ME 594
Homework 2

Work the following problems, SHOWING ALL OF YOUR WORK. This includes writing the proper equation(s), inserting the proper value(s), & calculating the final answer(s). If you utilize MATLAB or similar software, you may attach code and/or command line output to supplement your written work. You may assume the Earth is a perfect sphere of radius 6378 km. Include the following statement at the top of your assignment:

"I ATTEST THAT I HAVE NEITHER GIVEN NOR RECEIVED HELP (other than from the instructor) ON THIS ASSIGNMENT."

1. (50%) Consider an optical ground sensor at 35°N latitude & 35°E longitude. The image plane of its camera is 1500 pixels by 2000 pixels, the size of each pixels 0.005 mm by 0.005 mm, and the focal length is 72 mm. There are two particular objects in Earth orbit the sensor is tracking. The sensor operators determine that if there are times when the sensor can capture both objects in its field of view, this would be advantageous, since this would require fewer overall images to be taken to track the objects. At a particular instant in time, we know that object #1's position vector from Earth's center expressed in ECI coordinates is (5294.35, 3707.14, 2352.42) km, object #2's position vector is (5467.25, 3489.87, 2117.82) km, & that θ_g (Greenwich sidereal time) is 5°. Can the sensor capture both objects in its field of view at this instant? Assume the sensor can be pointed anywhere in its field of regard (i.e. anywhere above its horizon) and its image plane can be rotated about the boresight by any angle.

2. (50%) Consider a radar sensor and an optical sensor located together at 39°N latitude & 104°W longitude. At a particular instant in time, the radar sensor measures a range of 650.75 km to an object, and the optical sensor measures Az = 25.12° and El = 17.29° (in its TH frame) to the same object. What is the object's position vector from Earth's center expressed in ECI coordinates at this instant? Assume that θ_g (Greenwich sidereal time) is 0°.