GENG-8030 Computational Methods and Modeling for Engineering Applications

Summer-2023

Tutorial 4

All questions were taken from the course textbook:

Title	MATLAB for engineering applications
Author	William J. Palm
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Chapter 5: Advanced Plotting

6. To compute the forces in structures, sometimes we must solve equations similar to the following. Use the `fplot` function to find all the roots of this equation between 0 and 5:

$$x \tan(2x) = 10$$

11. Plot columns 2 and 3 of the following matrix **A** versus column 1. The data in column 1 are time (seconds). The data in columns 2 and 3 are force (newtons).

$$\mathbf{A} = \begin{bmatrix} 0 & -7 & 6 \\ 5 & -4 & 3 \\ 10 & -1 & 9 \\ 15 & 1 & 0 \\ 20 & 2 & -1 \end{bmatrix}$$

19.* The height $h(t)$ and horizontal distance $x(t)$ traveled by a ball thrown at an angle A with a speed v are given by

$$h(t) = vt \sin A - \frac{1}{2}gt^2$$
$$x(t) = vt \cos A$$

At Earth's surface the acceleration due to gravity is $g = 9.81$ m/s^2.

a. Suppose the ball is thrown with a velocity $v = 20$ m/s at an angle of 25°. Use MATLAB to compute how high the ball will go, how far it will go, and how long it will take to hit the ground.

b. Use the values of v and A given in part *a* to plot the ball's *trajectory;* that is, plot h versus x for positive values of h.

c. Plot the trajectories for $A = 45°$ corresponding to five values of the initial velocity v: 20, 24, 28, 32, and 36 m/s.

22. When a constant voltage was applied to a certain motor initially at rest, its rotational speed $s(t)$ versus time was measured. The data appear in the following table:

Time (sec)	1	2	3	4	5	6	7	8	10
Speed (rpm)	1210	1866	2301	2564	2724	2881	2879	2915	3010

Determine whether the following function can describe the data. If so, find the values of the constants b and c.

$$s(t) = b\left(1 - e^{ct}\right)$$

32. Create a polar plot of the following function for the range $0 \leq \theta \leq 2\pi$.

$$r = 6\cos^2(0.8\theta) + \theta$$

36. Planets and planetary satellites move in elliptical orbits. A certain ellipse centered at the origin has the equation

$$x^2 + \frac{y^2}{4} = 1$$

Another ellipse, also centered at the origin, is rotated relative to the first ellipse. Its equation is

$$0.5833x^2 - 0.2887xy + 0.4167y^2 = 1$$

We want to find all points where the ellipses intersect. Use the `fimplicit` function and the `hold` command to plot both ellipses on the same plot. Since both ellipses are centered at the origin, if they intersect they will intersect at four points, so you will need to use the `ginput` function for four points.

37. The popular amusement ride known as the corkscrew has a helical shape. The parametric equations for a circular helix are

$$x = a\cos(t)$$
$$y = a\sin(t)$$
$$z = bt$$

where a is the radius of the helical path and b is a constant that determines the "tightness" of the path. In addition, if $b > 0$, the helix has the shape of a right-handed screw; if $b < 0$, the helix is left-handed.

Obtain the three-dimensional plot of the helix for the following three cases and compare their appearance with one another. Use $0 \le t \le 10\pi$ and $a = 1$.

a. $b = 0.1$

b. $b = 0.2$

c. $b = -0.1$

42. A square metal plate is heated to 80°C at the corner corresponding to $x = y = 1$. The temperature distribution in the plate is described by

$$T = 80e^{-(x-1)^2}e^{-3(y-1)^2}$$

Obtain the surface and contour plots for the temperature. Label each axis. What is the temperature at the corner corresponding to $x = y = 0$?