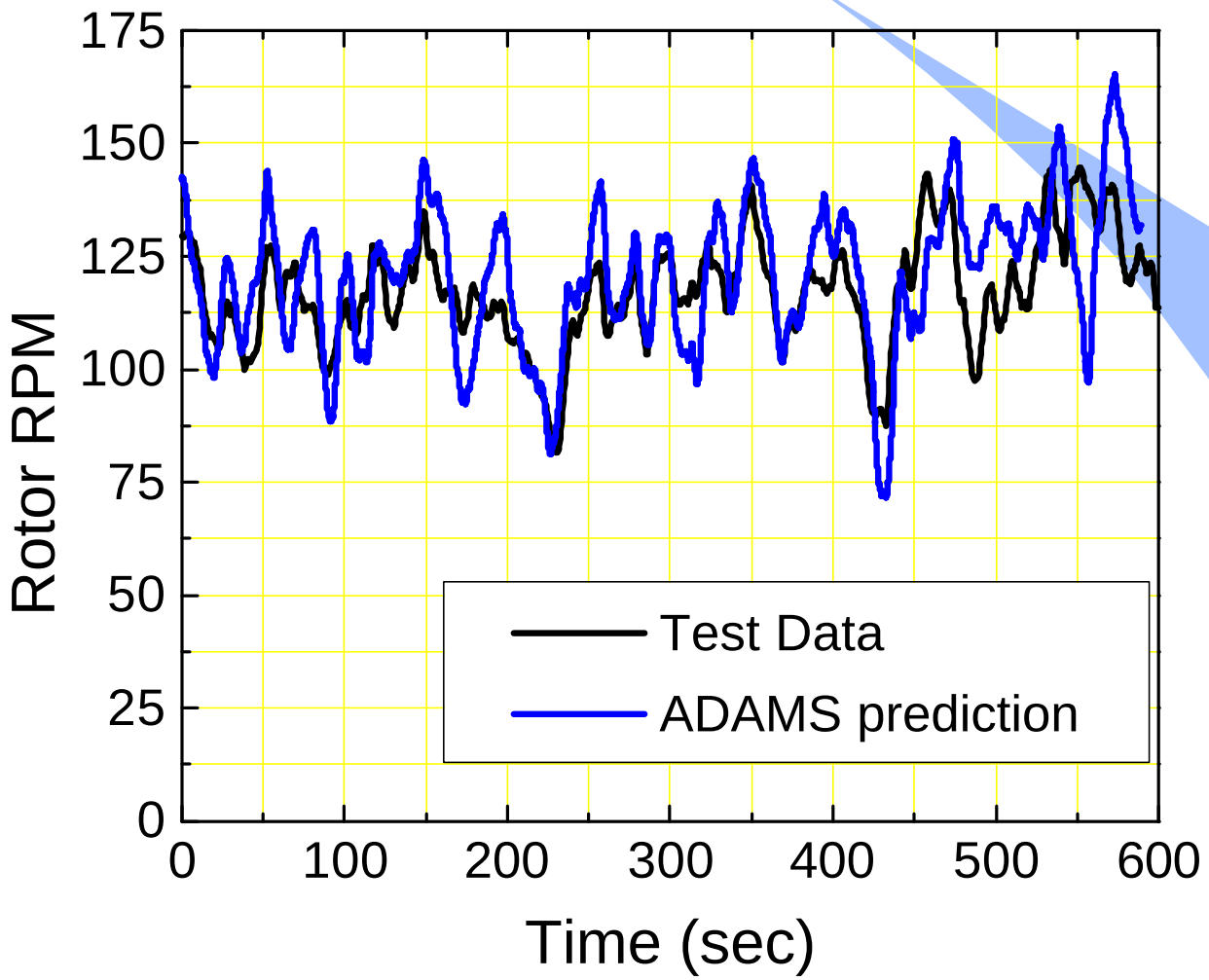
ADAMS model

- Modified aerodynamic subroutines for tail aerodynamics.
  - Tailboom Drag
  - Tailplane and rudder aerodynamics.
- Modeled both constant and variable speed.
- Free yaw
- 2 or 3 DOF (depending on RPM)

