مجلة كلية التراث الجامعة

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Proposed to Determine of the direction of Lorentz's power in 3d space by applied linear algebra

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Abstract:

In this work, we will guess how to find Lorentz power direction on moving electrical charges in a three-dimensional space(x,y,z) in magnetic field by deducing a new mathematical equation derived from the law of Lorentz force and by applying the laws of algebra vectors of eigenvalue and eigenvector to find the movement of three dimension charges with in the fluid , it turns out that this analysis has gained knowledge of the difference in the application of the Lorentz law, where the previous studies have come to find the quantitative amount of power and we discuss to determined the direction of movement through the application in the space of three-dimensional axis (x,y,z) the general equation was concluded to find the direction of movement of electric charges at a directional velocity and three-dimensional magnetic directional space.

$$[\theta^3 - (C_1 + v_2 + b_3)\,\theta^2 + (\begin{vmatrix} v_2 & v_3 \\ b_2 & b_3 \end{vmatrix} + \begin{vmatrix} C_1 & C_3 \\ b_1 & b_3 \end{vmatrix} + \begin{vmatrix} C_1 & C_2 \\ v_1 & v_2 \end{vmatrix}\,\theta - |A|] = 0$$

Where (v_1,v_2,v_3) is the directional velocity and (b_1,b_2,b_3) the directional magnetic and (C_1,C_2,C_3) the inferred quantity of the vector of Lawrence forces.

الخلاصة:

في هذا العمل سوف نناقش كيفية ايجاد اتجاه قوة لورنتز للشحنات الكهربائية المتحركة في فضاء ثلاثي الابعاد في حقل مغناطيسي باستخدام معادلات رياضية مشتقة من قانون لورنتز وبتطبيق المتجهات الجبرية للقيمة الاتجاهية والعددية للشحنات الكهربائية المتحركة في السوائل.واتضح ان هذا التحليل قد اكتسب معرفة الاختلاف في تطبيق قان©ن لورنتز.
في الدراسات السابقة قد تم تحديد الكمية العددية لقوة لورنتز وفي موضوع بحثنا هذا سوف نحدداتجاه القوة في فضاء ثلاثي الابعاد بالمحاور (x,y,z) وان المعادلة العامة لايجاد اتجاه القوة تم استنتاجها بالشكل التالي:

$$[\theta^3 - (C_1 + v_2 + b_3)\,\theta^2 + (\begin{vmatrix} v_2 & v_3 \\ b_2 & b_3 \end{vmatrix} + \begin{vmatrix} C_1 & C_3 \\ b_1 & b_3 \end{vmatrix} + \begin{vmatrix} C_1 & C_2 \\ v_1 & v_2 \end{vmatrix}\,\theta - |A|] = 0$$

Keywords:- Lorentz force law, magnetic field and applications linear algebra.

1- Introduction :

The usual way for magnetic fields to create convection in an electrochemical cell is by the magnetohydrodynamic (MHD) effect (Fig. 1). The magnetic field ***B*** acting in the cell is the externally imposed field, essentially unaltered by the flow of electrolyte or current. The interaction of the field with the local current density ***j*** induces a flow that tends to reduce the diffusion layer thickness and enhance mass transport [9]. The limiting current in the diffusion-controlled regime increases due to the localized magnetic stirring of the electrolyte. This convective force density has the same origin as the driving force in an electric motor. It is known as the Lorentz Force and is given by the following equation: $FL=j\times B$.

