MTH233

3-Dimensional Graphs – Vector Valued Functions

Project 2– Exercises

NAME: _____
SECTION: _____
INSTRUCTOR: _____

Exercise 1:
Make a graph of the vector valued function:

$$r(t) = \cos^2(2t)\vec{i} + \sin^2(3t)\vec{j} + \cos(2t - \pi/2)\vec{k}$$

a.) What are the MATLAB commands you used to generate the graph?
(1) Answer:

b.) What is the period of this parametric equation?
(*Hint: Use comet3 and different domains for t.)*
(2) Circle one:
1. *The function has no period*
2. *the period is* π
3. *the period is* 2π
4. *the period is* 4π

c.) Submit your graph.
(3) **Attach your graph to the worksheet.**

Exercise 2:
The approach to the Lincoln Tunnel in New York City from New Jersey resembles a helix. A possible model for this road is given by the parametric equations $r(t) = x(t)\vec{i} + y(t)\vec{j} + z(t)\vec{k}$ where

$$x(t) = (1-t)\cos 4\pi t$$
$$y(t) = (1-t)\sin 4\pi t$$
$$z(t) = 1 - t$$
$$and\ 0 \le t \le 1$$

a.) Compute the velocity vector $v(t)$ and the acceleration vector $a(t)$. Then generate these vectors using 500 points for t. (You can find v and a symbolically using `diff`, being careful not to reassign any variables.)

- $v(t)$ is
  (4) Circle one:
  1. $\big(-\sin(4\pi t) + 4\pi(1-t)\cos(4\pi t)\big)i + \big(-\cos(4\pi t) - 4\pi(1-t)\sin(4\pi t)\big)j - k$
  2. $\big(-\cos(4\pi t) - 4\pi(1-t)\sin(4\pi t)\big)i + \big(4\pi(1-t)\cos(4\pi t) - \sin(4\pi t)\big)j - k$
  3. $\big(-\cos(4\pi t) + 4\pi(1-t)\sin(4\pi t)\big)i + \big(-\cos(4\pi t) - 4\pi(1-t)\sin(4\pi t)\big)j - k$
  4. none of the above

- $a(t)$ is
  (5) Circle one:
  1. $\big(8\pi\sin(4\pi t) - 16\pi^2(1-t)\cos(4\pi t)\big)i + \big(-8\pi\cos(4\pi t) - 16\pi^2(1-t)\sin(4\pi t)\big)j$
  2. $\big(8\pi\cos(4\pi t) + 16\pi^2(1-t)\cos(4\pi t)\big)i - \big(8\pi\sin(4\pi t) - 16\pi(1-t)\cos(4\pi t)\big)j$
  3. $\big(-8\pi\cos(4\pi t) - 4\pi(1-t)\cos(4\pi t)\big)i + \big(8\pi\sin(4\pi t) - 4\pi(1-t)\sin(4\pi t)\big)j$
  4. none of the above

b.) Generate the graph for $r(t)$. Plot the velocity and acceleration vectors when $t = 1/2$ on this graph. Label the velocity and acceleration vectors. Submit the graph of $r(t)$ with the indicated velocity and acceleration vectors.
(6) **Attach your graph to the worksheet.**

Exercise 3:
Create a movie for $r(t) = \sqrt{4-t^2}\cos(2\pi t)\vec{i} + \sqrt{4-t^2}\sin(2\pi t)\vec{j} + t\vec{k}$
Be careful, what is the domain of this function?
Try values `N=100,AZ=45,EL=20,VEL=0.1,ACC=0.01` for csimovie parameters.

a.) Based on the movie, is $r'(t)$ perpendicular to $r(t)$?
(7) Circle one:
1. yes **2.** no

b.) Does $r'(t) \bullet r(t) = 0$?
(8) Circle one:
1. yes **2.** no

c.) Based on the movie, is the speed constant?
(9) Circle one:
1. yes **2.** no

d.) Compute $\|r'(t)\|$. Does $\|r'(t)\|$ = a constant?
(10) Circle one:
1. yes **2.** no

e.) $\|r(t)\|^2 =$
(11) Circle one:
1. 2 **2.** $8 - t^2$ **3.** $(4-t^2)(\cos(2\pi t) + \sin(2\pi t)) + t^2$ **4.** 4 **5.** none of the above

f.) $r(t)$ lies on the surface of
(12) Circle one:
1. a cone
2. sphere of radius 2
3. paraboloid
4. sphere of radius 4
5. none of the above