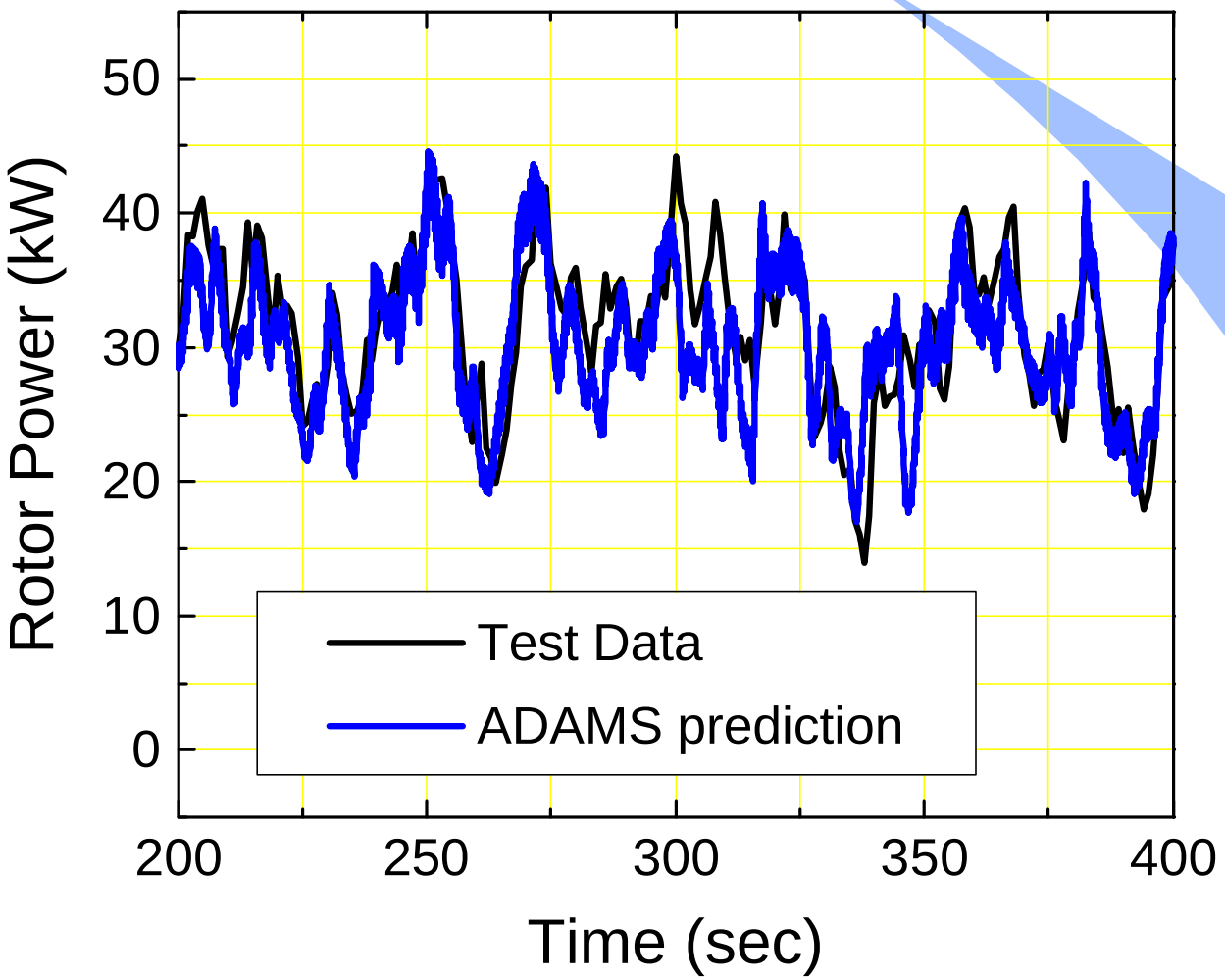
Model validation for S50,000



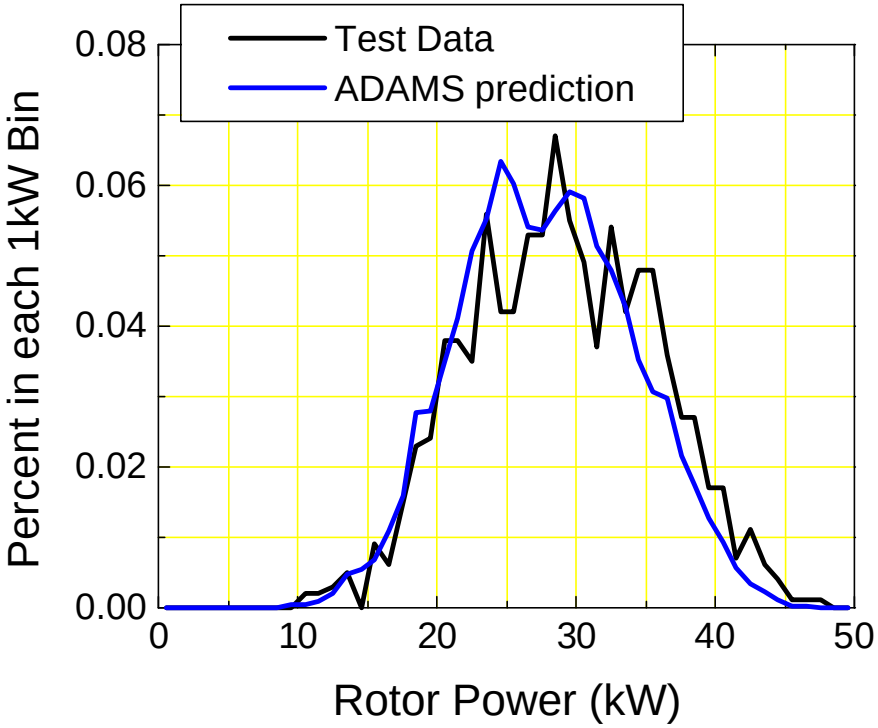
RPM Prediction (S50,000)



