Design of Wind Energy Systems – Summer Semester 2016
Design-Tutorial 3: Performance curves

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Required: **Aerodynamic design of the rotor**, done in CIP Tutorials 1 & 2

Tasks to be solved in CIP Tutorial 3:

1. Estimate the non-**dimensional performance coefficients** with help of WT_Perf for **tip speed ratios** from **0.5 to 20** and **pitch angles** of **0°, 5°, 10°, 15°, 20°, 30°**
2. Display the **power coefficient**; calculate the **torque coefficient** and the **thrust coefficient** over tip speed ratio for the different pitch angles (see point 1, above).
3. **Compare** the results to performance curves you find in literature.

Effect of different wind speeds under use of non-dimensional power coefficient curves

4. **Calculate** the resulting **rotor speed** for a wind speed of **rated wind speed minus 2 m/s**
   Hint: use your design tip speed ratio
5. Find the corresponding **power**, **torque** and **thrust coefficients** for this tip speed ratio.
6. Calculate the **power output** for this situation.
7. Find the **theoretical power**, the turbine extracts from the wind at **rated wind speed plus 2m/s**.
8. **Calculate** the **actual power coefficient** which results from the wind speed increase and the limitation of your turbine to rated power.
9. **Look up**, which tip speed ratio corresponds to the calculated power coefficient in the c_p-λ-curve.
10. Calculate the **resulting rotor speed**.
11. **Discuss** this result
12. How could the turbine **react** in this case, **how is the power coefficient** and therefore the power output **limited**?
13. Look up the **resulting value**, which you would use to limit the turbine's performance