Surfaces of Revolution

Michael Penna, Indiana University – Purdue University, Indianapolis

Objective

To illustrate how Maple can be used to draw some surfaces of revolution.

Narrative

In this project we illustrate how Maple can be used to draw some surfaces of revolution. While you may or may not understand how and why the commands you type produce the graphics they produce, the objective of this project is to provide you with some tools that will allow you to better visualize the surfaces of revolution discussed in the examples and exercises in the text: by making some relatively simple changes in the code below, you can draw a number of interesting surfaces. (See the Comments.)

Task

1. Type the command lines in the left-hand column below into Maple in the order in which they are listed. These commands produce graphics of surfaces of revolution.

`> # Your name, today´s date`	
`> # Surfaces of Revolution`	
`> restart;`	Clear Maple's memory.
`> with(plots):`	Using the `plots` package, ...
`> setoptions3d(axes=normal,orientation=[-140,80]):`	and the "appropriate" options ...
`> f := x -> sqrt(x);`	Let $f(x) = \sqrt{x}$.
`> plot(f(x),x=0..1);`	Graph f over the interval $[0, 1]$.
`> plot3d([t,f(t)*cos(theta),f(t)*sin(theta)],t=0..1,theta=0..2*Pi,color=t);`	Now rotate this graph about the x-axis, ...
`> plot3d([t*cos(theta),t*sin(theta),f(t)],t=0..1,theta=0..2*Pi,color=t);`	and about the y-axis.
`> k := -0.5;`	Assuming $k = -1/2$, ...
`> plot3d([t,(f(t)-k)*cos(theta)+k,(f(t)-k)*sin(theta)],t=0..1,theta=0..2*Pi,color=t);`	rotate this graph about the line $y = k$, ...
`> plot3d([(t-k)*cos(theta)+k,(t-k)*sin(theta),f(t)],t=0..1,theta=0..2*Pi,color=t);`	and about the line $x = k$.

2. Create graphics of the surfaces of revolution obtained by revolving the graph of $f(x) = \sin x$, $x \in [0, \pi]$ about the x-axis, about the y-axis, about the line $y = -1$, and about the line $x = -\pi/2$.

At this time, make a hard-copy of your typed input and Maple's responses. Then:

3. To the right of the image of each surface of revolution you created in Tasks 1 and 2, draw the image — including the coordinate axes, the axis of revolution, and the surface of revolution — by hand, illustrating the main features of the surface. (Since Maple will not always be available when you need a sketch of a surface of revolution, it is important to learn how to visualize and sketch a surface of revolution by hand.)

Your lab report will be a hard-copy of your typed input and Maple's responses (both text and hand-drawn graphics).

Comments

1. Upon clicking on a graphic generated by Maple, a (new) menu bar appears which allows you to change the appearance of the graphic. In particular, you can change the angles $\theta = -140°$ and $\phi = 80°$ from which each surface is viewed. These angles can be changed by: a) using the scroll arrows in the menu, b) retyping the values in the value boxes in the menu, and c) manually rotating the graphic itself. (We discuss 3-dimensional graphics in considerably more depth in our discussion of multivariate Calculus. By the time that course is over, you will not only have gained considerable experience adjusting the parameters in the 3-dimensional graphics menu bar, but you will also understand the commands we used in this project.)

2. What do you think would happen if you replaced $f(x) = \sqrt{x}$ by $f(x) = x^2$ in Task 1? Try it, and see if you're right!

3. How would you have to modify the above code to get the correct graphics if, instead of revolving the curve whose equation is $y = f(x)$ about various axes, you were to revolve the curve whose equation is $x = g(y)$ around the same set of axes? Try it, and see if you're right!