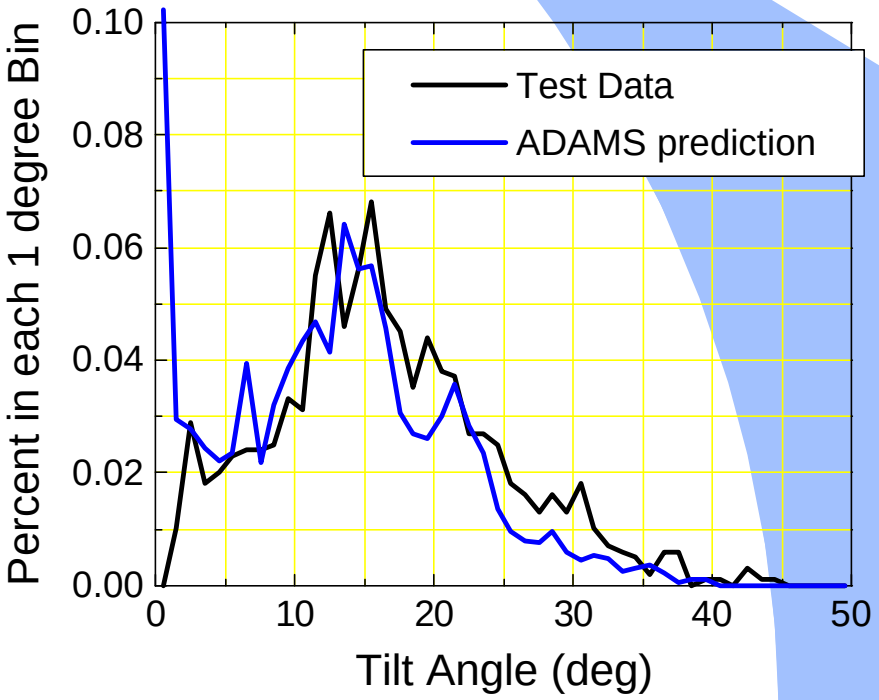
Performance validation for SL