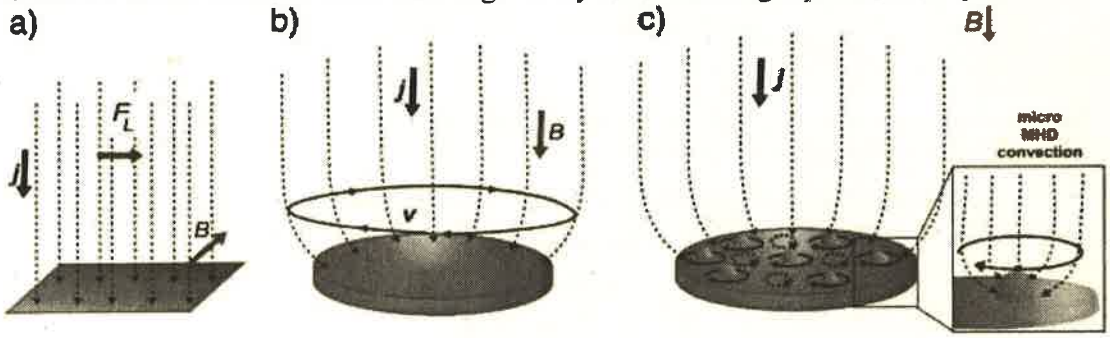


Fig (1)

the magnetohydrodynamic (MHD)

And Before starting to study and analyze the subject of our research is to try to find the direction of power Lorentz and its impact on the electric charge in the space of three – dimensional, we must present brief overview of the basic topics and mathematical equations which concerns our research, which were put in previous literature and research and as well as the importance and what are their application in our daily lives.

The Lorentz force Is an electromagnetic force that affects an electrical charge moving in an electrical field or a magnetic field called after the Dutch scientist (Hendrik Lorentz) who's discovered, and in previous research they founded based on the measurement of force on magnet system that acts upon the flow emphasizes on visualization and physical applications in the study of eigenvalue and eigenvector[1].

The application of Lorentz force in various of life and that around us in technology The effect of a certain force vertically on a moving charge in an electric field has very wide applications is:

1- Responsible for the production of electric energy from the power generating plants
2- Running electric motors and metro.

And in a natural phenomena The most important application of Lorentz's force the aurora

2-The effect of the Lorentz's force law on electric charges is moving in a three – dimensional space magnetic field [2]

If a charged particles moves vertically on lines of the magnetic field, then the negative charge $(q < 0)$ moving upward and the positive charge $(q > 0)$ moving down

- It was concluded from previous research The direction of Lorentz force depended on the type single charge .
  The relationship is opposite is represented by the following mathematical equation

$$|F_L| = q\,(E + \vec{V} \times \vec{B})$$

$$|\vec{V} \times \vec{B}| = |\vec{V}|\,|\vec{B}| \sin \propto$$

$\propto$ Is the angel between the direction charge and direction magnetic field
The direction of charge vertically on the magnetic field

$$\propto = 90 \quad \rightarrow \sin \propto = \sin 90 = 1$$

$$|\vec{V} \times \vec{B}| = |\vec{V}|\,|\vec{B}|$$

E = 0 because E is the electric field

$$|F_L| = q\,(\vec{V} \times \vec{B})$$

$$|F_L| = |q|\,|\vec{V}|\,|\vec{B}|$$

The influence of Lorentz power on electronical charges moves in a three dimensional space through which we can determine the direction of Lorentz force, which affects a magnetic field on a point charges q moving velocity (v) in 3d and on the axes (x,y,z) it represent (i, j, k).

Since it

q is a non vector quantity
E = 0 because E is the electric field
$\vec{V}$ is a vector quantity
$\vec{B}$ is a vector quantity

Now Many engineering students are usually introduced to the formal presentation of mathematics through a course in linear algebra. The abstract and formal nature of linear algebra originate two sources of difficulty in its understanding which were identified by Dorier and Sierpinska (2001): "The nature of linear algebra itself (conceptual difficulties) and the kind of thinking required for the understanding of linear algebra (cognitive difficulties)[3] .

