ME 115(a): Homework #2

(Due Thursday Oct. 21, 1999)

Problem 1: Can every orthogonal matrix be represented by a matrix exponential? That is, if $A \in \mathcal{O}(n)$, can A be represented by

$$A = e^C$$

for some real matrix C? (Hint: the determinant of e^C can be expressed as an exponential.)

Problem 2: Consider the following rotation matrix:

$$\begin{bmatrix} 0.882772 & -0.416266 & 0.217798 \\ 0.44976 & 0.882772 & -0.135756 \\ -0.135756 & 0.217798 & 0.966506 \end{bmatrix}$$

- **Part (a):** Find the axis of rotation and angle of rotation associated with this rotation.
- **Part (b):** Find the z-y-z euler angles of the above rotation.

Problem 3: Let Z-Y-X Euler angles be denoted by ψ, ϕ, and γ. That is, successfully rotate a body about its body fixed z, y, and x axes by the angles ψ, ϕ, and γ.

- **Part (a):** Develop an expression for the rotation matrix that describes the Z-Y-X rotation as a function of the angles ψ, ϕ, and γ.
- **Part (b):** Given a rotation matrix of the form:

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{bmatrix}$$

  compute the angles ψ, ϕ, and γ as a function of the r_{ij}.

Problem 4: Do Problem 4(a,b) in Chapter 2 of MLS.

Problem 5: Do Problem 8(b) in Chapter 2 of MLS.