

Comp3402 Wind Turbine Control (ctd/ctd)

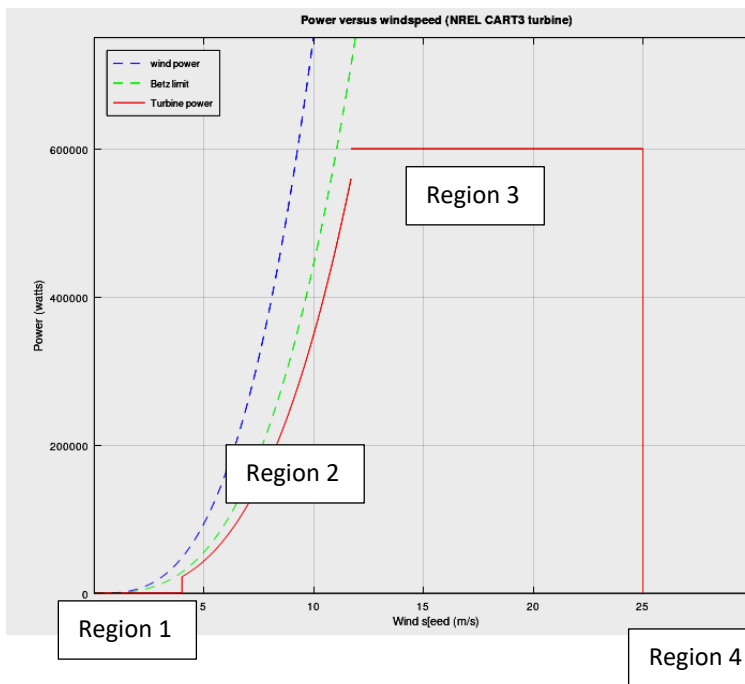
C.B.Price November 2022

Purpose	(i) To investigate how the CART3 turbine responds to realistic wind speed changes
Files Required	Unreal4 resources and Octave scripts.
ILO Contribution	LO 4
Send to Me	nix
Homework	Read chapter 4

Investigations

1 Parameters for the NREL-CART3 600kW turbine

Below are the parameters for this wind turbine, defined in Unreal and also Octave. On the left is the power curve showing the four regions, the energy in the wind and the Betz limit. These curves are all proportional to wind-speed cubed, i.e. v^3 .



R	Rotor radius	20m
ρ	Air density	1.2 kg/m^3
J	Inertia	613,301
λ_{opt}	Optimal tip speed ratio	6.6
C_{pmax}	Maximum power coefficient	0.4633
ω_{rated}	rated angular velocity	3.9521
v_{cutIn}	Cut-in wind speed	4 m/s
v_{cutOut}	Cut-out wind speed	25m/s
v_{Rated}	Rated wind speed	11.7 m/s

Important Stuff

1) The wind distribution with time is modelled by a Rayleigh probability distribution which is characterized by just one parameter – the mean wind speed.

2 Investigating the response to realistic variations in wind speeds

The default parameters for the turbine are shown below left. To select a time series, set the parameters as shown on the right. You should change the **Average Wind Speed** parameter. Note the **WindV Init** is set to 3 m/s, so the turbine has a cold start. You could change this, so that the turbine starts with the average speed you select. The **Change Interval** is how often in simulated seconds the speed is updated.

MAS22 Wind Turbine	
R	20.0
Rho	1.2
J	613301.0
Omega Rated	3.9521
Region 3Kp	2.0
Region 3Kd	10.0
Region 2Beta	3.7
Tsr Opt	6.6
Cp Max	0.4633
V Cut In	4.0
V Rated	11.7
V Cut Out	25.0
Omega Init	0.5
Wind VInit	3.0

Wind VInit	3.0
Wind	
Wind Type	Time Series
Stepped	
TimeSeries	
Average Wind Spe	11.0
Change Interval	1.0

For the Knockcronal proposed farm, wind speeds in the range of **VCutIn** to 12 m/s are used. These are for noise predictions. We can use this range for power prediction, but you could extend beyond the upper limit if you like.

Collect data for a range of wind speeds. You might like to divide the work with your classmates.

Make a snip of the turbine plots, and for each simulation type **mean(windV)** and **mean(power)** at Octave command line to get the average wind speed and power.

Make a summary plot of average power against average wind speed.

Then you might like to answer the following questions for each wind speed

- What region does the turbine operate in? Hint: What plot gives me this information?
 - If the turbine operates in more than one region, estimate the % of time it is found in each of the regions.
 - How well does the turbine controller 'smooth out' rapid fluctuations in wind speed? Does this depend on the average wind speed?
 - At which wind speed(s) does the turbine, on average, produce power closest to its rated power?
 - Anything else you can deduce from all this data?
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