**ME 596 Spacecraft Dynamics: Homework Assignment 3**

**Your submission must be submitted as a report, by which I mean your work must be written out as it would be in a report, showing and explaining all your work, and clearly stating your answers using complete sentences and references as appropriate, and the entire assignment must be neatly written or typeset.**

*Note well that a Matlab code listing does not constitute "showing your work."*

You must include your name, course number, and assignment number at the top of the first page.

You must upload your work as a *single* pdf file by 11:59 PM on the due date.

1. Develop $\mathbf{S}(\boldsymbol{\theta})$ for a "2-1-3" rotation from $\mathcal{F}_i$ to $\mathcal{F}_b$ so that $\boldsymbol{\omega}_b^{bi} = \mathbf{S}(\boldsymbol{\theta})\dot{\boldsymbol{\theta}}$.
   Where is $\mathbf{S}(\boldsymbol{\theta})$ singular?
2. Develop $\mathbf{S}(\boldsymbol{\theta})$ for a "1-3-1" rotation from $\mathcal{F}_i$ to $\mathcal{F}_b$ so that $\boldsymbol{\omega}_b^{bi} = \mathbf{S}(\boldsymbol{\theta})\dot{\boldsymbol{\theta}}$.
   Where is $\mathbf{S}(\boldsymbol{\theta})$ singular?
3. Explain the significance of the singularity in the two previous problems.
4. Devise and solve a problem of the form:

> The orientations of two spacecraft $A$ and $B$ relative to an inertial frame are given through the 1-2-3 Euler angle sequence:
> $\boldsymbol{\theta}_A = [xx \;\; xx \;\; xx]^\mathsf{T}$ and $\boldsymbol{\theta}_B = [xx \;\; xx \;\; xx]^\mathsf{T}$ degrees
> What is the relative orientation of spacecraft $A$ with respect to $B$ in terms of the quaternion? Note that another way of asking this question is "What is the quaternion corresponding to $\mathbf{R}^{AB}$?

Check your result so that you are certain it is correct.

You must show and explain your work, including the check to verify your answer is correct, as well as include your code. However, note that including your code does not constitute showing your work.

Your problem statement should be worded like the problem in the box above.