And to connected with The Lorentz matrix has many properties, it is orthogonal where $A^{-1} = A^{T}$, orthonormal where the magnitude of any of its unit column vector is equal to one (from this property one can obtain the value of the Lorentz factor γ), also it is symmetric where $A = A^{T}$ (for the Lorentz matrix with real elements)[6]

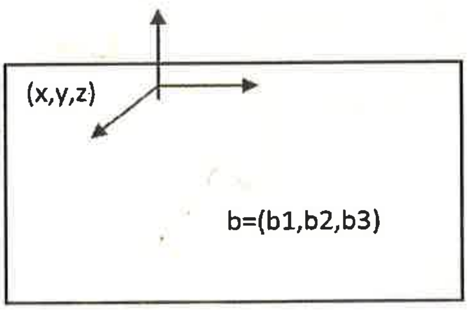
And simply to be able to write it in the following form[4]:

A(v)X = λX. …(*) Equation (*) can be written as [A(v) − λI] X = 0 which implies that |A(v) − λI| = 0

Where I is identity matrix and A is the elements of the speed vectors and magnetic field of the movement charges

Can be determined the direction of Lorentz force by represent a speed vector $\vec{V} = (v_1, v_2, v_3)$ *and vector magnetic field* $\vec{B} = (b_1, b_2, b_3)$ and apply the scaler product law.

Then the mathematical equation to determine the direction of force becomes as follows :-



$$|F_L| = q\,(\vec{V} \times \vec{B})$$

$$|\vec{V} \times \vec{B}| = \begin{vmatrix} i & j & k \\ v_1 & v_2 & v_3 \\ b_1 & b_2 & b_3 \end{vmatrix} \ldots\ldots\ldots (\,scaler\ product)$$

Then

$$|\vec{V} \times \vec{B}| = \begin{vmatrix} v_2 & v_3 \\ b_2 & b_3 \end{vmatrix} i - \begin{vmatrix} v_1 & v_3 \\ b_1 & b_3 \end{vmatrix} j + \begin{vmatrix} v_1 & v_2 \\ b_1 & b_2 \end{vmatrix} k \qquad (1)$$

$$= q[(\,v_2 . b_3 - v_3 . b_2)\,i - (\,v_1 . b_3 - v_3 b_1)j + (v_1 . b_2 - v_2 . b_1)k] \qquad (2)$$

$$= C1\,i - C2\,j + C3\,k$$

(If C1, C2, C3 is constant factor of the axises (x, y, z))

$C1 = q(v_2 . b_3 - v_3 . b_2)$

$C2 = q(v_1 . b_3 - v_3 . b_1)$

$C3 = q(v_1 . b_2 - v_2 . b_1)$

Then $|V \times B| = \begin{vmatrix} C_1 & C_2 & C_3 \\ v_1 & v_2 & v_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$

Then to determine the direction of these forces in a three dimensional space, We must be find the Eigenvector of Lorentz force matrix

Then we assume that $A = \begin{vmatrix} C_1 & C_2 & C_3 \\ v_1 & v_2 & v_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$ (the values of which are all known)

Then to solve the eigenvalue $(A - \theta I)X = 0 \quad \rightarrow |A - \theta I| = 0$

$$\Rightarrow \left| \begin{pmatrix} C_1 & C_2 & C_3 \\ v_1 & v_2 & v_3 \\ b_1 & b_2 & b_3 \end{pmatrix} - (\theta_1 \quad \theta_2 \quad \theta_3) \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \right| = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \qquad (3)$$

$$\Rightarrow \begin{vmatrix} C_1 - \theta_1 & C_2 & C_3 \\ v_1 & v_1 - \theta_2 & v_3 \\ b_1 & b_2 & b_3 - \theta_3 \end{vmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \qquad (4)$$

To find the determine is

$$[\boldsymbol{\theta^3 - (sum\ of\ diagonal\ elements)\ \theta^2 + (sum\ of\ diagonal\ minors)\theta - |A|] = 0}$$

$$[\boldsymbol{\theta^3 - (C_1 + v_2 + b_3)\ \theta^2} + (\begin{vmatrix} v_2 & v_3 \\ b_2 & b_3 \end{vmatrix} + \begin{vmatrix} C_1 & C_3 \\ b_1 & b_3 \end{vmatrix} + \begin{vmatrix} C_1 & C_2 \\ v_1 & v_2 \end{vmatrix}\ \boldsymbol{\theta - |A|] = 0} \qquad (5)$$

The values of eigenvalues $(\boldsymbol{\theta_1, \theta_2, \theta_3})$ are obtained by applying of mathematical methods to solve the equations of the third degree

And our last step to determine the direction of the movement of the force affecting the electric charge, we must find the eigenvector .

