Introduction to Flight Simulation (List 6)

Due: 23 November 2010

1. Let
\[ \mathbf{v}_1 = \begin{pmatrix} 10 \\ 1 \\ -3 \end{pmatrix}, \quad \mathbf{v}_2 = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}, \quad \mathbf{v}_3 = \begin{pmatrix} -4 \\ 5 \\ -7 \end{pmatrix}, \quad \mathbf{v}_4 = \begin{pmatrix} -1 \\ 3 \\ 8 \end{pmatrix}. \]

Compute (by hand), \( \mathbf{v}_1 \times \mathbf{v}_2 \), \( \mathbf{v}_2 \times \mathbf{v}_3 \), \( \mathbf{v}_3 \times \mathbf{v}_4 \). Compute \( \mathbf{v}_1 \times (\mathbf{v}_2 + \mathbf{v}_3) \) and \( \mathbf{v}_1 \times \mathbf{v}_2 + \mathbf{v}_1 \times \mathbf{v}_3 \).

2. Also compute \( \mathbf{v}_1 \cdot \mathbf{v}_2 \), \( \mathbf{v}_2 \cdot \mathbf{v}_3 \), \( \mathbf{v}_3 \cdot \mathbf{v}_4 \).

3. Assume that force \( \mathbf{F} = (4, 5, 6) \) works at position \( \mathbf{r} = (-1, 4, -3) \). Compute the resulting torque.
   Same for force \( (-4, 5, 7) \) at position \( \mathbf{r} = (-1, 3, 8) \).

4. Suppose that a plane (its center of gravity) is flying at speed \( (70, 3, 5) \) aligned exactly along the X-axis. Note the plane is slight sideslipping, and that it will not stay aligned. Assume that the plane has angular velocity \( (0.1; 0.3; -0.5) \). Compute the speed of the right wing tip on position \( (-5, 20, -1) \), and the speed of the rudder, on position \( (-20, 0, -5) \).