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Topic	Environmental Engineering

Implementation of the double multiple streamtube model for vertical axis wind turbines

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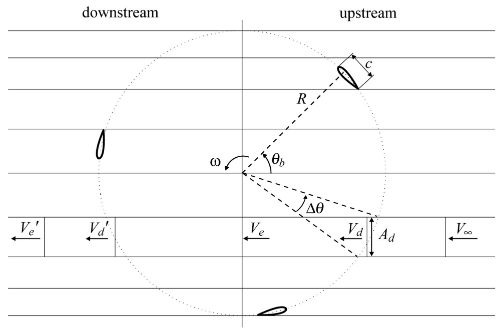
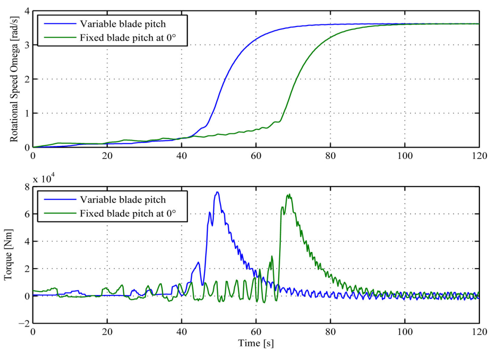
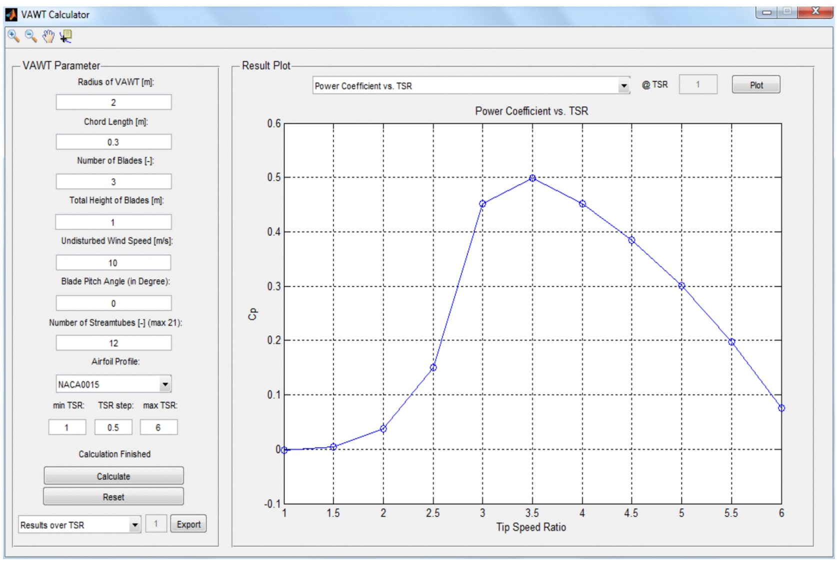


The double multiple streamtube model devides the turbine into multiple stream tubes and an upwind and downwind zone.



Variable blade pitch angle optimization with a reduction of 28.26% of the original startup time.



Graphical user interface (GUI) for parameter studies.

Introduction: Research interest in renewable energy continues to increase. Especially wind energy is getting popular because the efficiency of wind turbines has been increasing due to ongoing research. Still not every aspect of the functionality of wind turbines is fully understood. This is why we decided to take a closer look at the starting optimization of a straight bladed vertical axis wind turbine (SBVAWT) by implementing a physical calculation model in MATLAB.

Objective: The objective of this thesis is to implement the double multiple streamtube model (DMSM) for a SBVAWT in MATLAB. This code should generate accurate results faster than other computational simulation methods. It should also be applicable for algorithms to optimize for example the power performance curve or the starting time of a SBVAWT. In addition, a programmed graphical user interface should help to perform parameter studies for these optimizations in a simple manner.

Result: The implemented DMSM has been validated with experimental and simulated data from two different sources. The calculated power performance curves and other parameters were consistent with the reference data. But it was difficult to compare the generated values with real measurements due to the lack of implemented physical effects. In a second step, the implemented code was extended to calculate the startup ramp of a SBVAWT. Several parameter studies and starting time optimizations were carried out. The study with a variable blade pitch angle for the startup showed that a reduction of 28.26% of the original starting time can be achieved. To gain more accuracy in future simulations, the DMSM should have implemented more physical effects. In addition, wind tunnel experiments could help to improve the simulations with real measurements.