Electric Field Visualization

Modeling Motion Week 3 Computer Lab

This week we will use Python to visualize the electric field surrounding a set of point charges. We will draw electric field lines which show the direction of force resulting from the *superposition* of forces due to each individual charge. These field lines are directional and always begin at a positive charge and end at a negative charge. To draw them, we will use a numerical technique similar to Euler's method for solving differential equations. We start at a point near a positive charge and compute the electric field at that point by using Coulomb's law to compute the force that would act on an imaginary positive test charge at that point and dividing by the magnitude of the test charge.

This will give us a vector in the direction of the electric whose magnitude is the strength of the field at that point. By normalizing this vector (making it unit length) and multiplying by a small stepsize, we can take a small step to point which approximates the next point on that field line. We continue this process until we arrive near a negative charge.

1) Download `field.py` from the Modeling Motion Website.

2) Create a `charge.py` module which defines a class called `Charge`. This class should have several attributes:

   - A float to store the amount of charge.
   - A vector to store the position of the charge.
   - A `sphere` object to make a graphic on the screen.
   - If the charge is positive, it should have a *list* of 20 `curve` objects which will represent the field lines emanating from that charge.
   - The `__ini__()` method should take a color argument to give the graphic representation the given color.

3) Import the charge into `field.py` you should see a red charge with field lines going straight out from it.

4) Now modify `field.py` so that the `plotfield()` function takes a list of charges and draws the field lines from all positive charges.

5) To test, create a group of at least 4 charges with two positive and two negative and verify that the field looks correct. Turn in the final program including the `charge.py` module and a plot of the field around one of your charge configurations.

Extra

Animate one or more of the charges by changing its position and re-plotting the field lines for the whole system.