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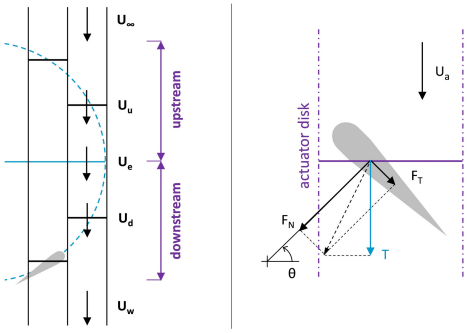
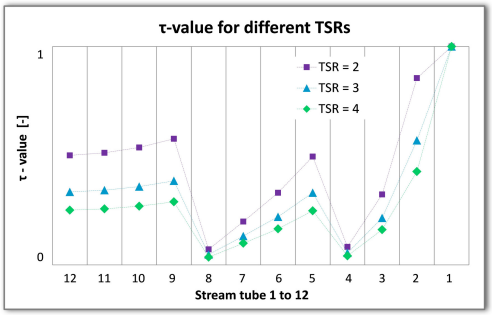
Implementation and Simulation of a Vertical Axis Wind Turbine Model

Matlab-model based on the Double Actuator Disk Theory



The Double Actuator Disc Theory divides the horizontal section into an upwind and downwind zone. Each zone is then divided into multiple stream tubes.

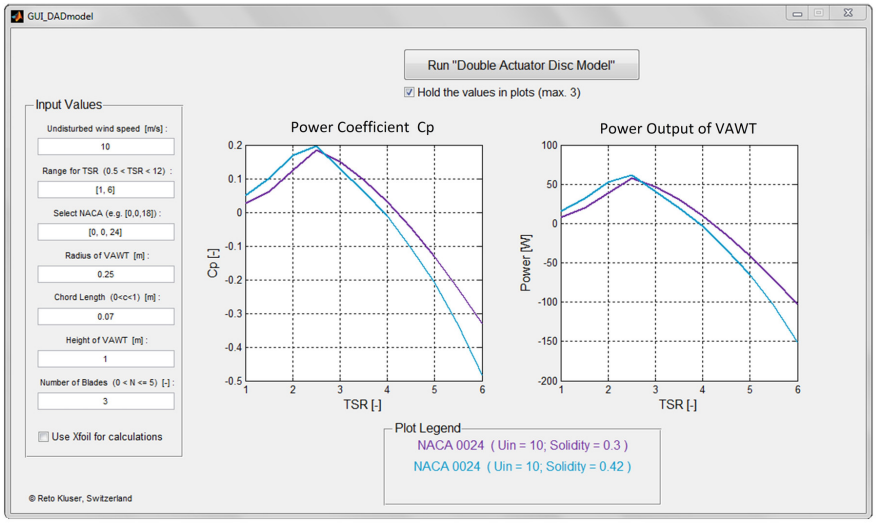


This diagram shows the behaviour of the Regeneration Time Factor "τ". A τ-factor equal to 1 means that the stream tube could fully regenerate.

Introduction: People realise more and more the disadvantages of fossil fuels and nuclear power. Therefore, renewable energies are given more attention again. Wind power is one of the fastest growing renewable energy sources. A lot of research is put into optimising the output of wind turbines and reducing the cost for their production. Among others, the Institute for Energy Technology in Rapperswil and the Energy Research Institute at NTU are researching in this topic, which is the reason for this Master Thesis about vertical axis wind turbines.

Objective: The objective of the thesis is the development of a model for a straight-bladed vertical axis wind turbine model in Matlab. Moreover, the model may also be applicable at a later stage to be used in an optimisation algorithm for different parameters. In order to understand the parameters, which have an influence on the behaviour of the turbine, several simulations with different parameters should be carried out and compared.

Result: The implemented Double Actuator Disc (DAD) model has been validated with two CFD simulations and with experimental data. The generated values and the behaviour of the DAD-model are consistent with the data generated by the other models. It can therefore be assumed that the model is implemented correctly and it can be used for further simulations and optimisations. Moreover, a new factor has been introduced to the DAD-model, which leads to significantly better results. The so called Regeneration Time Factor "τ" assumes a regeneration of the wind velocities in the stream tubes and it is based on a time ratio. Further information about the new Regeneration Time Factor can be found in the documentation of the Master Thesis. Finally, a graphical user interface (GUI) was created for an easier handling of the DAD-model.



A graphical user interface (GUI) was created for an easier handling of the DAD-model. The GUI shows all input values and feeds them to the model.