PhD position at IFP Energies nouvelles (IFPEN)

Mathematics

Wind energy cost minimization by wind turbine control adaptation to wind farm flow control

Wind energy demands significant space, leading to the grouping of wind turbines into farms with an increasing number of turbines. A drawback of densely packed wind farms is the aerodynamic interference between turbines, causing wake losses. To mitigate these losses, it is possible to slightly control, at least partially, the wind flow within the farm by acting on the aerodynamics of the turbine rotors, thereby modifying their wakes. This approach is known as wind farm control.

A barrier to the development of farm control on commercial wind farms is the concern about potential turbine damage from operating them under conditions which they were not designed for. This concern applies to both the actuated turbines, which may, for example, operate misaligned with the wind direction or underproduce, and to the non-actuated turbines situated in the wake of others, as they will experience altered wakes. The objective of this thesis is to study how individual turbine control can be adapted to minimize turbine deterioration under the aforementioned conditions, while setting a global objective of minimizing the cost of energy for the entire farm. This work will be conducted under the joint supervision of IFPEN and GIPSA-Lab. It follows a thesis on wind turbine control aimed at managing a fatigue trade-off between several turbine components, and several theses and studies on wind farm control. The student will develop optimal control and observation strategies, aiming at adapting control parameters to effectively minimize a criterion corresponding to the cost of wind energy. The outcomes of the thesis could eventually lead, if sufficiently advanced, to tests on a reduced-scale wind farm in a wind tunnel.

Keywords: Wind turbines, Wind farms, Control, Estimation, Optimal Control, Optimization, Predictive control

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IFPEN supervisor	Dr, David COLLET, Research engineer, Control, signal and systems department, david.collet@ifpen.fr, 0000-0002-0022-9572
PhD location	IFPEN, Lyon, France
Duration and start date	3 years, starting in fourth quarter 2025 (Novembre 3)
Employer	IFPEN
Academic requirements	University Master degree mathematics or mechanical engineering
Language requirements	Fluency in French or English, willingness to learn French
Other requirements	Control systems, optimization, signal processing

To apply, please send your cover letter and CV to the IFPEN supervisor indicated above.

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