

**ASEN 5070**

**Exam No. 3**

**12/08/06**

**Open book and notes take home exam.**

**Please do not give or accept help on this exam.**

**Due 12/20/06**

1. (25%) A spacecraft is to fly by a comet whose radius is 2 km. The time of closest approach is  $t_k$ . At  $t_k$  an estimate and variance-covariance are calculated of the spacecraft position. The estimate is calculated in a 2-D coordinate system in a plane that contains the center of the comet and the spacecraft at  $t_k$ , with the center of the comet at the origin of the coordinate system. The values for the nominal trajectory and estimate ( in km) at  $t_k$  in this 2\_D coordinate, and the variance-covariance for the errors in  $\hat{x}$  are

$$X^* = \begin{bmatrix} 4 \\ -1 \end{bmatrix}, \quad \hat{x} = \begin{bmatrix} -2 \\ -5 \end{bmatrix}, \quad P = \begin{bmatrix} 9 & 4.8 \\ 4.8 & 4 \end{bmatrix}.$$

- a. What is the correlation coefficient?
  - b. At closest approach, sketch the comet, the spacecraft's estimated position, and the 3- $\sigma$  probability ellipse.
  - c. Is the comet outside of the 3- $\sigma$  probability ellipse?
2. (30%) Problem # 42 of the text.
3. (20%) Problem # 43 of the text, parts a and b.
4. (25%) Answer true or false
- a. In the general orbit determination problem the estimation error covariance matrix will be a realistic estimate of solution accuracy\_\_\_\_\_
  - b. The semimajor, semiminor, and intermediate axes of the probability ellipsoid lie along the principal axes \_\_\_\_\_
  - c. A major advantage of the state noise compensation technique is that it provides an estimate of the unmodeled acceleration\_\_\_\_\_

- d. A major advantage of solution via orthogonal transformations is that accuracy is enhanced because only the  $H$  matrix and not  $H^T H$  is operated on\_\_\_\_\_
- e. In general, the larger the absolute value of the correlation coefficient between two parameters, the more accurate the solution for the individual parameters\_\_\_\_\_