First from the matrix ((A - $\boldsymbol{\theta_1}$ $I)X = 0$) if $\boldsymbol{\theta_1}$ is value information found previously

And finding the vectors $(x1, x2, x3)$ by using the Gaussian elimination which represent the direction force movement .

3- Test numerical examples

3-1 Example 1

A charged particle of (2.2μ) moves in a three –dimensional space, moving with a speed vector of $(\overrightarrow{V} = -2i + 3j + k)$ in a regular magnetic field the intensity of its direction $(\vec{B} = -4i + 4j + k)$ then find the force vector affecting the electrical charge.

We have

$$\vec{F} = q\,(\vec{V} \times \vec{B})$$

$$(\vec{V} \times \vec{B}) = \begin{vmatrix} i & j & k \\ -2 & 3 & 1 \\ -4 & 4 & 1 \end{vmatrix} = \begin{vmatrix} 3 & 1 \\ 4 & 1 \end{vmatrix} i - \begin{vmatrix} -2 & 1 \\ -4 & 1 \end{vmatrix} j + \begin{vmatrix} -2 & 3 \\ -4 & 4 \end{vmatrix} k$$

$$= -i - 2j + 4k$$

Where (i, j, k) represents the orientation of the axes (x,y,z)

Hence

$\vec{F} = q\,(-i - 2j + 4k)$

$\vec{F} = -2.2\,i - 4.4\,j + 8.8\,k$

$\vec{F} = (-2.2, -4.4, 8.8) = (C_1, C_2, C_3)$

Then $|V \times B| = \begin{vmatrix} C_1 & C_2 & C_3 \\ v_1 & v_2 & v_3 \\ b_1 & b_2 & b_3 \end{vmatrix} = \begin{vmatrix} -2.2 & -4.4 & 8.8 \\ -2 & 3 & 1 \\ -4 & 4 & 1 \end{vmatrix}$

To find the eigenvalues from Eq .3 ,one can obtain

$$\left|\begin{pmatrix} C_1 & C_2 & C_3 \\ v_1 & v_2 & v_3 \\ b_1 & b_2 & b_3 \end{pmatrix} - (\theta_1 \quad \theta_2 \quad \theta_3)\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}\right| = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$\left|\begin{pmatrix} -2.2 & -4.4 & 8.8 \\ -2 & 3 & 1 \\ -4 & 4 & 1 \end{pmatrix} - (\theta_1 \quad \theta_2 \quad \theta_3)\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}\right| = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

Then
$$\left|\begin{pmatrix} -2.2 - \theta_1 & -4.4 & 8.8 \\ -2. & 3 - \theta_2 & 1 \\ -4 & 4 & 1 - \theta_3 \end{pmatrix}\right| = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

And from Eq.5 ,yields

$$[\theta^3 - (-2.2 + 3 + 1)\,\theta^2 + (\begin{vmatrix} 3 & 1 \\ 4 & 1 \end{vmatrix} + \begin{vmatrix} -2.2 & 8.8 \\ -4 & 1 \end{vmatrix} + \begin{vmatrix} -2.2 & -4.4 \\ -2 & 3 \end{vmatrix})\,\theta - (46.2)\,] = 0$$

$[\theta^3 - (1.8)\,\theta^2 + (16.6)\,\theta - (46.2)\,] = 0$ (6)

We will assume that $\theta = x$ and if x = 2.5 that make Eq.6 its value approach equal to zero and we using MATLAB programming
to solve third degree

$(x-x_0)(ax^2+bx+C)=0$ (7)

Hence $a = 1, C = -18.48$

$then\ (x-2.5)(x^2+bx-18.48)=0$ (8)

And from value of (a and c) then b = 0.7

Then Eq.8 becomes

$(x-2.5)(x^2+0.7x-18.48)=0$

Then $x_1 = 2.5$ *and* $x_2 = -4.663$ *and* $x_3 = 3.963$

Now to solve the eigenvector of this matrix *and if the eigenvalue* $(\theta_1, \theta_2, \theta_3) = (2.5, -4.663, 3.963)$ *and the resulting matrix is non − singular*

