Power Optimizing Control

Student Project Proposal

Background

In the vestas control system, the controller aims at optimizing performance subject to various constraints (i.e. power, loads, wear, noise, operational ranges, etc.) based on a model of the turbine and the expected operating environment. However, the model will always be imperfect either due to inherent characteristics (aerodynamic, structural) of the turbine; or due to assumptions about the inflow (i.e. shear, turbulence, veer, upflow, etc.) which will vary away from the design conditions depending on the site weather, climatic conditions or in general aerodynamic degradation.

Scope

A model-based controller design will not necessarily guarantee the optimum power performance and the aim of this project will be to investigate alternative controller topologies, which allow the controller to adapt/learn differences from the design model and changing conditions to extract more power during partial load. The optimum is unknown thus this project aims to design a controller, to get closer to it and seek to estimate such unknown optimum.

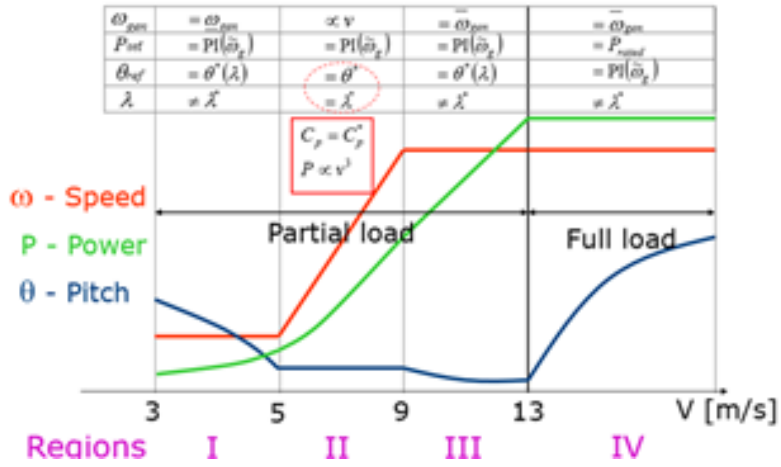
It is therefore suggested to make a study of possible data driven control methodologies, which can change optimal tip speed ratios ($\lambda*$) and optimum pitch angles ($\theta*$) as function of the wind speed, which therefore aims at changing the control solution in region I, II and III (partial load). This could be formulated as a correction to the existing control references or as a completely new controller approach. Machine learning but also traditional adaptive or robust control methods could be employed based on the interests of the candidate.

Keywords:

Control, reinforcement learning, machine learning, optimization, adaptive control.

APPLY

Contact person:
Silvia Martinez
E-mail:
siema@vestas.com



Operating regions of a variable pitch wind turbine. The power and speed trajectories are purely for example and not related to any specific turbine. Asterisk superscript indicates optimum operating point.