



UNIVERSITY: Public University of Navarre (UPNA)

WIT PROGRAMME'S RESEARCH LINE NAME:

Optimization and control applied to the development of advanced material and technologies for energy production

DOCTORAL PROGRAMME: Doctorate in Communications Technology, Bioengineering and Renewable Energies <https://www.unavarra.es/escuela-doctorado/doctorate-programs/current-plan/engineering-and-architecture/doctorate-in-communications-technology-bioengineering-and-renewable-energies?languageId=1>

COMPLETE DESCRIPTION OF THE LINE

The exponential increase in the size of onshore and offshore wind turbines is bringing significant challenges to wind energy engineering, and specifically to wind energy control. To be cost-effective, both the tower and the blades of these large structures are increasingly flexible and therefore, more sensitive to the loads produced by the stochastic nature of wind and waves. The development of even larger and more efficient wind turbines is limited by the mechanical fatigue and extreme loads due to vibration in their components.

In recent years, many solutions taken from structural control field have been proposed to alleviate these vibrations, mostly based on the use of passive, semi-active and active dampers. These solutions are built on top of existing wind control schemes, such as the pitch and torque control loops. However, there are no control-oriented, systemic designs, in which these new actuators are integrated with pre-existing ones in a sole, multi-objective, coordinated control system. This PhD will explore the design of such control system from the perspective of robust multivariable control.



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RESEARCH GROUP NAME: Advanced Wind Turbine Control (within UPNA's Dynamical Systems and Control Group)

COORDINATOR:

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MEMBERS OF THE LINE RESEARCH:

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ANOTHER RESEARCH LINES OF THE GROUP: list of them

- Robust control and estimation
- Wind turbine control and estimation
- Quantitative feedback theory
- Multivariable control
- Modelling and control of distributed parameter systems
- Control of welding processes



- Entities involved in research lines and contact person:
 - ✓ Academic entities:
 - University of the Basque Country (Xabier Ostolaza)
 - Flensburg University of Applied Sciences (David Schlipf)
 - University of La Rioja (Montserrat Gil-Martínez)

 - ✓ Industrial entities:
 - Siemens Gamesa Renewable Energy (Jesús Arellano, Control Section Manager)

- Joint supervision of doctoral thesis with international universities or non academic institutions:
 - Two (current) joint supervisions with Siemens-Gamesa Renewable Energy, one focusing on QFT control of large soft-soft wind turbines, and the other one working on advanced feedforward control based on LIDAR measurements.

- Brief group overview



The group activity focuses on robust control and its application on multivariable, non-linear and distributed parameter systems. In particular, the group has expanded the theoretical basis of quantitative feedback theory (QFT) to cope with monovariable and multivariable uncertain dynamical systems subject to measurable disturbances, proposing methods that find the best combination of feedback and feedforward action in such scenario.

The group works in close collaboration with companies in the wind-power industry since 2013, contributing to the application of robust techniques to turbine control systems and the design of algorithms to estimate variables which are difficult to access. This cooperation has led to 17 technological transfer projects and 2 industrial PhD theses, currently underway.

REQUIREMENTS:

Academic degrees: Engineering, Physics or Mathematics.

Additional requirements:

Required: Control theory, classical control, frequency-domain methods.

Desirable: Robust control, Wind turbine modelling and simulation, System identification, Mechanical loads and fatigue, Aerolastic codes (FAST, Bladed, or similar), Matlab.