PHYS 160 - Assignment # 5

Due: Friday, February 26, 2016

Purpose: Learn to set up a slightly more complicated solution to a problem.

You want to help your biologist friend in her research on the agressiveness of mosquitos attacking each other in flight. She has set up a model for the trajectories followed by mosquito **A** which is trying to catch up to another mosquito, mosquito **B**. In her model, the following functions give the coordinates of each mosquitos in 3-D as function of time t.

$$Ax(t) = 2.3\cos(t) + \sqrt{0.5}\sin(\sqrt{3.1}t) + 0.1\cos(2.7t) \tag{1}$$
$$Ay(t) = 1.3\cos(t) + \sqrt{0.8}\sin(\sqrt{2.0}t) + 0.1\cos(2.1t) \tag{2}$$
$$Az(t) = 2.3\cos(t) + \sqrt{1.5}\sin(\sqrt{1.5}t) + 0.2\cos(1.3t) \tag{3}$$

$$Bx(t) = 2.3\cos(t) + \sqrt{0.5}\sin(\sqrt{3.1}t) + 0.1\cos(2.7t) \tag{4}$$
$$By(t) = 1.3\cos(t) - \sqrt{0.8}\sin(\sqrt{2.0}t) - 0.1\cos(2.1t) \tag{5}$$
$$Bz(t) = 2.3\cos(t) + \sqrt{1.5}\sin(\sqrt{2.5}t) + 0.2\cos(1.3t) \tag{6}$$

1. Form maple functions, $Ax(t)$, $Ay(t)$ and $Az(t)$, for mosquito **A** and $Bx(t)$, $By(t)$ and $Bz(t)$ for mosquito **B**, to parametrically specify the locations of the two mosquitos.

2. Plot the two trajectories followed by the mosquitos in a time interval $t = $ *[0,20]*.

3. Find analytically (using Maple) the distance between the two mosquitos at all times. Call this Maple function $dist(t)$.

4. Plot this distance function, $dist(t)$, in the time interval $t = $ *[0,20]*.

5. Find the overall maximum distance and the overall minimum distance between the two mosquitos in the time interval $t=$*[0,20]*, based on the exact maple function $dist()$.

6. At what time do these extrenum distances occur?

7. Does mosquito **A** catch mosquito **B** ?

8. If not, estimate how close does mosquito **A** get to mosquito **B** (respond in floating point number format) ?

To render the coordinate model more realistic, you suggest to measure the coordinates of the mosquitos and record the data on a numerical time grid. This can be emulated using your friend model.

1. Sample the time interval $t = [0,20]$ using *one hundred points, 100* and record this time grid in an array $tt[]$.

2. Compute the coordinates of the mosquitos at each time step and store these locations in arrays.

3. Plot a straight line between the two mosquitos at all time steps.

4. Animate this line between the two mosquitos over the time interval $t = [0,20]$.

Hints: Use Maple Help for commands you *may need, i.e., spacecurve, line, plot3d, fsolve, assign, ...*