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Simulation the Distribution of Electrical Charges Fields

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Abstract: In this study, by using computer simulation software, we consider the distribution of electric charge for determine field lines. With given the mechanism of simulation code in this article, one can use similar methods for different analyzed cases.

Keywords: Simulation, Electric Field, Maple Software

1. Introduction

Electric charge is a property of matter, when the material is in the vicinity of the force will be charged. There are two types of positive and negative electric charge. Or object with the same name as thrust loads between the two materials is created and vice versa if they be opposite, attraction is created between them. International system of Units chose electrical charge unit be Coulomb (C). Of course in electrical engineering from the unit ampere hours (Ah) are also used. In the study of interactions between charged bodies, is sufficient knowledge of classical electrodynamics and quantum effects discard.

Electric charge is a conserved property, which means that the electric charge is produced in material, electrically charged subatomic particles of matter that determines the electronic properties. An electrical charged material, producing electromagnetic fields and influenced them. Interaction between a moving charge and an electromagnetic field caused by electromagnetic forces. This force is one of the four fundamental forces [1].

The experiments [2] in the twentieth century, have provided an explanation of the quantum of electric charge (this practice is called quantum). Charge of an electron is approximately equal to e=1.602 × 10 ^ 19 C (Of course there are particles called quarks have time to several ⅓e) proton and electron time to time e is equal to -e. The study of charged particles and explain their relationship with photons, called quantum electrodynamics [3].

One of the fundamental features of the matter is that for electrostatic attraction or repulsiveness in the presence of other materials. Electrical charge properties which originates back to many subatomic particles of matter. Charge of the particles that are found to be free to integer multiples of the elementary charge (charge of an electron), in this case we say that electric charge is quantized. Michael Faraday in his electrolysis experiments found that electric charge is quantized. Robert Millikan in his experiments measure the charge of a proton [4].

So we say that the charge of an electron as discrete values -1 and+1 times is a proton. Same time they are charged particles repel each other and attract other particles. Coulomb law of electrostatic force between two charged particle acquires the numerical value and stated that the amount of this force is directly related to the size of the particles is inversely proportional to the square of the distance between the two particles.

The charge of an antiparticle equals that of the corresponding particle. Quarks are fundamental load equal to -1/3 or+2/3 times, but no quark has been found to be free (theoretical because it is found in the discussion of asymptotic freedom) [5].

Electric charge of an object is equal to the sum of the electrical charges of particles. Matters is made of atoms, and atoms have equal numbers of protons and electrons in its core, thus they are electrically neutral. An ion, atom (or group of atoms) that has lost or gained one or more electrons brought are not neutral. Sometimes constituent ions throughout the body and has spread to the object is positive or negative charge. The bodies conducting electricity is sometimes easier or better (depending on the type of material) earn or lose electrons and become positive or negative net charge. This physical phenomenon called static charge or non-zero static. Feel free to rub together two dissimilar materials such as amber glass on a fur or silk we can generate static electricity. In this way, non-conductive object can gain or lose a significant amount of the charge. Sometimes an object is zero charge for non-uniformly distributed load (e.g., due to an electromagnetic field or dipoles in the material) in this case is called a polar body [6-10].

2. Simulation of the Electric Field for the Different Distribution of Charges

In this section by using Maple software, considered some of the distribution charge and obtain the electric field lines.

-Code for overall status of the two-dimensional mode:

```
>restart;
r:=<i, j>:
r1:=<x, y>:
with (VectorCalculus): SetCoordinates (cartesian [x, y]):
   R:=Norm (<i-x, j-y>):
   p:=p (x, y):
   E1:=E1 (i):
   E2:=E2 (j):
with (plots):
fieldplot ([E1, E2], i=-a..a, j=-a..a, fieldstrength=fixed, options);
```

where Vector points of interest Space=r, Vector load distribution=r1

The distance r and r1=R, The density distribution of the load=P

Along the horizontal axis=E1, Towards the vertical axis=E2

View vector field=fieldplot

The program has a charge density or data input.

