ME 115(a): Homework #2

(Due Wednesday, February 6, 2008)

Problem 1: (5 points) Consider the following rotation matrix:

$$\begin{bmatrix} 0.866025 & -0.353553 & 0.353553 \\ 0.353553 & 0.933013 & 0.0669873 \\ -0.353553 & 0.0669873 & 0.933013 \end{bmatrix}$$

Find the axis of rotation and angle of rotation associated with this rotation.

Problem 2: (10 points) Can every orthogonal matrix be represented by a the exponential of a real matrix? 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 3: (15 points) Let Z-X-Y Euler angles be denoted by ψ, ϕ, and γ. That is, successfully rotate a body about its body fixed z, x, and y axes by the angles ψ, ϕ, and γ.

- **Part (a):** Develop an expression for the rotation matrix that describes the Z-X-Y 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: (10 points) Do Problem 4(a,b) in Chapter 2 of MLS.

Problem 5: (10 points) Do Problem 5 in Chapter 2 of MLS.

Problem 6: (10 points) Do Problem 10 (a,b) in Chapter 2 of MLS. Do not worry about the question of surjectivity in 10(b).