Wind Technologies Ltd.

New drivetrain for wind turbines dramatically decreases lifetime capital costs

speedgoat
real-time simulation and testing

wind technologies

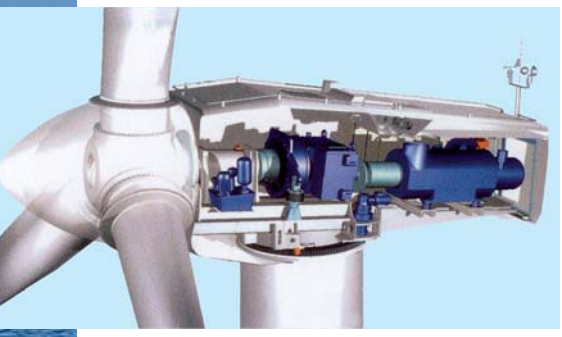
Wind Technologies are using Speedgoat products to control innovative new wind turbine generators. Their technology offers dramatic cost savings and reliability improvements, but requires a complex control system.

Wind Technologies, leading the WinDrive Consortium, including SENVION, Romax, Mita-Teknik, Speedgoat, the University of Cambridge, and Delft University of Technology, are working on the industrialization of a revolutionary drivetrain concept, enabling the total lifetime capital costs of the drivetrain to be reduced by up to 83%!

A 3MW Brushless Doubly-Fed Induction Generator (DFIG) prototype is being constructed as a proof of concept. The project is expected to be completed by April 2015, and is sponsored by the EU's Seventh Framework Programme with €1.5 million.

Benefits

Brushless DFIG offers significant cost reductions and reliability improvements when compared with conventional DFIG's. It does not require slip-rings or carbon extraction equipment, and as the machine operates at a slower speed than conventional DFIG, the failure-prone high-speed stage of the gearbox can be eliminated.



CAD rendering of the drivetrain

Control strategy

Brushless DFIG is inherently an unstable machine in open-loop operation and requires a robust controller to manage the speed and power of the generator. This is critical for extracting maximum power from the wind.

"We wanted to find a solution which allowed the design team to rapidly prototype and modify control loops in real-time based on models developed in Simulink", says Dr. Abdi, CEO of Wind Technologies.

To develop a control strategy efficiently, within the shortest possible time frame, it is important to have the ability to easily test and modify coding algorithms. Before the Speedgoat solution, the Wind Technologies team had to hard code every change in the microcontroller. This resulted in significant time delays and reduced quality.

Real-time control

A Speedgoat Education real-time target machine was chosen because of its rugged mechanical and electrical design, and low cost to academic institutions. The system was delivered with an IO101 analog input I/O module to read voltage, current and torque input signals, and a configurable FPGA-based I/O module with quadrature decoding and PWM generation support, which was used to read the rotor position and speed, and to control the inverter.

Testing & simulation

Engineers used Simulink to model the Brushless DFIG. This provided the team with a baseline with which to test and evaluate the control algorithms on a standard development computer.

During this simulation phase, the model was subjected to step-changes in torque and demanded power, representing the changes in wind speed and load power typically experienced in large wind turbines. The model was also tested to verify that the generator complied with current grid-code regulations.

