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Control of Power Train Loads

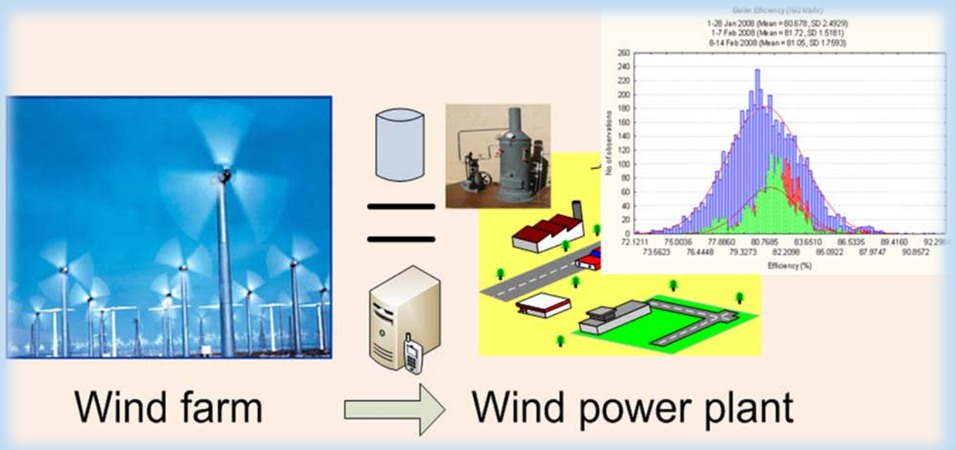
Andrew Kusiak
The University of Iowa, Iowa City, USA
andrew-kusiak@uiowa.edu

Abstract summary

Variable loads along the power train are the primary cause attributed to the failure of gears, bearings, and other mechanical components. The concept of anticipatory control applied to a wind power train is presented. This new approach to power train load management is based on the data reflecting the current status of the power train. The model driving the optimization of the power train loads considers four different objectives, including minimization of the torque variability and power maximization. A software tool for power train load management is presented. This new approach to power train load control is based on the data reflecting the current status of the power train. Such data is collected by a typical SCADA system. The model driving the optimization of the power train loads considers four different objectives, including minimization of the torque variability and power maximization. Details of the model that is applicable to different turbines are presented

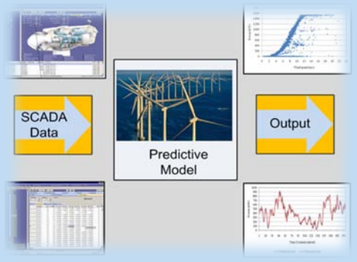
Objectives

Goal: Transform a wind a farm into a wind power plant

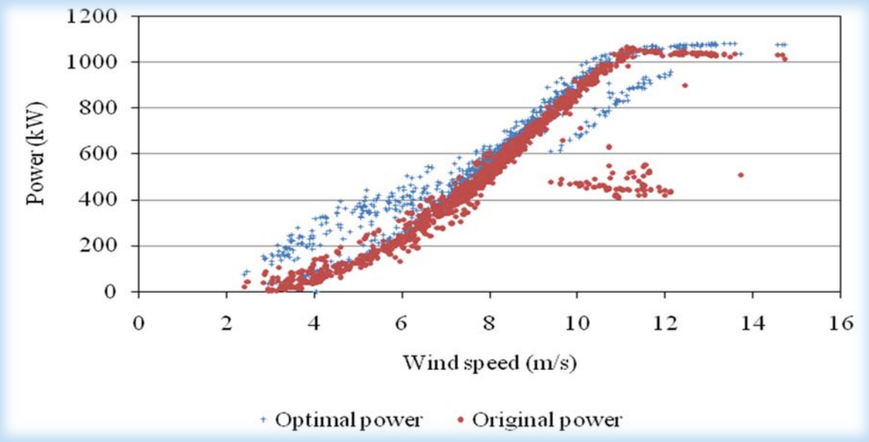


Example objectives:

- ✓ Minimization of the torque ramp rate
- ✓ Maximization of the power produced
- ✓ Maximization of the power quality