Then $(A-\theta I)X = 0$

If $\theta 1 = 2.5$

$$\Rightarrow \left[\begin{pmatrix} -2.2 & -4.4 & 8.8 \\ -2 & 3 & 1 \\ -4 & 4 & 1 \end{pmatrix} - 2.5\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}\right]\begin{pmatrix} X1 \\ X2 \\ X3 \end{pmatrix} = 0$$

$$\begin{pmatrix} -4.7 & -4.4 & 8.8 \\ -2 & 0.5 & 1 \\ -4 & 4 & -1.5 \end{pmatrix}\begin{pmatrix} X1 \\ X2 \\ X3 \end{pmatrix} = 0$$

We conclude by solving mathematical the eigenvector of linear system

$x_1 - x_2 - 2.2\,x_3 = 0$ (9)

$x_2 + 2.6\,x_3 = 0$ (10)

$x_3 + 6.1\,x_3 = 0$ (11)

Then $x_2 + 6.1\,x_3 = 0 \Rightarrow x_2 = -6.1\,x_3$ (12)

and if let $x_1, x_2 = 1$ and from Eq.12 ,we put in Eq.9 then we will get eigenvector (3.2,1,1) $=(x_1, x_2, x_3)$ *represents the coordinates on the axes* (x, y, z) *in three dimantionl space which represnt direction* of the movement of the force affecting the electric charge.

Coding :-

```
s=q=input('enter the movement charg=');
v1=input('v1=');v2=input('v2=');v3=input('v3=');
b1=input('b1=');b2=input('b2=');b3=input('b3=');
m1=0;m2=0;m3=0;
m1=m1+[(v2*b3)-(v3*b2)];
m2=m2+[(-v1*b3)+(v3*b1)];
m3=m3+[(v1*b2)-(v2*b1)];
disp(m1);disp(m2);disp(m3)
C1=q*m1;C2=q*m2;C3=q*m3;
```

```
disp(C1);disp(C2);disp(C3)
A=[C1,C2,C3;v1,v2,v3;b1,b2,b3]
disp(A)
syms('w1','w2','w3');
B=[w1,0,0;0,w2,0;0,0,w3];
S=A-B;
disp(S)
M=det(S)
disp(M)
syms F
K=solve('((F^3)-(1.8*F^2)+(16.6*F)- 46.2=0)','F');
disp(K)
w=0:pi/4:pi*4;
r=(w.^3)-(1.8*w.^2)+(16.6*w)- 46.2;
[a,b,c]=cylinder(r,100);
mesh(a,b,c)
xlabel('x-axis')
ylabel('y-axis')
zlabel('z-axis')
title('the eigenvalue for electric charges moving in a magnetic field')
```

