Homework 1 assignment for ECE597/697SI
Posted: 9/24/2013
Due: 10/01/2013

Note: In all written assignments, please show as much of your work as you can. Even if you get a wrong answer, you can get partial credit if you show your work. If you make a mistake, it will also help the grader show you where you made a mistake.

Problem 1 (25 Points): CASA radar specifics

a. In your own words, briefly explain the shortcomings of the existing weather radar system (NEXRAD) used by the National Weather Service.

b. How much of the atmosphere below 1km (in terms of surface of the continental United States) is not covered by this system?

c. Explain how the Doppler effect can be used for radar-based wind-velocity measurement?

d. What is the height of the center of the beam of a CASA radar at a distance of 30 km (at 0.9° degrees elevation angle of the antenna)?

e. What is the average radiated power of i) a CASA radar, ii) a NEXRAD WSR-88D radar?

Solution:
  a. Look to high
  b. 75%
  c. Radars can measure shift in frequency between transmitted pulse and received echo.
  d. ~100m
  e. i) $13\, W$, ii) $1000\, W$

Problem 2 (25 Points): CASA radar network

a. What is the definition of a CASA dense radar network concept?

b. What is the ideal distance between two CASA radars and what is the maximum radius out to which a radar scans the atmosphere?

c. Name the five major components of the CASA control loop and briefly explain their functionality

d. What is the benefit, when it comes to wind velocity measurements, of scanning a volume in the atmosphere with more then one radar?

e. Briefly explain the concept of the CASA Off-the-Grid radar sensor network concept and name 5 major difference compared to the CASA systems that had been installed in Oklahoma.

Solution:
  a. Dense network concept is the thousands of small, low-cost, short-range radars mounted on communication towers, buildings, and other infrastructure
elements that communicate with one another to adjust their sensing strategies in direct response to the evolving weather and to changing end-user needs. Provides finescale storm mapping throughout the entire troposphere—from the boundary layer up to the tops of storms.

b. 30km, 40km
d. 2-dimensional wind vector in addition to radial velocity can be determined.

Problem 3 (25 Points): Work breakdown structure

In Chapter 4 “Systems Engineering Management” the Work Breakdown Structure approach was introduced. In this problem, you are tasked with developing WBS for a system of your own choosing (just don’t use the one that’s given as an example in the lecture slides). Please provide a WBS at the level indicated in Figure 1. Since some systems can be very complex no more than 5 subsystems should be regarded at level 3.

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
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<td>1. System Project</td>
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<td>1.1.1.1.5 Documentation</td>
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<td>1.1.1.2 Component A2</td>
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Figure 1

Solution:

Problem 4 (25 Points): Systems Engineering Process
a. Name the five steps of the Systems Engineering Process and the major components of each step.

b. Name the major components of the System Lifecycle.

c. Explain the difference between validation and verification.

d. Systems Engineering and Project Planning & Control both are part of the overall Project Management. Which components fall under each of these two categories (Systems Engineering and Project Planning & Control) and which ones are covered by both?

e. Name the 5 major characteristics of a Systems Analyst!

Solution:

- **Validation:** Is the system valid for the client/user?

  "You built the right product"

- **Verification:** Is the system designed according to its specification?

  "You built the product right"
d. 5 Characteristics:
   a. Deep understanding of system environment w.r.t. operational and physical characteristics
   b. Must be able to model the system environment
   c. Provides much of the quantitative data to define required system performance
   d. Construct system simulations for trade-off studies in concept definition phase
   e. Conducts analysis to derive quantitative measures of performance of system prototype(s)