

- modelling and simulation
- control design
- system troubleshooting
- technology transfer and training
- energy efficiency investigation
- software tools



Wind Turbine and Wind Farm Training Course

on the Improved Control of Wind Turbines, Onshore and Offshore Wind Farms

Summary

The aim of this three days' training course is to consider the design of wind turbine control systems, methods to improve them both in terms of performance and reliability, and consider advanced methods for the control of wind farms. It will particularly focus on offshore wind farms where problems of robustness and reliability dominate. This course is intended to provide a tutorial introduction to the control and condition monitoring techniques involved and also an overview of the current state of the art in both wind turbines and wind farms.

The training course is to be organised by ISC Ltd., which is one of the leading partners in a European Union supported project AEOLUS on offshore wind farm control and members of this project will contribute to the event.

The level of the course will be introductory with demonstrations so that engineers appreciate the techniques described. It will also provide a tutorial overview of the research in wind turbine control systems aimed at improving energy capture, reducing breakdowns and limiting maintenance costs. The training course will provide training via hands on simulation experience for tuning controllers and assessing performance. It will include industrial perspectives and new developments.

The wind farm training course will cover instrumentation, condition monitoring and fault diagnosis and there will be a review on the state of the art of the subject. It will include a demonstration overview of the research in offshore wind energy systems aimed at reducing breakdowns and limiting maintenance costs. Some of the new developments to be reported will be based upon that from European Union funded projects and particularly Aeolus which is concerned with reducing fatigue loading and power regulations in offshore wind farms.

The topics covered will include:

- Modelling and simulation of nonlinear wind turbine control systems
- Classical and PID control law design for regulating loops
- Problems in the Implementation of classical or PID controllers
- Overview of the use of Classical Control Design in Wind Turbine Applications
- Optimising the performance of turbine and wind farm controls
- Supervisory Control for Wind farm Control
- Interaction between regulating loop and supervisory control designs
- Control design and condition monitoring methods for wind farms
- The Challenges of Offshore Wind Farm Control
- Control design to reduce fatigue and maintenance problems in offshore farms
- Fatigue and Nonlinearities (simple controllers and design methods)
- Advanced modelling and supervisory controls for wind farms
- New predictive supervisory control design methods for wind farms
- Problems in the design of offshore wind farm controls
- Fault monitoring, reliability, robustness and reconfiguration to reduce need for manual intervention in offshore installations
- Predictive control for supervisory wind energy systems
- Introduction to Optimal Control Design Methods
- Disturbance rejection using Optimal and LQG design
- Nonlinearities (simple controllers and design methods)
- Design issues including the effects of delays and robustness.
- The problems of reliability and fatigue control
- Robustness, monitoring and reconfiguration
- The AEOLUS project results.

The training course follows a very successful workshop event held in May 2011 in Glasgow and it will again try to provide opportunities to foster social and technical interactions between the attendees.

The training course is aimed at engineers in industry both in the consultancy and commissioning sectors as well as in the operating companies. The course will be suitable for both those involved with the design and commissioning of wind turbine controls and also those responsible for developing new systems or operating wind energy devices. There will be a significant contribution from companies involved in the sector.

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To summarise the training course should be of interest to:

- Wind turbine control loop designers
- Electric utility design and planning engineers
- Consulting engineers
- Researchers in wind control related areas
- Project managers
- Managers of design departments
- Engineering technicians and maintenance staff

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Agenda

Day 1: Understanding Wind Turbine System and Control System

- 0845 Registration*
- 0900 Welcome and Introduction to the Course by Professor Mike J Grimble
- 0910 Motivation and Need for Control System for Wind Turbine System
- 1000 Tea/Coffee*
- 1015 Modelling of Wind Turbine System
- 1200 Hands-On Session:** Modelling of Wind Turbine System
- 1300 Lunch*
- 1345 Wind Turbine Operation and Feedback Control Loops
- 1515 Tea/Coffee*
- 1530 Linearisation of Nonlinear Wind Turbine System
- 1615 Hands-On Session:** Linearisation of Nonlinear Wind Turbine System
- 1700 Closed*

Day 2: Classical and Advanced Control of Wind Turbine System

- 0900 Principal of PID Control Law Design and Tuning for Regulating Loops
- 1030 Tea/Coffee*
- 1045 Implementation Issues of Classical or PID Controllers
- 1145 Hands-On Session:** Designs of PID Controller for Wind Turbine System
- 1300 Lunch*
- 1345 Overview of the Use of Classical Control Design in Wind Turbine Application
- 1445 Tea/Coffee*
- 1500 Introduction to Optimal Control Design Methods for Wind Turbine Controls
- 1600 Hands-On Session:** Optimal Control Design Methods for Wind Turbine System
- 1700 Closed*

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Day 3: Offshore and Onshore Wind Farm Control

- 0900 Introduction to the General problem of Wind Farm Modelling and Control
- 1015 *Tea/Coffee*
- 1030 Introduction to Predictive Control Design Methods (for use in Wind Farm control)
- 1100 Application of Classical and Advanced Supervisory Predictive Control for Wind farms
- 1200 *Lunch*
- 1300 Demonstrations** of Predictive Supervisory Control for Wind Farms and Improvements to Performance and Reliability Discussion farms
- 1400 Overview of Other Advanced Control Methods for Wind Turbines and Wind Farms
- 1500 *Tea/Coffee*
- 1515 New Condition Monitoring Methods for Wind Farms
- 1600 Fatigue and Loading in Offshore Wind Farms and the Results of the EU AEOLUS Project (including summary of talk Project Leader – Professor Thomas Bak, Aalborg) given by Prof Mike Grimble.
- 1645 Discussion
- 1715 *Close*