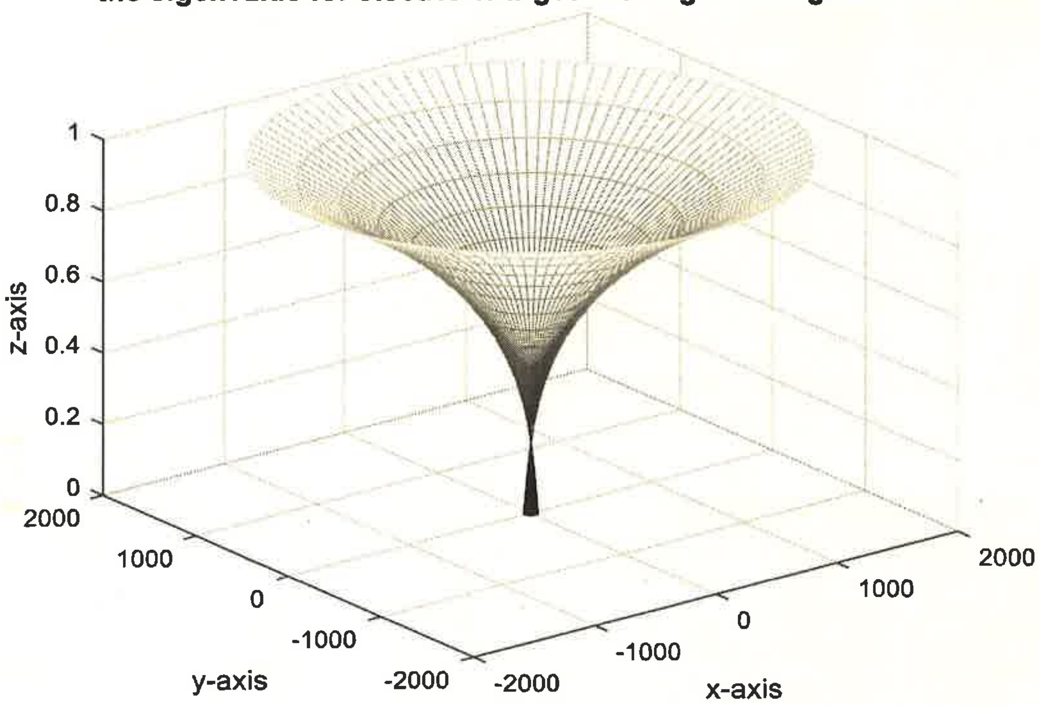


Fig (2)

3-2 Example 2

A charged particle of (8.4) moves in a three –dimensional space, moving with a speed vector of $(\overrightarrow{V} = i + 2j + k)$ in a regular magnetic field the intensity of its direction $(\vec{B} = 2j + 2k)$ then find the direction of the force vector affecting the electrical charge.

We have

$$\vec{F} = q\,(\vec{V} \times \vec{B})$$

$$(\vec{V} \times \vec{B}) = \begin{vmatrix} i & j & k \\ 1 & 2 & 1 \\ 0 & 2 & 2 \end{vmatrix} = \begin{vmatrix} 2 & 1 \\ 2 & 2 \end{vmatrix} i - \begin{vmatrix} 1 & 1 \\ 0 & 2 \end{vmatrix} j + \begin{vmatrix} 1 & 2 \\ 0 & 2 \end{vmatrix} k$$

$$= 2\,i - 2\,j + 2\,k$$

Where it (i, j, k) represents the orientation of the axes (x,y,z)

Hence

$\vec{F} = q\,(2\,i - 2\,j + 2\,k)$

$\vec{F} = 8.4\ (\ 2\,i - 2\,j + 2\,k)$

$\vec{F} = 16.8\,i - 16.8\,j + 16.8\,k$

$\vec{F} = (16.8, -16.8,\ 16.8) = (\ C_1, C_2, C_3)$

Then $|V \times B| = \begin{vmatrix} C_1 & C_2 & C_3 \\ v_1 & v_2 & v_3 \\ b_1 & b_2 & b_3 \end{vmatrix} = \begin{vmatrix} 16.8 & -16.8 & 16.8 \\ 1 & 2 & 1 \\ 0 & 2 & 2 \end{vmatrix}$

To find the eigenvalue of the force, we apply the following:-

$$\left|\begin{pmatrix} C_1 & C_2 & C_3 \\ v_1 & v_2 & v_3 \\ b_1 & b_2 & b_3 \end{pmatrix} - (\theta_1 \quad \theta_2 \quad \theta_3)\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}\right| = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$\left|\begin{pmatrix} 16.8 & -16.8 & 16.8 \\ 1 & 2 & 1 \\ 0 & 2 & 2 \end{pmatrix} - (\theta_1 \quad \theta_2 \quad \theta_3)\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}\right| = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$\left|\begin{pmatrix} 16.8 - \theta_1 & -16.8 & 16.8 \\ 1 & 2 - \theta_2 & 1 \\ 0 & 2 & 2 - \theta_3 \end{pmatrix}\right| = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

and from Eq .5

$$[\theta^3 - (16.8 + 2 + 2)\,\theta^2 + (\begin{vmatrix} 2 & 1 \\ 2 & 2 \end{vmatrix} + \begin{vmatrix} 16.8 & 16.8 \\ 0 & 2 \end{vmatrix} + \begin{vmatrix} 16.8 & -16.8 \\ 1 & 2 \end{vmatrix})\,\theta - (63.8)\,] = 0$$

