

Homework #1
ME 4470/ESE 4470/ME 5475-02
Wind and Tidal Energy

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Assigned: 09/10/15

Due: 09/23/15

This homework is worth 32 points

1. (5) Provide a short answer to the questions below, and provide a reference from reading the Executive Summary section ES.1 (Introduction) from Wind Vision to support your claims (page number and line number).
 - (a) By how much has the installed capacity of wind turbines increased since 2008?
 - (b) Other influences could have a positive effect on the deployment of wind energy. Name three.
 - (c) For the Wind Vision Study Scenario, how much of a decrease in cost of wind-generated electricity was assumed at different points in the study?
 - (d) What level of penetration does offshore wind have in 2030 in Wind Vision Study Scenario?
 - (e) What is the purpose of the baseline scenario?
2. (7) Provide a short answer to the questions below, and provide a reference from reading the Executive Summary section ES.2 (State of the Wind industry) from Wind Vision to support your claims (page number and line number).
 - (a) Has the growth of the wind industry met, exceeded, or fallen short of the levels set in the 20% by 2020 report? Give two specific examples to support your answer.
 - (b) Although the domestic wind industry grew in response to development levels experienced between 2008 and 2013, list the challenges to the industry that caused some plants to scale back or close their operations.
 - (c) What factors affect the Levelized Cost of Electricity (LCOE)?
 - (d) What factor(s) have caused electricity demand to remain flat over the past several years?
 - (e) The focus of technical improvements in the wind industry has shifted away from improvements to single turbines. To where has the focus shifted?
 - (f) The integration of wind into the electricity supply has been easier than many expected. What factors made this possible?
 - (g) What has been the primary hurdle in the way of developing many sites with excellent wind resources?

3. (20) A common way of determining the suitability of a site for wind power is to make measurements at a specific location and then compare to long-term data available from locations such as airports. In this assignment, we will look at airport data from the Laramie airport (the reported winds are for a height of 10 m). A Matlab program that reads the data file and returns the wind speed (and other parameters) is provided.
- (a) Develop a program that is capable of reading the data in the file. Convert wind speeds to an 80 m height as this is a common hub height used for commercial turbines. Use a power law estimation with a roughness coefficient of $a=0.19$ for this purpose. Provide a plot of the wind speed at 80 m for the month of January 2014 to demonstrate this capability.
 - (b) Use this program to determine the monthly average wind speed (you should get 12 averages - one for each month) for the 10 years of data included in the file. Plot this average wind speed versus month. Calculate the average monthly wind speed for just 2014 and compare it to the longer 10 year average. Discuss what you find.

You may use whatever software you want for performing these calculations, but I will not be able to help with all packages as my expertise is limited to more traditional programming.

Issues:

- Read through the program that reads in the data and ensure you understand what it is doing.
- The wind data file is very large, so read times can be long if you repeatedly read from the file. One way to handle this (if you choose), is to split the file into many smaller files that contain a shorter interval of data (1 month instead of 10 years). This is not mandatory, but you may want to attempt this first.
- We will use this data and program (or pieces of it) in the next assignment, so spend the time to get this working well.

Follow a presentation of your work identifying what is given, what you are asked to find, the data provided, assumptions, etc. Include plots and tables as requested above, but e-mail your programs to me rather than including the printed version. Please spend time discussing your approach (complete with equations and how they were implemented) and discussing the results - just don't hand in plots with no explanation. A simple rule for the level of detail requires is that you should be able to understand completely what you did if you picked this assignment up 3 years from now.