ASEN 5010 Homework Assignment No. 5

Due Date April 18, 2013

READ CHAPTERS 1, 2, 4, 8

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 8.1

Problem 2: S&J, Problem 8.2

Problem 3: S&J, Problem 8.3

Problem 4: S&J, Problem 8.4(a)-(c)

Problem 5: S&J, Problem 8.6

Problem 6: S&J, Problem 8.8

Problem 7: You are to control a spacecraft with the control law

$$\boldsymbol{u} = -[P]\boldsymbol{\omega}$$

with the aim to arrest any angular rotation. The spacecraft attitude is not a consideration here.

a) Prove that for a rigid body with inertia matrix $[I]$ this control is globally asymptotically stabilizing.

b) What is the expected closed-loop dynamics of this system?

c) Are these stability claims still valid if your inertia matrix model is not correct? Justify your answer.

Problem 8: Verify that the MRP Lyapunov function $V = 2K\ln(1 + \boldsymbol{\sigma}^T\boldsymbol{\sigma})$ leads to the elegantly simple derivative $\dot{V} = \boldsymbol{\omega}^T(K\boldsymbol{\sigma})$.