Hi everybody! HW8 should be fairly short and hopefully fairly straightforward -- not a lot of complex coding.

We're operating out of Handout 51. You will make 12 plots total:

1a Polarization signature of a dihedral corner reflector	1 plot co-pol, 1 plot cross-pol
1b Polarization signature of a dihedral corner reflector + power from unpolarized background contributions	1 plot co-pol, 1 plot cross-pol
2a Polarization signature of a rough surface with Bragg scattering Then, find the ratio of this to the dihedral with no background	1 plot co-pol, 1 plot cross-pol Ratio: 1 plot co-pol, 1 plot cross-pol
2b Polarization signature of a rough surface with Bragg scattering + power from unpolarized background contributions. Then, find the ratio of this to the dihedral with unpolarized background.	1 plot co-pol, 1 plot cross-pol Ratio: 1 plot co-pol, 1 plot cross-pol

I would recommend use **MATLAB's "surf"** function for the plots. (Matplotlib plt.plot_surface). You can also plot using imagesc in MATLAB or Matplotlib's plt.imshow.

One axis of the surface plots will be **chi**, one will be **psi**, and your Z-axis will be the power **P** returned from the object at the polarization (chi, psi).

Scattering matrix: shown in **Eq 16.8**, this has 4 components: The power from a horizontal transmission and horizontal return Sh'h, the power from a vertical transmission and vertical return Sv'v, and the cross-terms from different types of transmission and return Sv'h and Sh'v.

The scattering matrices for a corner reflector and for the Bragg model are shown in Table 16.1. For example, for a sphere, the scattering matrix has Sh'h = a, Sv'h = 0, Sh'v = 0, and Sv'v = a, according to the scattering matrix shown in Table 16.1. You will similarly find the 4 scattering elements for a corner reflector and a Bragg model from this table.

The power you are plotting comes from **Equation 16.13.** You want to plot **P** as a function of **chi** and **psi.**

To get to P, you need to get M and F.

The most tedious part of the HW is **constructing the Stokes Matrix M**. You have **Table 16.2**, which defines the 4x4 Stokes matrix **M**. Note that Sh'h = S_(hh) in M, this is kind of inconsistent notation but it all means the same thing. So you can **populate each element of M** using the values of Sh'h, Sv'v, Sv'h, and Sh'v that you found from Table 16.1. This is tedious (maybe 16 lines of code) but straightforward.

The last thing you need to do to find **P** is get an equation for **F.**

Equation 16.9 shows an equation for F as a function of chi and psi (right-most definition). You can "normalize" relative to I (e.g. set I = 1) for this problem. For the co-polarized case, F is the same on transmit and receive. For cross-polarized, F is orthogonal on receive to on transmit. You will need to **adjust χ and ψ** to orient the ellipse in the other direction and rotate it 90 degrees around the origin (see **Fig. 16.1** to determine how to appropriately adjust **χ and ψ** to find "$F_{\perp}$" You'll know you did this right and they are orthogonal if the dot product $F \cdot F_{\perp} = 0$).

Finally, a note on the **"unpolarized background contributions"** for part **b** of each problem. The element **M(1,1)** is the total power at all polarizations. All other elements of M are cross-terms representing one polarization being stronger than others. So to add unpolarized background contributions, you want to put the total power from your directional situation in M(1,1) -- i.e. the same M(1,1) as in part (a). Using the knowledge that the background has no tendency to polarize, what do you think the other elements of the matrix M should be for the unpolarized background?

You can calculate the power for (a) and the power for the background separately and then add them up, so $P_{total} = P_{dihedral} + P_{background}$ (or for P2, $P_{total} = P_{bragg} + P_{background}$). Or, you can use linearity and add the M's before you calculate the power so $M_{total} = M_{dihedral} + M_{background}$ etc.

Hopefully this guide makes it easy to do the HW! This shouldn't take you too long following these directions, please LMK if you're confused anywhere!