

## PhD position at IFP Energies nouvelles (IFPEN) in Mathematics

# Design of Real-time Estimation Algorithms for Fault Detection and Load Mitigation Control at the Wind Farms Scale

In the field of wind energy, operators are now focusing on using existing wind farms more efficiently, reducing farm-level mechanical stress and reducing maintenance costs through improved fault detection. In this context, our central question will be "How to design an algorithm capable of optimally and robustly estimate the wake and 3D wind field in real-time at the wind farm scale?". Indeed, the estimation of these complex quantities is a necessary step to go further: once the state of the wind farm has been accurately estimated, it can be used to design new and better fault detection algorithms, and controllers for the distribution of the load on the farm. Up to now, most fault detection algorithms and load distribution controllers in the wind farm are based on a static assumption for wind direction and wind speed, and that the wind comes from two/three fixed directions. In addition, the classical approaches consist mainly of centralized estimation and parametric wake models and are unfortunately unable to answer our central question due to the inaccuracy of the estimation results and the complexity of the calculations. We are facing a sound scientific challenge. We will use methods of Gaussian Processes modeling and advanced filtering in a context of distributed computations.

The results of the thesis will allow two major advances: 1) Drastically improved estimation performance of complex quantities in real time (wake, 3D wind field) that can be used for fault detection and load mitigation control. 2) Drastically improved robustness against failures in the communication network.

**Keywords:** Estimation, Machine learning, Gaussian process, Distributed computation, Filtering, Wind energy, Wind farm

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<b>Doctoral School</b>	ED432 - Sciences des Métiers de l'Ingénieur
<b>IFPEN supervisor</b>	Dr. Olivier LEPREUX, Research engineer, Control, Signal, Systems Dpt., recruit.postdoc@ifpen.fr
<b>PhD location</b>	IFP Energies nouvelles, Lyon, France
<b>Duration and start date</b>	3 years, starting preferably on October 1, 2019
<b>Employer</b>	IFP Energies nouvelles, Lyon, France
<b>Academic requirements</b>	University Master degree in mathematics, automatic control or signal proc.
<b>Language requirements</b>	Fluency in English
<b>Gross monthly salary</b>	2245 € (first year), 2430 € (second year), 2580 € (third year).

For more information or to submit an application, see [theses.ifpen.fr](http://theses.ifpen.fr) or contact the IFPEN supervisor.

### About IFP Energies nouvelles

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