ASEN 5010 Homework Assignment No. 3

Due Date March 5, 2013

READ CHAPTERS 1, 2, 3, 4.1–4.2

Note: if you don't attempt to solve a problem or sub-problem, then you'll be deducted the points you would have been given. Yes, it is possible to make negative points. For example, if a problem is worth 15 points, and you chose simply ignore it, then you'll receive -15 points for this part. If everything else is correct in the homework, you'll end up with a 70.

Problem 1: S&J, Problem 3.21,

Problem 2: S&J, Problem 3.23,

Problem 3: S&J, Problem 3.25,

Problem 4: S&J, Problem 3.28,

Problem 5: S&J, Problem 3.29,

Problem 6: A spacecraft has four attitude sensors, sensing four unit vectors (directions), $\hat{\boldsymbol{v}}_k$ with $k = 1, 2, 3, 4$. We know the first sensor (k=1) is more accurate than the others, but we don't know the relative accuracy of the other three. At an instant in time, the four vectors measured by the sensors have the body frame components:

$$ {}^{\mathcal{B}}\hat{\boldsymbol{v}}_1 = \begin{pmatrix} 0.8273 \\ 0.5541 \\ -0.0920 \end{pmatrix} \quad {}^{\mathcal{B}}\hat{\boldsymbol{v}}_2 = \begin{pmatrix} -0.8285 \\ 0.5522 \\ -0.0955 \end{pmatrix} \quad {}^{\mathcal{B}}\hat{\boldsymbol{v}}_3 = \begin{pmatrix} 0.2155 \\ 0.5522 \\ 0.8022 \end{pmatrix} \quad {}^{\mathcal{B}}\hat{\boldsymbol{v}}_4 = \begin{pmatrix} 0.5570 \\ -0.7442 \\ -0.2884 \end{pmatrix} \tag{1} $$

At the same time, the four vectors are determined to have inertial frame components:

$$ {}^{\mathcal{I}}\hat{\boldsymbol{v}}_1 = \begin{pmatrix} -0.1517 \\ -0.9669 \\ 0.2050 \end{pmatrix} \quad {}^{\mathcal{I}}\hat{\boldsymbol{v}}_2 = \begin{pmatrix} -0.8393 \\ 0.4494 \\ -0.3044 \end{pmatrix} \quad {}^{\mathcal{I}}\hat{\boldsymbol{v}}_3 = \begin{pmatrix} -0.0886 \\ -0.5856 \\ -0.8000 \end{pmatrix} \quad {}^{\mathcal{I}}\hat{\boldsymbol{v}}_4 = \begin{pmatrix} 0.8814 \\ -0.0303 \\ 0.5202 \end{pmatrix} \tag{2} $$

Because of the inaccuracies of the instruments, these vectors may not actually be unit vectors, so you should normalize them in your calculations. Use the Triad algorithm to obtain 3 different estimates of the attitude $[BI]$, using $\hat{\boldsymbol{v}}_1$ as the most precise element.

Problem 7: Using the vectors $\hat{\boldsymbol{v}}_1$ and $\hat{\boldsymbol{v}}_2$ of the Triad problem, solve for the $[BI]$ matrix using Davenport's q-method. What is the attitude difference to the first Triad solution (using $\hat{\boldsymbol{v}}_1$ and $\hat{\boldsymbol{v}}_2$)? Use the principal rotation angle as the scalar error measure.

Problem 8: Using the vectors $\hat{\boldsymbol{v}}_1$ and $\hat{\boldsymbol{v}}_2$ of the Triad problem, solve for the $[BI]$ matrix using the QUEST method. What is the attitude difference between to the q-method solution? Use the principal rotation angle as the scalar error measure.

Problem 9: S&J, Problem 2.12,

Problem 10: S&J, Problem 2.13,

Problem 11: S&J, Problem 4.1,

Problem 12: S&J, Problem 4.3,

Problem 13: S&J, Problem 4.7,