Modify the shape of the power curve

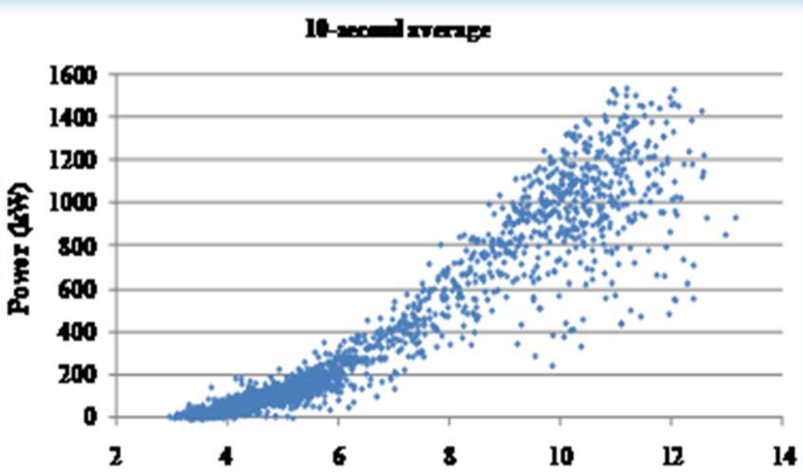


Methods

Data mining/Knowledge discovery

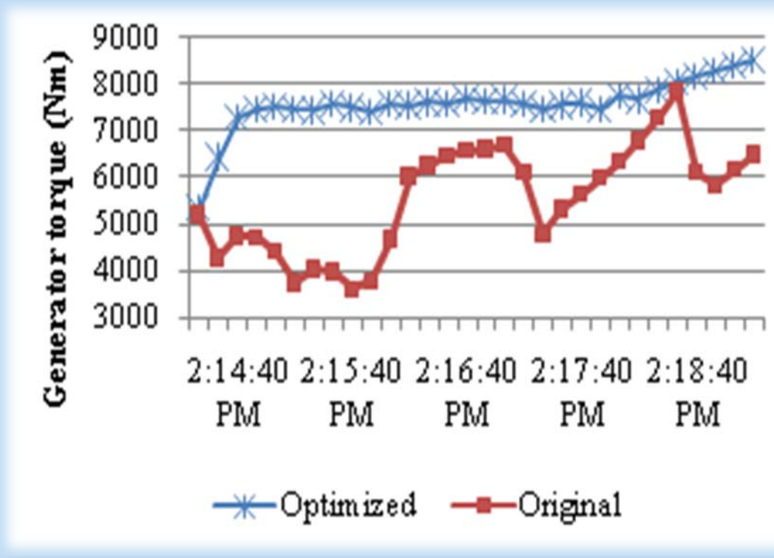
Results

Power curve for 10-second wind speed data



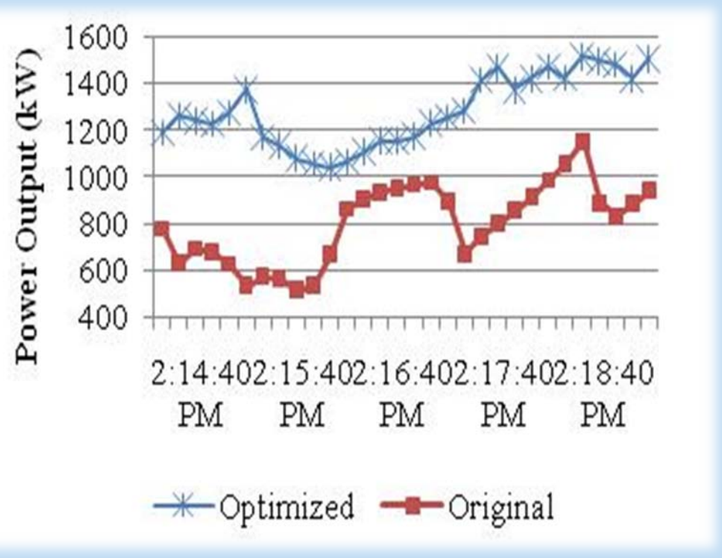
Highly variable turbine behavior (variable loads)

Optimized vs original torque



Smoothed out torque

Optimized vs original turbine power



Increased power at the same wind speed

Conclusions

The model and algorithms developed in this research were embedded in software enabling assessment of the impact of variable loads on the turbine life cycle. The software tool for power train load control was tested on the data collected from 1.5 MW wind turbines. The functionality of the software is featured in a live demonstration. The impact of this tool on the lifetime of the power train components will be unprecedented. Insights into the control of power train loads are provided.

References

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- ✓ A. Kusiak *et al*., Short-Term Prediction of Wind Farm Power: A Data-Mining Approach, *IEEE Transactions on Energy Conversion,* Vol. 24, No. 1, 2009, pp. 125-136.
- ✓ J. Engler and A. Kusiak, Web Mining for Innovation, *ASME Mechanical Engineering*, Vol. 130, No. 11, November 2008, pp. 38-40.

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