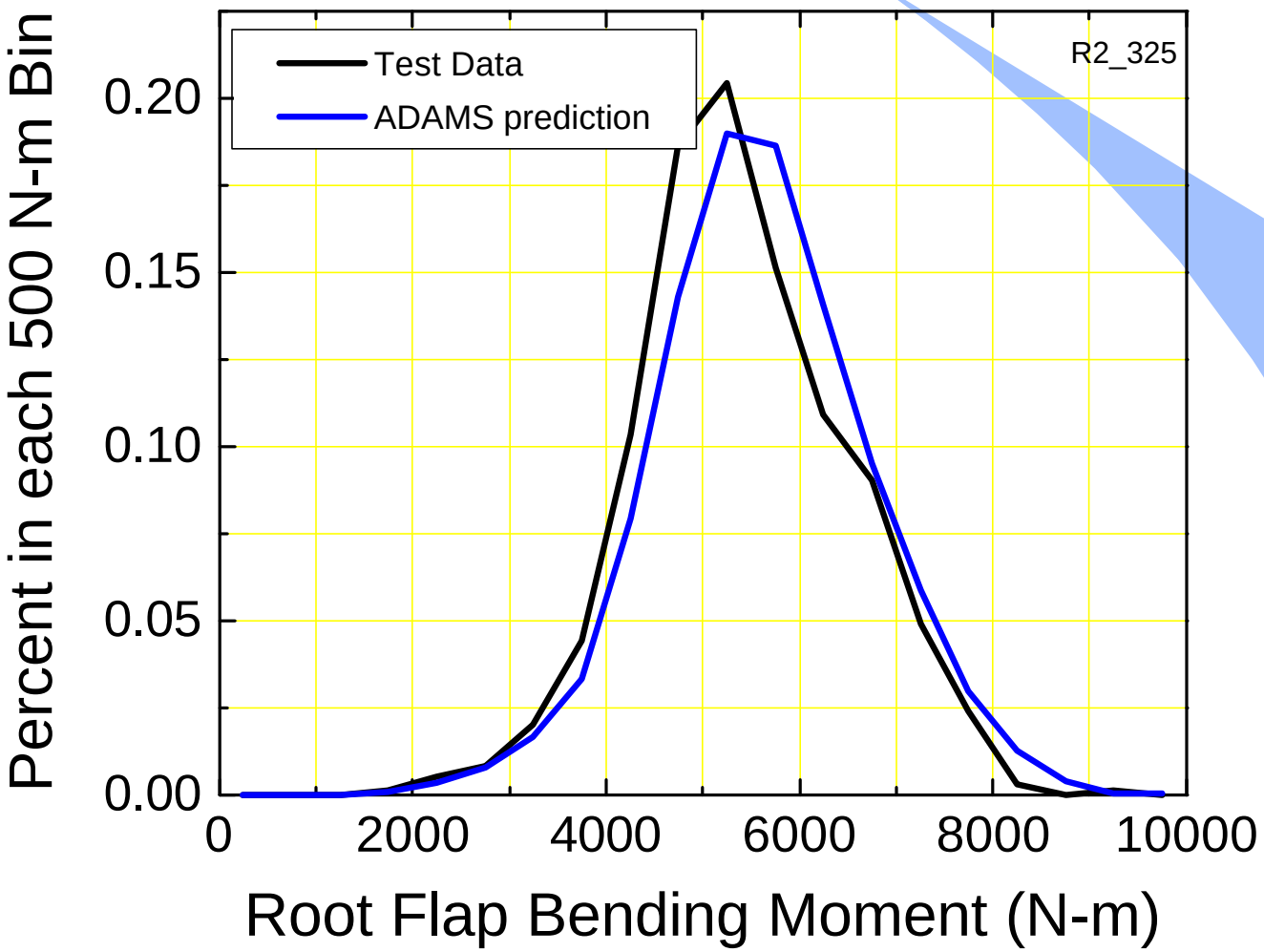
Performance validation for SL



Histograms for 1000 seconds of data.