A) A positive charge in center of coordinate:

```
> restart;
> r := `<,>`(i, j); r1 := `<,>`(x, y);
> with(VectorCalculus);
> SetCoordinates(cartesian[x, y]);
> R := Norm(`<,>`(i-x, j-y));
> rho := 1;
> x := 0; y := 0;
> E1 := rho*(i-x)/R^3;
> E2 := rho*(j-y)/R^3;
> with(plots);
> fieldplot([E1, E2], i = -10.. 10, j = -10.. 10, fieldstrength = fixed, grid = [20, 20], arrows = SLIM, color = BLUE);
```

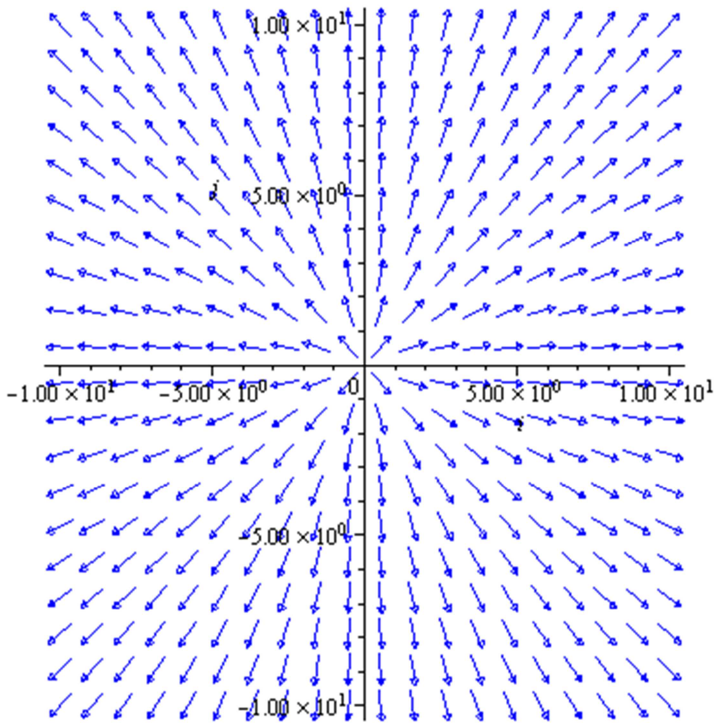

Figure 1. *Field lines for a positive charge in center of coordinate.*

B) Electric dipole in the center of coordinates:

```
> restart;
> r := `<,>`(i, j); r1 := `<,>`(x, y);
> with(VectorCalculus);
> SetCoordinates(cartesian[x, y]);
> R := Norm(`<,>`(i-x, j-y));
> rho := 1;
> x := 0; y := 0;
> E11 := rho*(i-x)/R^3; E12 := rho*(i-y)/R^3; x :=.1; y :=.1; E21 := -rho*(i-x)/R^3; E22 := -rho*(i-y)/R^3;
> E1 := E11+E21; E2 := E12+E22;
> with(plots);
> fieldplot([E1, E2], i = -.3...3, j = -.3...3, fieldstrength = fixed, grid = [20, 20], arrows = SLIM, color = BLUE);
```

