PHYS2502 Mathematical Physics   Lab #10   3 Apr 2022

This lab assignment is at 8am, the morning after the date shown, although you should able to complete it easily before the end of the lab period. When you're done, upload your code to the github *repository, and a PDF of your output to the* canvas *page for the course.*

This lab will let you play with 3D rotation matrices, by showing what happens to a solid object after it is rotated about the x-, y-, or z-axes. This can all be done using the matrix manipulation and visualization tools in MATHEMATICA.

Check the documentation for how to define a vector (it is just a list), a matrix (it is just a list of lists) and how to multiply a matrix times a vector (it is just a ".".)

First choose a graphic object to display. If you look at the documentation for Graphics3D you'll see a list of options for the many different graphic primitives. I used Cone, which has some symmetry, but I encourage you to try other solid objects. If you are really ambitious, check out ExampleData[{"Geometry3D", "SpaceShuttle"}] and similar examples.

Use Graphics3D to display your object and make sure it does what you expect. Use the options Axes→True and PlotRange inside Graphics3D so that you can check that your object is oriented correctly, before you start rotating it. I found it handy to combine the Graphics3D command with ListLinePlot3D, using Show, so that you can draw lines for the x-, y-, or z-axes.

Now define 3×3 matrices for each of the following operations,

- A rotation through an angle α about the x-axis
- A rotation through an angle β about the y-axis
- A rotation through an angle γ about the z-axis
- A parity reversing reflection through the origin, that is $(x, y, z) \to (-x, -y, -z)$

and check your matrices by performing each of the following operations on your original object, and drawing the result:

a) A rotation by 90° about the x-axis
b) A rotation by 90° about the y-axis
c) A rotation by 90° about the z-axis
d) A rotation by 90° about the x-axis followed by a rotation by 90° about the z-axis
e) A rotation by 90° about the z-axis followed by a rotation by 90° about the x-axis
f) A parity reversing reflection
g) A parity reversing reflection followed by a 180° rotation about the y-axis

You are welcome to try other examples, for example a 45° rotation about some axis, and other combinations of two-axis rotations.

You can also use Manipulate (which has the same syntax as Animate) to try some combination of axis rotations and manipulate the angles by hand.