# Internship on LiDAR modelling and Wind Field Reconstruction for Offshore Wind Turbines

## Summary

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| Internship: | Wind Field Reconstruction based on LiDAR measurements  6 months, starting from March 2021 on  Based at SGRE Rouen/France  Compensation of around 1100€/month |
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| Key words: | Renewable Energy, LiDAR measurements, Wind Field Reconstruction, Fluid Mechanics, Model validation, |

## Description

### Introduction and Subject Description

The proposed internship is situated in the larger context of Offshore Wind Energy R&D in the Normandy region of France.

The design process of a modern Offshore Wind Turbine is based on a detailed assessment of all mechanical loads based on Numerical Simulations of the entire turbine and its environment. Siemens-Gamesa Renewable Energy (SGRE), current world market leader in Offshore Wind Energy, develops such Numerical Models in-house to improve the prediction of loads and to extend the validity of the existing modes to a wider range of environmental conditions.

The proposed internship will take place at the R&D office of Siemens Gamesa in St Etienne du Rouvray, very close to Rouen. The R&D team there consists of people with a wide range of backgrounds in Numerics, Physics and Engineering, and it is responsible for the development of advanced aerodynamic solvers and numerical simulations, wind and wake models, methods to monitor turbine blades and predict defects, models for the compliance of the electrical grid as well as applying Artificial Intelligence and Neural Networks as predictors for loads. Once developed, these models are validated using Statistical methods, certified and integrated into the tool chain for loads computations. These models are furthermore subject to a constant process of re-evaluation and optimization.

Modelling the wind approaching a turbine is a field of ongoing research, largely enabled by the availability of non-intrusive upwind LiDAR velocity measurements by devices installed on the turbine nacelle. The significantly increased data rate and the upwind distribution of the samples taken over time allow to not only characterise the wind field by its statistics, but to model the incoming flow field on a coarse scale.

### Internship objectives

The aim of the internship is summarised in the following points :

1. Modelling of the measurement volume of the LiDAR
   1. At the focal point
   2. Using a quadrature based on multiple points distributed along the LOS
   3. Using a quadrature also in radial direction to model the beam shape
   4. Using a fully random distribution of scattering points
2. Modelling the data acquisition process based on a generalized approach
   1. Recording a time-dependent signal based on the scattering signal received from the tracer particles
   2. Binning of the signal into segments and FFT
   3. Averaging the power spectra over multiple segments to get the Doppler spectrum
   4. Averaging the Doppler spectrum to get the Vlos
3. Testing and evaluating the models
   1. Synthetic turbulence
   2. Transported IEC gusts and other gust models
   3. Perhaps vortex models
   4. Quantifying computational time, qualitative analysis on the source of measurement uncertainties

### Candidate profile:

* MSc student in the last year with all courses finished
* Competences: Programming on an advanced level is a requirement, Numerical Analysis, Fluid Mechanics/Turbulence, Aerodynamics, Partial Differential Equations/Fourier Transforms
* Good skills in Matlab or Python, knowledge in C/C++ or Fortran is a plus
* Scientific curiosity, capability to work in a team of researchers, drive to solving complex problems and no fear of Mathematics
* Language : English

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