As discussed in the reading assignment, the magnetic field lines for a long, straight current are circles around the wire. What about the magnetic field vectors themselves? If you draw them as little straight arrows with beginning and ends, what would the figure look like? Be creative and try to give an evocative visual description.

Good description, nice comparison

As stated, the magnetic field lines around a long straight current circle around the wire. **At any given point on these circles, the magnetic field vector is tangential to the circle meaning they will shoot out at a 90 degree angle from the distance to the wire**. Doing this at various points across the circle would create an image **resembling the blade of a buzzsaw.**

Including the variation with distance

The **magnetic field vectors would be arrows that are tangent to the field lines**, which are circles around the wire. **The length of these arrows, or magnitude of the vectors decrease as they move further away from the wire.** If the current is coming out of the plane, the direction of the magnetic field is counterclockwise. If the current is going into the plane, the direction of the magnetic field is clockwise.

But vectors at nearby points do not connect one to the next!

At each point, **the circular magnetic field vectors would look like a many-sided polygon**, with each vector being tangent to the circular field lines at each point.

Lightning bolts carry an electrical current of up to about 200 kA. Despite the lovely branching pattern, consider an isolated segment that can be treated as approximately straight, so you can treat it as a line current. How far away from it would you have to be for the magnetic field it produces to be equal in magnitude to the Earth's field of 0.03 mT?

Well presented, algebra done first, skipped on some simplification, but correct!

The electric field at any given point from the lightning bolt is equal to μ x the current (I) / (2π x radius r).

In this example this electric field must be equal to 0.03 x 10^-3 T, so

B = (μI)/(2πr) = 3 x 10^-5 T

The **radius would then be equal to μI/2πB** which in this case is

[(4π x 10^-7 T m/A)(2 x 10^5 A)] / (2π x 3 x 10^-5 T)

Using estimation, the π's should cancel out, leaving **(4 x 10^-7 T m/A x 2 x 10^5 A) / (2 x 3 x 10^-5), which should end up being around 4/3 x 10^3 m away from the lightning bolt, or around 1333 m away.**

Another good example, a bit more detail, still basically correct

Using **B=u0I/2pir, I know r=uoI/2piB** substituting into the formula,

r=(200*10^3A*4π * 10^-7 T*m/A)/2π*0.03*10^-3T.

r=(200*10^3*2*10^-7*10^3)m/0.03

(dp - rearrange here for clarity **r=(200*2/0.03) * 10^(3-7+3)m**)

r=40m/0.03

r approximately = 40m*100/2 = 2000m

I need to be 2000m away from the isolated lightening segment

Everything clear, minor error immediately apparent

Using the equation **B= (4pi * 10^-7 Tm/A * I)/(2pi*s)**

Solving for "s" we get: **s= (4pi * 10^-7 Tm/A * I)/(2pi*B)**

Converting kA to A= 200kA(1000 A/1 kA)= 200,000 A

Converting mT to T= 0.03 mT (0.001T/1mT) = 0.00003 T

Plug in known values: **(4pi * 10^-7 Tm/A * 200,000A)/(2pi*3*10^-5 T)**

Simplify: **(400,000 *10^-7 m)*(3*10^-5) = (0.04m)(3 *10^-5)= 1.2 * 10^-6 m**

A positively charged particle is moving near a long straight current. The particle's velocity is parallel to the current and in the same direction. What is the direction of the magnetic force on it?

a. Toward the current

b. Away from the current

c. Parallel to the current, i.e., in the direction of motion

d. Anti-parallel to the current, i.e., opposite the direction of motion

e. Around the current (either way!)

f. The force is zero