CSCI–4190 Introduction to Robotic Algorithms, Spring 2004
Exercise 4: out Thursday February 12, due Tuesday February 17

In the following questions, all equation numbers refer to the Assignment 2 handout.

1. Write out the specific functions and matrices you will use in this assignment for the state update equation:
   - $\Phi[\mathbf{x}, \mathbf{u}]$ (the system function in Equation 3)
   - the Jacobians $J_{\mathrm{x}}$ and $J_{\mathrm{u}}$ (i.e. actually calculate all the derivatives in Equation 6)
2. In the covariance matrix $P_{\mathrm{u}}$ (Equation 1), what will the $\sigma_{da}$ and $\sigma_{ad}$ terms be?
3. Copy the equation for the Kalman gain (Equation 11) and indicate the size of each matrix in this formula. Also indicate the size of the matrix resulting from the inverse operation.
4. Write out the form of the Jacobian $J_H$. (See Equation 6 for an example). Explain what the terms of this matrix are. (Relate them to the sensor or measurement process, not just "this is the derivative of $a$ with respect to $b$.") Explain how you would compute these derivatives. (You do not have to calculate these derivatives, as it is a little tedious, and I have already done this for you in the support code.)