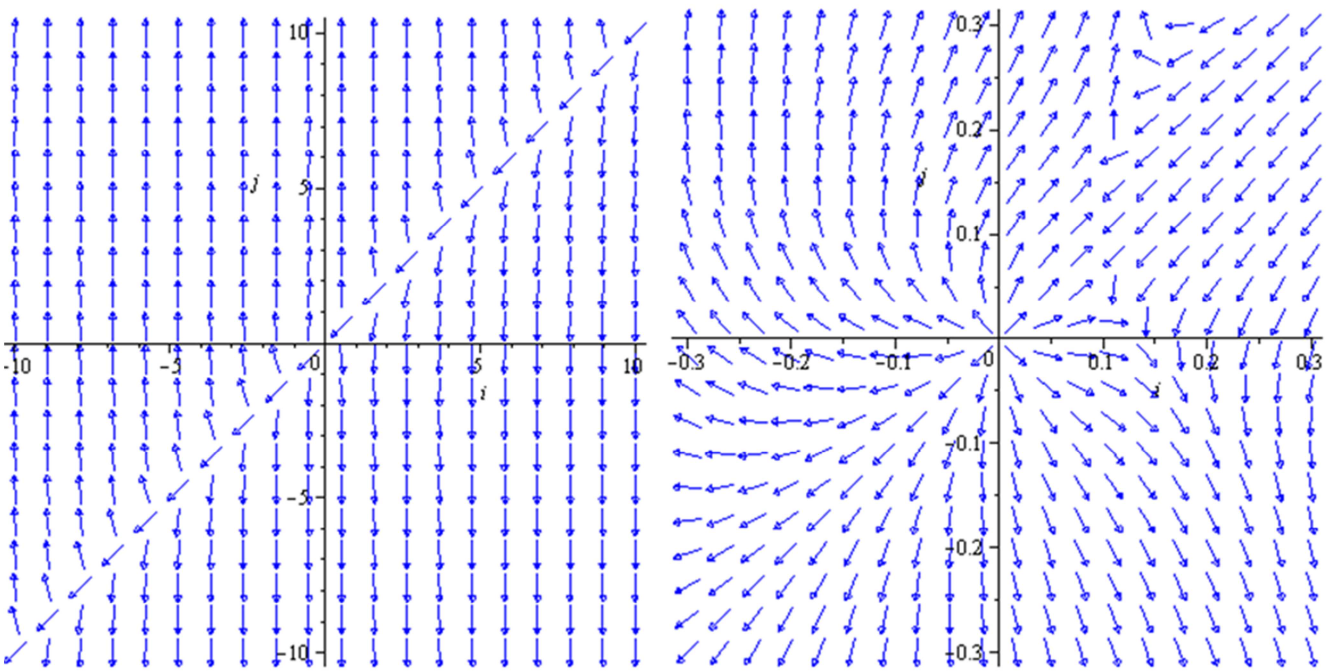

Figure 2. Left from near view and right from far view.

C) Electric quadrupole in specific coordinates

```
> restart;
> r := `<,>`(i, j); r1 := `<,>`(x, y);
> with(VectorCalculus);
> SetCoordinates(cartesian[x, y]);
> R := Norm(`<,>`(i-x, j-y));
> rho := 1;
> x := 5; y := 5;
> E11 := rho*(i-x)/R^3; E21 := rho*(i-y)/R^3; x := 4; y := 4; E12 := rho*(i-x)/R^3; E22 := rho*(i-y)/R^3; x := 4.33; y := 4.33; E13 := -rho*(i-x)/R^3; E23 := -rho*(i-y)/R^3; x := 4.66; y := 4.66; E14 := -rho*(i-x)/R^3; E24 := -rho*(j-y)/R^3;
> E1 := E11+E21+E13+E14; E2 := E21+E22+E23+E24;
> with(plots);
> fieldplot([E1, E2], i = 3.. 6, j = 3.. 6, fieldstrength = fixed, grid = [20, 20], arrows = SLIM, color = BLUE);
```

