Homework 2: ECE 6390 Sum 2014

Due 7/7/2014, you may work in *singles* or *pairs*

Physical Noise in RF Satellite Noise

The noise temperature of an earth station receiver dish will change depending on what it is pointed at. Answer the following questions about noise temperature for various physical scenarios.

1. As seen from the surface of the earth, how many steradians does the sun take up in the sky? What is the noise temperature of the sun at microwave frequencies? (You will need to do a little internet research for this.)

2. An ideal circular dish with radius \( R \) has the following power radiation pattern:

\[
U(\alpha) = \left( J_1 \left( \frac{2\pi R}{\lambda} \sin \alpha \right) \frac{\sin \alpha}{\sin \alpha} \right)^2
\]

for \( \alpha < \pi/2 \) (0 elsewhere). Where \( \alpha \) is the angle from boresight and \( J_1(x) \) is the ordinary Bessel function (can be calculated using the command `besselj` in Matlab™).

With this pattern, an estimate of noise temperature can be achieved by spatially averaging physical noise temperatures over the gain pattern. Using physical noise temperatures of 290 K for the Earth and 6 K for the “open sky”, make the following effective noise calculations:

a. What is the effective noise temperature of a satellite dish pointing at zenith during the night time? At the horizon during the night time? At zenith with the sun centered in the boresight?

b. Graph the effective physical noise power for the dish in dBm/MHz when it is pointed at zenith directly at the sun as a function of dish radius \( 10\lambda < R < 100\lambda \).

c. Repeat (b) for the case when the sun is at an elevation of 45° above the horizon.