

## EWIS

Being one of the leading institutes on wind energy research, ECN has established the new EWIS (ECN Wind Industrial Support) group in 2009 to better bring the R&D results to the market. During the last three decades, ECN has developed expertise on aerodynamics, structural analyses, turbine control, offshore operation and maintenance, and grid connection. With the growing wind industry, ECN received more requests for assistance and EWIS has become the vehicle to support the wind energy industry in their product developments.

EWIS's focus is on the high end of the market which means that we will make use of tools and knowledge that have been developed in-house and include the latest R&D results!

The EWIS team is a mixture of young professionals and experienced researchers which ensures a fast response and high quality.

**More information**  
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## Training Control of Wind turbines

### Purpose

The purpose of the course is to give an overview of the different wind turbine control objectives and the control algorithms that can be used to achieve these.

### Organisation and content

The course is given in two days. The first day is dedicated to building basic knowledge on control, and giving an outline of the structure and the different control components that are encountered in typical conventional wind turbine controllers, as used in the industry. This baseline control includes loops that use the generator torque and the blade pitch mechanism to achieve power regulation, rotor speed control, drive-train damping, and feed-forward control of estimated rotor-effective wind speed. Some additional topics that are covered are gain-scheduling, wind speed estimation, filter design, and peak-shaving.

During the second day the focus lies on advanced control for fatigue load reduction on important wind turbine components, such as tower, blades, shaft, etc. More specifically, it will be discussed how tower vibration in the fore-aft direction can be reduced using collective blade pitch control, how the side-to-side tower motion can be actively damped by using control of generator torque, and how individual pitch control can mitigate fatigue loads in the blades and other wind turbine components.

Some of the discussed control loops are accompanied by interactive examples in the Matlab / Simulink environment. Participants that are specifically interested in acquiring software tools for wind turbine control design can purchase the ECN Control Design Tool, which is offered with a more extensive, dedicated course.

The contents of the course are provided in more detail below.



**Target Group:** Wind turbine control designers, research institutes, universities.

**Required educational level of attendees:** Engineers/scientists. Knowledge of control and/or Matlab/Simulink is not required, but is an advantage.

**Track record:** This is a new course offered as an alternative to the course ECN Control Design Tool for people who do not wish to purchase the Control Design Tool.

**Minimum/maximum number of participants:** In principle there is no limitation on the number of participants but groups with more than 10 participants need some special arrangements which need to be negotiated.

**For more information about this training, please contact:**

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## Day 1

### Morning: wind turbine relevant background knowledge on control

- Wind turbine modelling for control design
- Basic feedback control laws (P,PI,PD) and their properties
- Exercises with Matlab

### Afternoon: baseline wind turbine control

- Blade pitch control for rotor speed: design, evaluation, filters, gain-scheduling, peak shaving
- Generator torque control for power regulation
- Drive-train damping control
- Wind speed estimation and feedforward control

## Day 2

### Morning: tower fatigue load reduction

- Tower fore-aft damping by collective blade pitch control
- Tower side-to-side damping by generator torque control

### Afternoon: individual pitch control for blade fatigue load reduction

- Turbine modelling for individual pitch control
- Wind excitation on blades and rotor
- Coleman transformation to non-rotating coordinates
- Individual pitch control design and implementation
- Gain scheduling of individual pitch controllers
- Dealing with actuator constraints in individual pitch control.