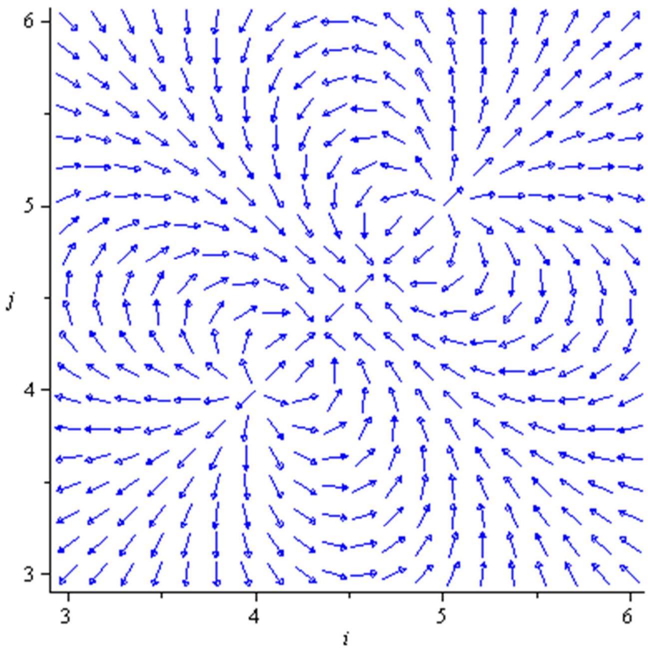

Figure 3. *Field lines for Electric quadrupole.*

D) A charge rod load density is proportional to the width:

```
> restart;
> r := `<,>`(i, j); r1 := `<,>`(x, y);
> with(VectorCalculus);
> SetCoordinates(cartesian[x, y]);
> R := Norm(`<,>`(i-x, j-y));
> rho := y;
> E1 := Int(Int(rho*(i-x)/R^3, x = -0.1e-2.. 0.1e-2), y = -100.. 100); E2 := Int(Int(rho*(i-y)/R^3, x = -0.1e-2.. 0.1e-2), y = -100.. 100);
> with(plots);
> fieldplot([E1, E2], i = -200.. 200, j = -200.. 200, fieldstrength = fixed, grid = [30, 30], arrows = SLIM, color = gold);
```

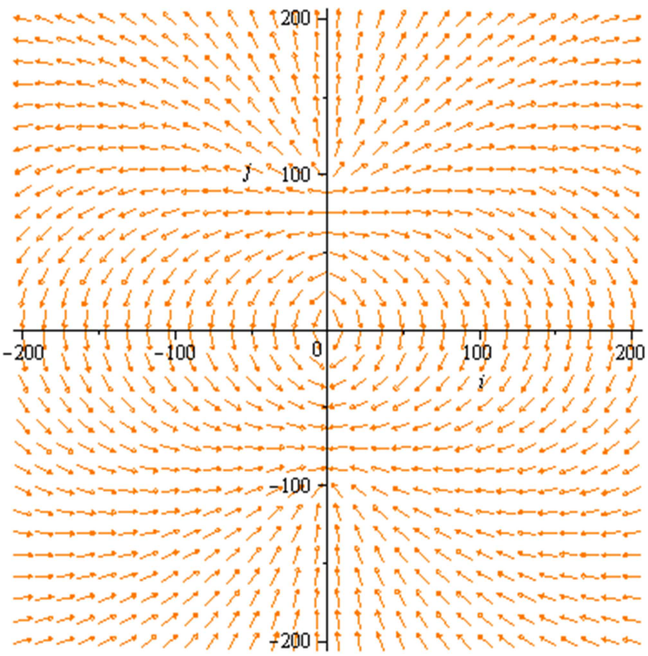

Figure 4. *Field lines for a charge rod.*

E) A positively charged rod with a diameter of 0.002 in the shape of a equation y=x^ 2 is from -2 to 2:

```
> restart;
> r := `<,>`(i, j); r1 := `<,>`(x, y);
> with(VectorCalculus);
> SetCoordinates(cartesian[x, y]);
> R := Norm(`<,>`(i-x, j-y));
> rho := 1;
> E1 := Int(Int(rho*(i-x)/R^3, y = x^2-0.1e-2.. x^2), x = -2.. 2); E2 := Int(Int(rho*(i-y)/R^3, y = x^2-0.1e-2.. x^2), x = -2.. 2);
> with(plots);
> fieldplot([E1, E2], i = -5.. 5, j = -5.. 5, fieldstrength = fixed, grid = [20, 20], arrows = SLIM, color = black);
```