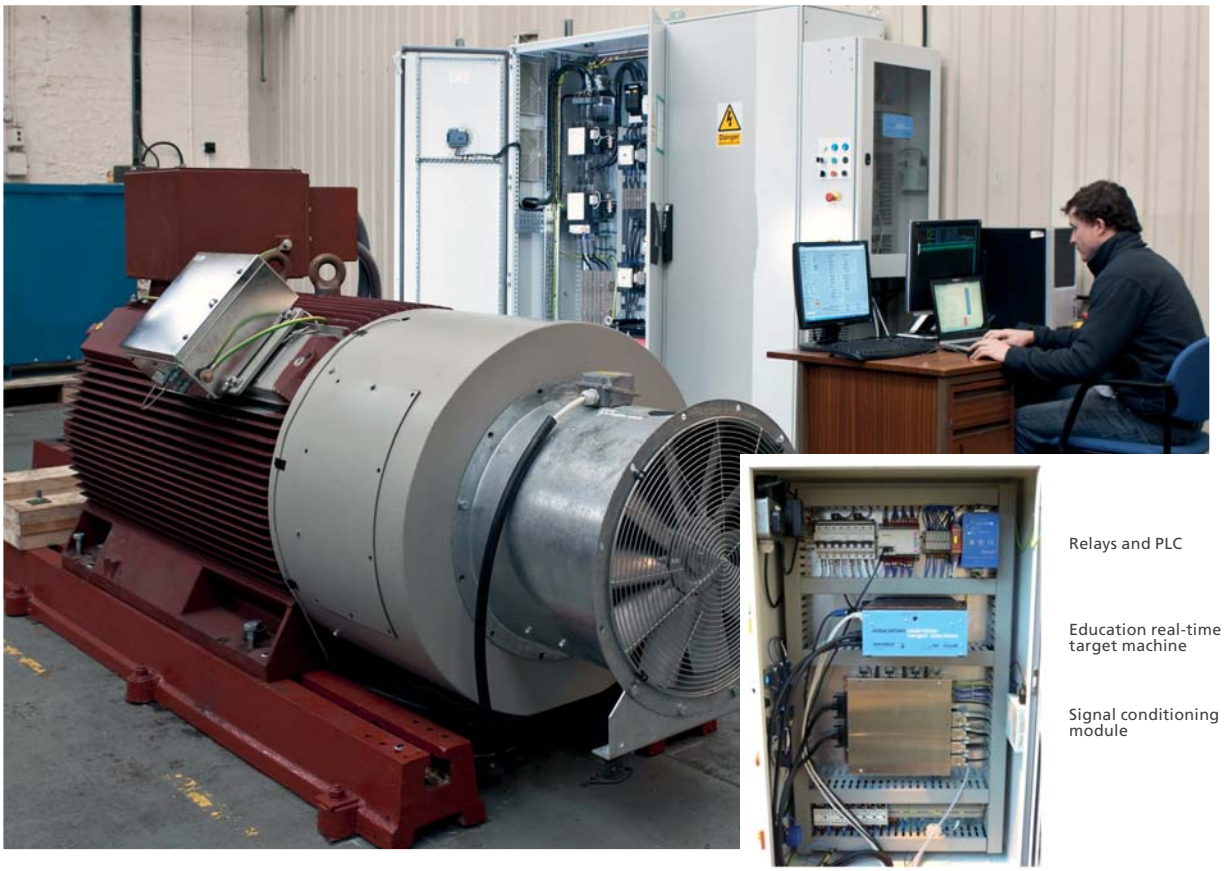
Once an algorithm had been tuned for optimum performance, engineers were able to easily transfer the model to the Speedgoat target machine to control the physical generator in real-time. Model parameters were adjustable directly, on the fly from the development computer.

Speedgoat's value contribution

"The ability to easily and effectively transfer code from Simulink to the Speedgoat real-time target machine has resulted in a significant time saving over the course of the project.

We did not experience any bugs (typical in DSP programming) using Speedgoat, this resulted in 30% more robustness and higher reliability", said Dr. Abdi.

Dr. Ehsan Abdi, CEO, Wind Technologies



Controlling 250 kW Brushless DFIG using an Education Real-Time Target Machine

Relays and PLC

Education real-time target machine

Signal conditioning module

Cabinet with control system

Wind Technologies Ltd

Cambridge, UK

www.windtechnologies.com

Speedgoat products used

- Education real-time target machine
- IO101 analog input I/O module
- Motion Control FPGA package with PWM generation and capture, and quadrature decoding I/O

MathWorks software used

- MATLAB®
- Simulink®
- MATLAB Coder™
- Simulink Coder™
- Simulink Real-Time™

Learn more

www.speedgoat.ch/userstories

speedgoat
real-time simulation and testing