$[\theta^3 - (20.8)\,\theta^2 + (86)\,\theta - (100.8)\,] = 0$

We will assume that $\theta = x$ and if $x = -3$ that make Eq.6 its value approach equal to zero and we using MATLAB programming to solve third degree

$[x^3 - (20.8)\,x^2 + (86)\,x - (100.8)\,] = 0$ (13)

And to solve third degree

$\Rightarrow (x - x0)\,(ax^2 + bx + C) = 0$

Hence $a = 1, C = 33.6$

then $(x + 3)(x^2 + bx + 33.6) = 0$

$x^3 + bx^2 - 100.8x + 3x^2 + 3bx + 100.8 = 0$

$(b + 3)x^2 = -20.8\,x^2 \Rightarrow b + 3 = -20.8 \Rightarrow B = -23.8$

$(x + 3)(\,x^2 - 23.8\,x + 33.6) = 0$

To solve second degree equation by using (distinctive method)

If a=1, b= -23.8 , C= 33.6

Then $x_1 = -3$ *and* $x_{2,3} = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$

$\Rightarrow x_2 = 2.6 + 0.11\,i$ *and* $x_3 = 2.6 - 0.11\,i$

Now to solve the eigenvector of this matrix

$$A = \begin{pmatrix} 16.8 & -16.8 & 16.8 \\ 1 & 2 & 1 \\ 0 & 2 & 2 \end{pmatrix}$$

Now to solve the eigenvector of this matrix *and if* $(\theta_1, \theta_2, \theta_3) = (-3, 2.6 + 0.11\,i, 2.6 - 0.11\,i)$

and the resulting matrix is non − singular

Then $(A - \theta I)X = 0$

If $\theta 1 = 3$

Then :- $(A - \theta I)X = 0$

If

$$\theta 1 = -3 \Rightarrow \left[\begin{pmatrix} 16.8 & -16.8 & 16.8 \\ 1 & 2 & 1 \\ 0 & 2 & 2 \end{pmatrix} + 3\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}\right]\begin{pmatrix} X1 \\ X2 \\ X3 \end{pmatrix} = 0$$

$$\begin{pmatrix} 19.8 & -16.8 & 16.8 \\ 1 & 5 & 1 \\ 0 & 2 & 5 \end{pmatrix}\begin{pmatrix} X1 \\ X2 \\ X3 \end{pmatrix} = 0$$

$19.8\,X1 - 16.8\,X2 + 16.8\,X3 = 0$ (14)

$X1 + 5X2 + X3 = 0$ (15)

$2X2 + 5X3 = 0$ (16)

From Eq . 15 $-3\,x1 = -2\,x2 \Rightarrow x2 = \frac{3}{2}\,x1$ (17)

and we put Eq. 4 in Eq. 1, we will get the following

$5.6\,x1 + 4.4\left(\frac{3}{2}\,x1\right) + 8.8\,x3 = 0$

$5.6\,x1 + 6.6\,x1 = -8.8\,x3 \Rightarrow 12.2\,x1 = -8.8\,x3 \Rightarrow x1 = 0.72\,x3$

If we let assume that ($x1 = 1$)

then $x2 = 1.5$ *and* $x3 = 0.72$ *then* $(x1, x2, x3) = (1, 1.5, 0.72)$

Then $(x1, x2, x3)$ *represents the coordinates on the axes* (x, y, z) *in three dimantionl space which represnt direction* of the movement of the force affecting the electric charge.