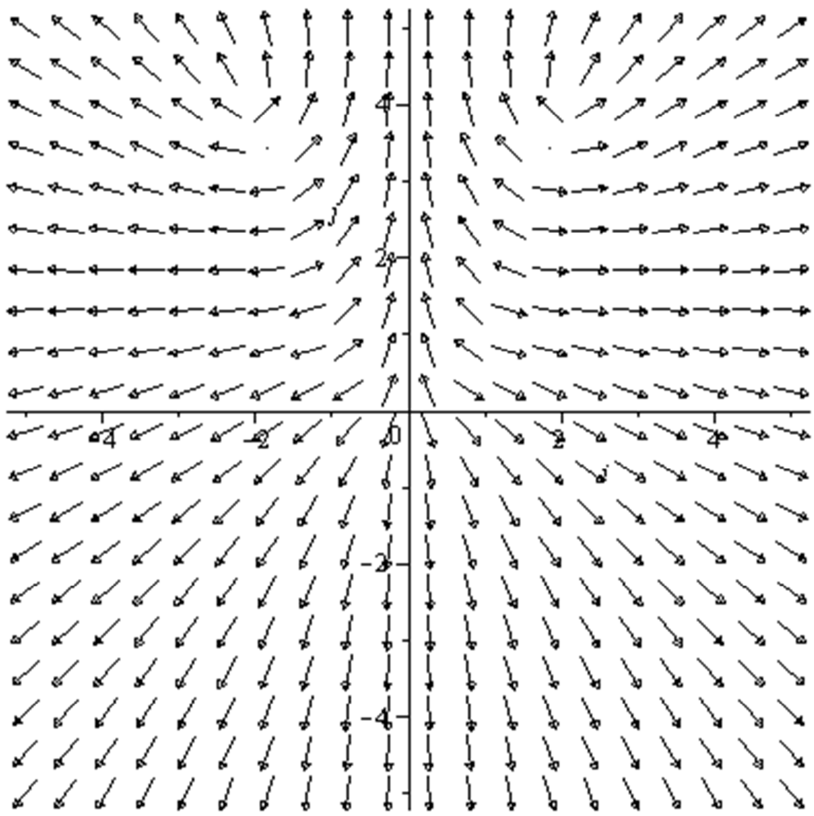

Figure 5. *Field lines for a positively charged rod.*

F) Examples of three-dimensional mode:

```
> restart;
> r := `<,>`(i, j, k); r1 := `<,>`(x, y, z);
> with(VectorCalculus);
> SetCoordinates(cartesian[x, y, z]);
> R := Norm(`<,>`(i-x, j-y, k-z));
> rho := 1;
> x := 1; y := 1; z := 1;
> E11 := rho*(i-x)/R^3; E21 := rho*(j-y)/R^3; E31 := rho*(k-z)/R^3;
> x := 2; y := 2; z := 2;
> E12 := rho*(i-x)/R^3; E22 := rho*(j-y)/R^3; E32 := rho*(k-z)/R^3;
> E1 := E11+E12; E2 := E21+E22; E3 := E31+E32;
> with(plots);
> fieldplot3d([E1, E2, E3], i = 1.. 2, j = 1.. 2, k = 1.. 2, fieldstrength = fixed, grid = [8, 8, 8], arrows = SLIM, color = green);
```

