ME751: Assignment 4

Problem 1. Do problem 9.4.1 out of Haug's book.

Problem 2. Do problem 9.6.2 out of Haug's book. Note a slightly different notation used in the book: Haug's $d2$ is our $DP2$ basic geometric constraint. Additionally, he uses a prime to refer to a quantity expressed in the L-RF: $\mathbf{s}'^P$, instead of $\bar{\mathbf{s}}^P$ that we use.

Problem 3. Do problem 9.6.3 out of Haug's book.

Problem 4. Assume that you have two bodies i and j and the relative motion of i and j is such that a point P on i always belongs to a plane of body j. Define a set of attributes for this GCon and then using them specify the Algebraic Constraint Equation[s] associated with the GCon. How many degrees of freedom does this GCon remove? In plain words, explain what motion body i could still experience if body j were fixed.

Problem 5. Given $\bar{\omega}$ for a body i, the time derivative of the Euler Parameters as $\dot{\mathbf{p}}_i = \frac{1}{2}\mathbf{G}_i^T \bar{\omega}_i$. Prove that this value of $\dot{\mathbf{p}}_i$ is consistent, in that it satisfies the constraint obtained when you take a time derivative of the Euler Parameter normalization constraint.

Problem 6. Use the Newton-Raphson method to solve for a solution α of the equation

$$f(x) = x^6 - x - 1 = 0$$

As an initial guess, use $x^{(0)} = 2$. Provide a table that on the first column has the iteration counter k, next column contains $x^{(k)}$, then $f(x^{(k)})$, then $x^{(k)} - \alpha$, and finally $x^{(k+1)} - x^{(k)}$. Note that the solution that you should find is $\alpha = 1.13472413840152$. Explain what happens if you start with $x^{(0)} = -1$.

Problem 7. Derive the expression of $\bar{\mathbf{\Pi}}_i^{DP2}$ and $\bar{\mathbf{\Pi}}_j^{DP2}$, and $\bar{\mathbf{\Pi}}_i^{D}$ and $\bar{\mathbf{\Pi}}_j^{D}$.