

Basic Blade Design

Exercise for lecture #1 Introduction to Wind Turbine Aerodynamics

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Blade Design According to Betz for the NREL 5MW Wind Turbine

In this exercise, blades according to Betz should be designed for the NREL 5MW Reference Wind Turbine [1] and compared to the original blades. In this exercise we will use only the airfoil NACA64-A17 for the sake of simplicity. For the original blades, more airfoils are used.

Please follow the following steps

- a) Find the design tip speed ratio λ_D , rotor radius and number of blades in [1].
- b) Find useful design values for the angle of attack α_A and of lift coefficient c_L . Use the airfoil data in file [NACA64_A17.dat](#).
- c) Calculate the distribution of twist angle $\beta(r)$ and of chord length $c(r)$ over the radius at the positions from the file [NRELOffshrBslne5MW_AeroDyn_Equil_noTwr.dat](#).
- d) Compare your values to the ones from the NREL design. What are the main differences?

You can use either the Matlab script [Exercise01.m](#) or the provided Excel file [Exercise01.xlsx](#).

References

- [1] J. Jonkman, S. Butterfield, W. Musial, and G. Scott. *Definition of a 5-MW Reference Wind Turbine for Offshore System Development*. Tech. rep. TP-500-38060. NREL, 2009. DOI: [10.2172/947422](#).