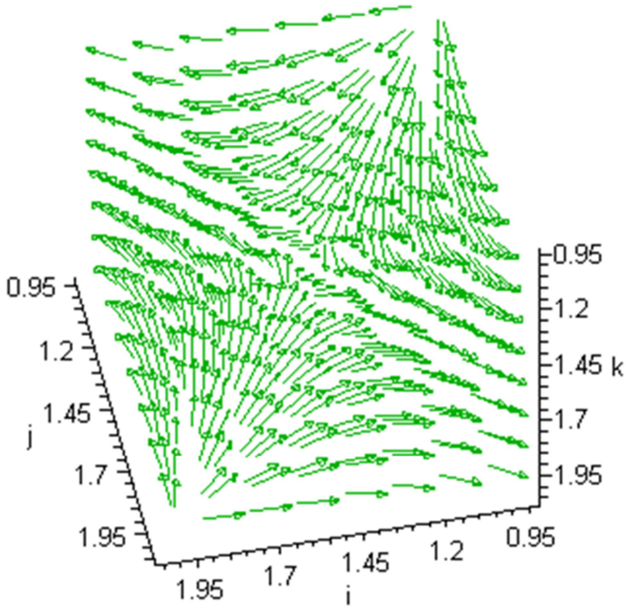

Figure 6. *Field lines for two positive charge.*

```
> restart;
> r := `<,>`(i, j, k); r1 := `<,>`(x, y, z);
> with(VectorCalculus);
> SetCoordinates(cartesian[x, y, z]);
> R := Norm(`<,>`(i-x, j-y, k-z));
> rho := 1;
> x := 1; y := 1; z := 1;
> E11 := -rho*(i-x)/R^3; E21 := -rho*(j-y)/R^3; E31 := -rho*(k-z)/R^3;
> x := 2; y := 2; z := 2;
> E12 := rho*(i-x)/R^3; E22 := rho*(j-y)/R^3; E32 := rho*(k-z)/R^3;
> E1 := E11+E12; E2 := E21+E22; E3 := E31+E32;
> with(plots);
> fieldplot3d([E1, E2, E3], i = 1.. 2, j = 1.. 2, k = 1.. 2, fieldstrength = fixed, grid = [8, 8, 8], arrows = SLIM, color = red);
```

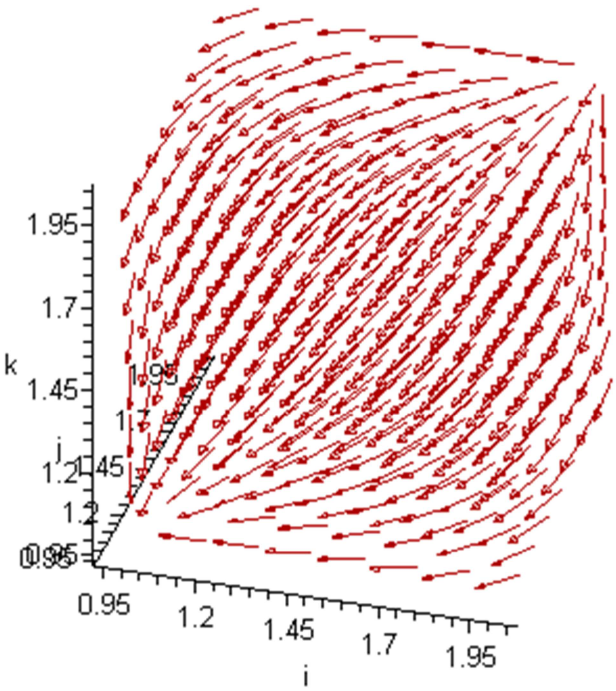

Figure 7. *Field lines for Both positive and negative electric charge.*

G) Rod has a positive electrical charge long-distance lines that are perpendicular:

```
> restart;
> r := `<,>`(i, j, k); r1 := `<,>`(x, y, z);
> with(VectorCalculus);
> SetCoordinates(cartesian[x, y, z]);
> R := Norm(`<,>`(i-x, j-y, k-z));
> rho := 1;
> E1 := Int(Int(Int(rho*(i-x)/R^3, x = -0.1e-2.. 0.1e-2), y = -0.1e-2.. 0.1e-2), z = -10.. 10);
> E2 := Int(Int(Int(rho*(i-y)/R^3, x = -0.1e-2.. 0.1e-2), y = -0.1e-2.. 0.1e-2), z = -10.. 10);
> E3 := Int(Int(Int(rho*(i-z)/R^3, x = -0.1e-2.. 0.1e-2), y = -0.1e-2.. 0.1e-2), z = -10.. 10);
> with(plots);
> fieldplot3d([E1, E2, E3], i = -100.. 100, j = -100.. 100, k = -100.. 100, fieldstrength = fixed, grid = [8, 8, 8], arrows = SLIM, color = blue)
```

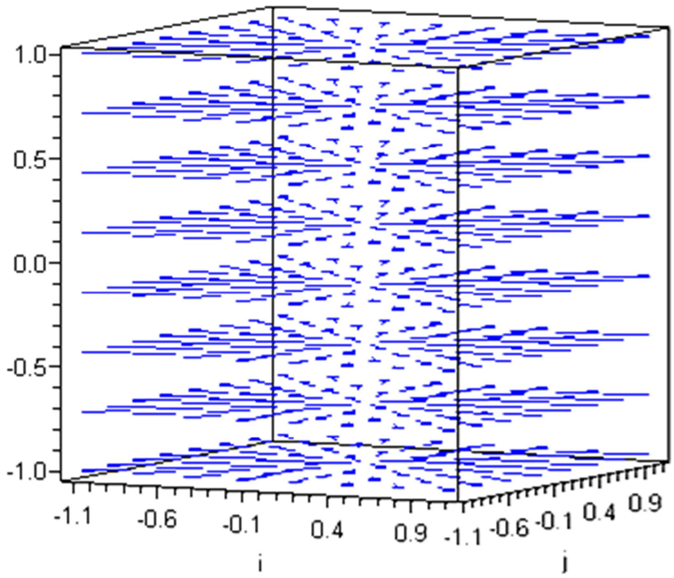

Figure 8. *Rod has a positive electrical charge long-distance lines that are perpendicular.*

