"Wind power uncertainty modelling"

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Context:

Wind Energy is a very promising alternative energy, which is the matter of significant efforts from the academic and industrial communities. These efforts are justified by the need to improve the profitability of this source of energy, which cannot be expanded just because of its environmental advantages. Concerning the turbines, the profitability improvement will come from the traditional learning curve but also from the technical progress including the control techniques. However a very important aspect concerns the accuracy of the resource forecasting. The wind is a very uncertain resource. Moreover the physical characteristics of the wind, like the speed and

the direction are involved in a power law related to the turbine. This power law is a nonlinear function provided by the manufacturer, but what is given is also an approximation of the reality. Eventually what is needed is the probability distribution of the energy produced by the turbine.

Subject of the stage :

The subject of the stage is a design study of wind power uncertainty modelling. There are two approaches in uncertainty modelling: We can distinguish the *"audit"* from the *"design"* case. In the *"audit case"*, only the power data is used to assess the variability of the annual power production. Whether, in the *"design case"*, wind power variability is modeled on the basis of both wind measurements and wind/power data Audit modeling is obviously restricted to the cases where operational data from existing wind farms is already available; design modeling helps assessing the prior uncertainty before investing on a new project

This stage is concern with the *"design modeling case"*. The first task will be to establish a check-list of all uncertainty sources:

- gross operational deviations to the vendor's power curve due to metrological failures;
- operational control (for the points grossly under the power curve)
- cut-off misfits
- noise around the power-windspeed curve

Each of which may be estimated through regression-like models, and hence be assessed as to the relative impact onto annual production. This uncertainties should be compare to the parametric estimation uncertainties. We also adress disentangling gross deviations from noise.

This work will be based on real data. The supervisors will furnish datasets of wind speed and wind power measured on some turbines in France and in Hong-Kong during the last years.