Homework 4
Answer all the questions

ME297

SJSU Eradat

Due Tuesday Oct. 18

4.1) Rules of thumb

- Decisions are made by efficiently applying "rules of thumb" to make quick approximations. Throughout your career, you should make sure to collect these and know how and when to use them (Jime Burge). As part of your homework assignments, **you should review the relevant notes and find at least 6 useful rules of thumb from the last week's lecture notes LN7 - LN10**. Report them in the following format.

Name for Rule	Small Angle Approximation
The Rule of Thumb	$\sin\theta \cong \theta$ (in radians)
When is this used?	This is used for small angles (< 0.2 radians or 11.5^0) Application of this approximation greatly simplifies analysis and calculation
Limitations	The percent error in the approximation is roughly $\theta^2/6$ x 100% so the approximation is valid to < 1% for angles < 0.24 radians (14°) and is valid to 0.01% (100ppm) for angles < 1.4. (you find this by calculating $(\sin\theta - \theta)*100$ for a range of angles and arguing when if you use it is a situation what kind of error you are signing up for)

4.2) rotation of a plane mirror around z-axis

Show that effect of γ-rotation around z-axis on a mirror matrix wih its normal on the +z direction is:

$$M_r = R_z(\gamma) M_z R_z^T(\gamma) = M_z$$

4.3 Finding the prism and rotation matrices

a) Follow the methods discussed in the lecture to find the matrix for the 45^0 roof. Follow the coordinates and bouncing pencil method and consider the parity change at reflections.

b) Do the same to find the prism matrix for the retroreflector (corner cube)

c) Calculate the rotation matrix around x and y axis by an arbitrary amount (theta) for the 45^0 roof.

d) Calculate the rotation matrix around x and z axis by an arbitrary amount (theta) for the corner cube.

e) Find the x,y,z rotation matrices for the small angles.

4.4 Adjusting the tolerances (continued from 3.4)

- For the system of problem 3.4 adjust the tolerances so that the beam stability on the fiber is +/-0.1 micrometer.
- Do this using the methods explained on lecture 10 pages 12 and 13 create a spreadsheet and calculate the sensitivities.
- Do the tolerance adjustments such that it makes most economic sense.

4.5 Assigning initial tolerances

- Assign initial tolerances for the lens assembly and ccd array you have selected for your project based on the information and methods of LN10. If you can get accurate information for your specific parts fine, otherwise use the rules of thumb for now.