EECS 725 – Introduction to Radar

Homework Assignment #4 (50 points)
Consider a bistatic radar scenario with the following parameters:

Geosychronous Spaceborne Transmitter

Radar operating wavelength, λ	2 cm
Position (x; y; z)	-23,578 km; -20,050 km; 22,254 km
Velocity (v_x; v_y; v_z)	0 m/s; 0 m/s; 0 m/s

Airborne Receiver

Position (x,y,z)	0 km; 0 km; 4.35 km
Velocity (v_x, v_y, v_z)	0 m/s; 300 m/s; 0 m/s

In addressing problems 1 to 3 listed below, consider a planar surface in the x-y plane (z = 0) extending ±6 km in both x and y.

Problem 1. For the bistatic scenario described above, plot the **isorange** contours at 740-m intervals for the 12-km x 12-km planar surface.

Problem 2. For the bistatic scenario described above, plot the **isodoppler** contours at 1500-Hz intervals for the 12-km x 12-km planar surface.

Problem 3. For the bistatic scenario described above, plot the **isopower** contours at 1-dB intervals for the 12-km x 12-km planar surface. (Assume power varies only due to spherical spreading loss, i.e., ignore antenna gain variations and scattering variations.)

Linear FM waveforms

Problem 4. Numerically generate a chirp waveform that varies from 100 MHz to 300 MHz over a 10-μs interval sampled every 1 ns. Plot the normalized spectral power of this waveform over the frequency range of 50 MHz to 400 MHz with a scale that ranges from 0 dB to -40 dB.

Problem 5. Represent three targets at different ranges by adding together scaled versions with specified delays of the linear FM waveform developed in problem 4. The waveform from target 1 has an amplitude of 0.1 and a delay of 25 ns; the waveform from target 2 has an amplitude of 1 with a delay of 150 ns; and the waveform from target 3 has an amplitude of 0.25 and a delay of 160 ns. Multiply this composite waveform representing the targets with the waveform from problem 4 and plot the normalized spectral power of this product expressed in dB over the frequency range of 50 kHz to 10 MHz. Interpret the resulting plot. (Zero padding the original waveform is recommended, i.e., appending a vector of zeroes to the beginning and end of the waveform vector.)