ME 115(b): Problem Set #6
(Due March 8, 2001)

Problem #1: Problem 14 in Chapter 5 of MLS. Do the ellipsoid and the torus.

Problem #2: Derive the contact equations for one planar ellipse rolling/sliding on another planar ellipse. Recall that the boundary of the ellipse can be parametrized as:

$$\begin{bmatrix} x(u) \\ y(u) \end{bmatrix} = \begin{bmatrix} a\cos(u) \\ b\sin(u) \end{bmatrix}$$

Note that when $a = b$, the ellipse is a circle. Derived the equations for the condition shown in Figure 1 Under what conditions does the relative curvature become ill defined?

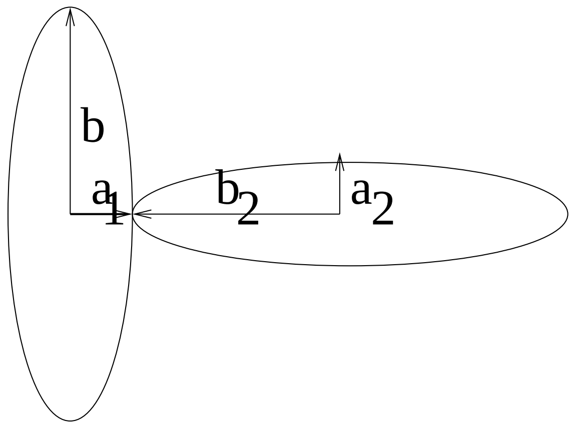

Figure 1: Rolling Ellipses

Problem #3

Part (1): The surface of an ellipsoid can be parametrized in a variety of ways. One particular parametrization follows. For an ellipsoid with principle dimensions 2A, 2B, 2C (with $A > B > C$), the surface can be covered by the 8 *orthogonal* coordinate patches:

$$f(u,v) = \begin{bmatrix} \pm A\sqrt{\frac{(A-u)(A-v)}{(A-B)(A-C)}} \\ \\ \pm B\sqrt{\frac{(B-u)(B-v)}{(B-A)(B-C)}} \\ \\ \pm C\sqrt{\frac{(C-u)(C-v)}{(C-A)(C-B)}} \end{bmatrix}$$

where $u \in [C, B]$, $v \in [B, A]$. Verify that that these coordinates are indeed orthogonal.

Part (2): Using the results of Part (1), solve Problem 15(b) in Chapter 5 of MLS.