EE6506 Computational Electromagnetics: Jan - May 2019, Uday Khankhoje
Assignment 3, 26.02.2018, due 11.03.2018 (12p in ESB323)

Clearly state the CONCEPT involved in solving each problem. Do NOT write lengthy answers. Make reasonable assumptions and STATE them. You are free to discuss with your classmates, look at reference books, and work with one other classmate (though you may work alone if you wish). Looking for solutions online is not allowed. You must submit a comprehensive report (preferably produced in LaTeX) detailing your work (one submission per group).

1. In this question you will calculate the radar cross-section (RCS) of an aircraft. We will keep the problem in 2D and consider only the top view of the aircraft. A sequence of nodes are provided, which form the vertices of a polygon that describes the outline of the aircraft (units: m). Simulate 1:100 scaled version of the aircraft defined by the data points given in the "nodes.mat" file: `http://www.ee.iitm.ac.in/uday/2019a-EE6506/nodes.mat`. Assume the illuminating radar to be operating at 10 GHz and write codes for each of the cases below:
   (a) Assume the aircraft is composed of a homogeneous carbon fibre material with $\epsilon_r = 14 - 13j$ and solve using the surface integral approach.
   (b) Solve the same problem as above, but by using a volume integral approach. You can use the inbuilt matlab function `inpolygon`. Describe your approach to mesh the domain of interest.
   (c) Assume the aircraft is made up entirely of a metal (i.e. PEC), and solve using the surface integral approach.

   For each part:
   – be sure to show graphs of numerical convergence so as to arrive at the correct discretization – consider two illuminating angles, one illuminating the aircraft nose front-on, and the other rotated 90° from this. For each illuminating angle, you should plot the bi-static RCS at all possible viewing angles by means of a polar plot.

   Also comment on:
   – the comparison between surface and volume integral approaches in terms of computational time and memory resources. How will these resource requirements scale as you increase frequency?
   – the comparison of RCS between carbon fibre and metallic aircraft frames
   – any other significant observations, either in terms of computational aspects, or material aspects affecting RCS.

   As reference, you may use the following code that was written for the surface integral formulation for scattering from a cylinder:
   `http://www.ee.iitm.ac.in/uday/2018a-EE6506/code/main_surf_pulse_delta.m`
   `http://www.ee.iitm.ac.in/uday/2018a-EE6506/code/green.m`
   `http://www.ee.iitm.ac.in/uday/2018a-EE6506/code/gradgreen.m`.
   Note, the coordinates of the scattering object are hardcoded in the above code, and hence it can't be used directly for the given problem.

At the start of your submission, please hand write the following text:

I/We, _____(name(s)), state that the submitted work is my/our original work. I/We have discussed with these people: _____, and referred to these books: _____.
_____(sign and date).