3. Electric Field vs. Magnetic Field

The area around a magnet within which magnetic force is exerted, is called a magnetic field. It is produced by moving electric charges. The presence and strength of a magnetic field is denoted by "magnetic flux lines". The direction of the magnetic field is also indicated by these lines. The closer the lines, the stronger the magnetic field and vice versa. When iron particles are placed over a magnet, the flux lines can be clearly seen. Magnetic fields also generate power in particles which come in contact with it. Electric fields are generated around particles that bear electric charge. Positive charges are drawn towards it, while negative charges are repelled.

A moving charge always has both a magnetic and an electric field, and that's precisely the reason why they are associated with each other. They are two different fields with nearly the same characteristics. Therefore, they are inter-related in a field called the electromagnetic field. In this field, the electric field and the magnetic field move at right angles to each other. However, they are not dependant on each other. They may also exist independently. Without the electric field, the magnetic field exists in permanent magnets and electric fields exist in the form of static electricity, in absence of the magnetic field.

Table 1. *Summary of Electromagnetic Fields property.*

Electric Field	**Magnetic Field**	
Nature	Created around electric charge	Created around moving electric charge and magnets
Units	Newton per coulomb, volts per meter	Gauss or Tesla
Force	Proportional to the electric charge	Proportional to charge and speed of electric charge
Movement In Electromagnetic field	Perpendicular to the magnetic field	Perpendicular to the electric field
Electromagnetic Field	Generates VARS (Capacitive)	Absorbs VARS (Inductive)
Pole	Monopole or Dipole	Dipole

Magnetic fields are created whenever there is a flow of electric current. This can also be thought of as the flow of water in a garden hose. As the amount of current flowing increases, the level of magnetic field increases. Magnetic fields are measured in milliGauss (mG).

An electric field occurs wherever a voltage is present. Electric fields are created around appliances and wires wherever a voltage exists. You can think of electric voltage as the pressure of water in a garden hose – the higher the voltage, the stronger the electric field strength. Electric field strength is measured in volts per meter (V/m). The strength of an electric field decreases rapidly as you move away from the source. Electric fields can also be shielded by many objects, such as trees or the walls of a building.

An electric field is essentially a force field that's created around an electrical charged particle. A magnetic field is one that's created around a permanent magnetic substance or a moving electrically charged object. In an electromagnetic field, the directions in which the electric and magnetic field move, are perpendicular to each other. The units which represent the strengths of the electric and magnetic field are also different. The strength of the magnetic field is represented by either gauss or Tesla. The strength of an electric field is represented by Newton per Coulomb or Volts per Meter. The electric field is actually the force per unit charge experienced by a non moving point charge at any given location within the field, whereas the magnetic field is detected by the force it exerts on other magnetic particles and moving electric charges. However, both the concepts are wonderfully correlated and have played important roles in plenty of path breaking innovations. Their relationship can be clearly explained with the help of Maxwell's Equations, a set of partial differential equations which relate the electric and magnetic fields to their sources, current density and charge density.

4. Conclusion

The electric field at any point in space because there are at any point in space can always take a field line. At any point along the line of electric force can only be defined in a single line of it. In other words, Power lines may not intersect just in time point. The power of positive charge (the starting point of the line) and negatively charged off (the power lines) are nearby. They have a positive charge to a negative charge and can pass through the insulator. Because there is no electric field inside conductors (zero), loads them to remain in equilibrium. There is no electric field inside the conductor line. In other words, the electric field lines do not pass through the conductor. However, In this research we studied some computer simulations of these lines that provided a better understanding of this issue.

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