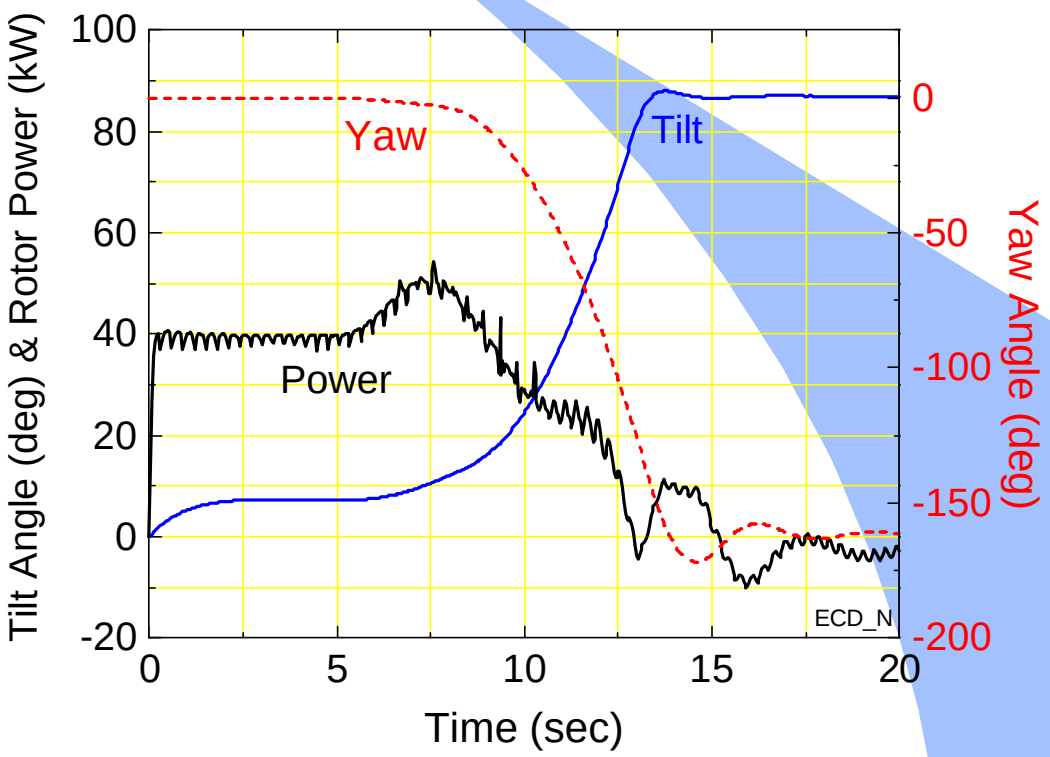


Loads validation for SL

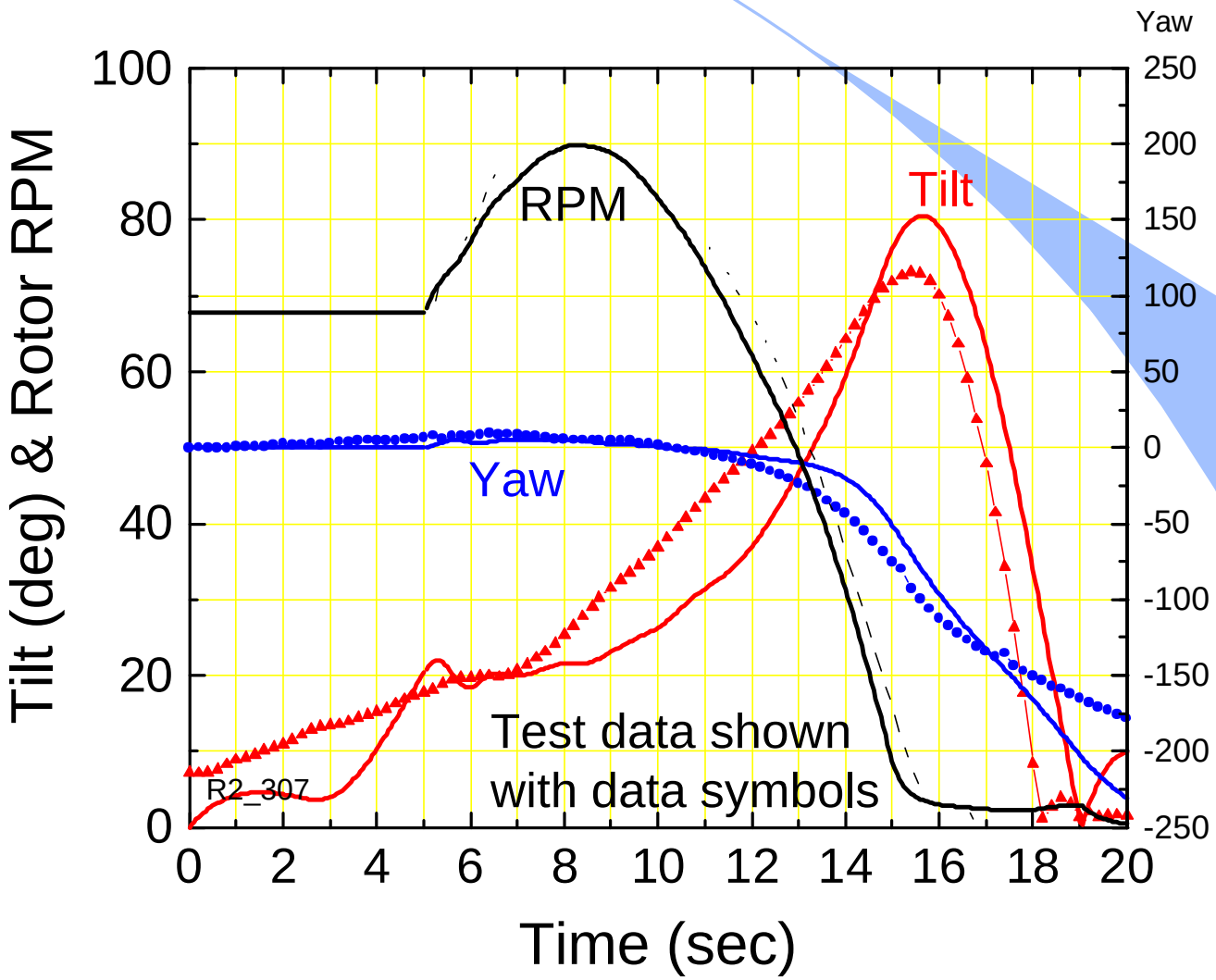


Modeling IEC Wind

- Ran 23 IEC standard winds
- Ran with and without faults
- Predicted system response and loads.



Modeling of emergency shutdown



Conclusion

- ADAMS accurately modeled Synergy free tilting turbine configuration.
- Good predictions for both variable and fixed rotor speed.
- Modeling was used to specify tilt geometry for desired power regulation.
- Modeling capabilities include loads and response in normal, IEC standard, and emergency conditions.

Acknowledgments

- Synergy Power Corp.
- Utah Municipal Power Agency
- City of Spanish Fork