Coding

```
>> q=input('enter the movement charg=');
v1=input('v1=');v2=input('v2=');v3=input('v3=');
b1=input('b1=');b2=input('b2=');b3=input('b3=');
m1=0;m2=0;m3=0;
m1=m1+[(v2*b3)-(v3*b2)];
m2=m2+[(-v1*b3)+(v3*b1)];
m3=m3+[(v1*b2)-(v2*b1)];
disp(m1);disp(m2);disp(m3)
C1=q*m1;C2=q*m2;C3=q*m3;
disp(C1);disp(C2);disp(C3)
A=[C1,C2,C3;v1,v2,v3;b1,b2,b3]
disp(A)
syms('w1','w2','w3');
B=[w1,0,0;0,w2,0;0,0,w3];
S=A-B;
disp(S)
M=det(S)
disp(M)
syms F
K=solve('((F^3)-(20.8*F^2)+(86*F)- 100.8=0)','F');
disp(K)

>> w=0:pi/4:pi*4;
r=(w.^3)-(20.8*w.^2)+(86*w)- 100.8;
[a,b,c]=cylinder(r,100);
mesh(a,b,c)
xlabel('x-axis')
ylabel('y-axis')
zlabel('z-axis')
title('the eigenvalue for electric charges moving in a magnetic field')
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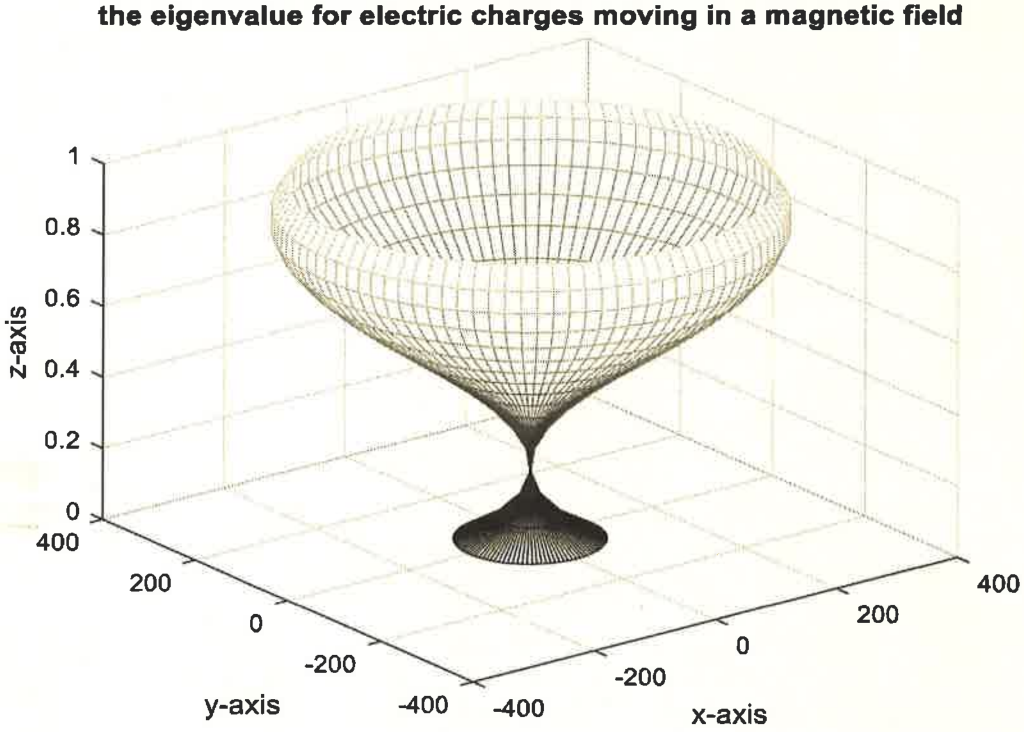

Fig(3)

4- conclusions

The definition of eigenvalue and eigenvector is very difficult for students since the two sides of the equation represent different mathematical processes, and at the same time both sides represent the same vector[4].

And In previous studies concept The Lorentz force equation is a very useful tool in simplifying the calculation the value of forces between charges, where those charges have an inverse-square-law polar distribution and extend to infinity.

In light of the results obtained from the application of the equation mathematical in linear algebra law in the Lorentz equation, it turns out that this analysis has gained knowledge of the difference in the application of the Lorentz law, where the previous studies were to determine the quantitative amount of power and in this research was determined the direction of movement the electric charges moving in a magnetic field through the application in the space of three-dimensional axis (x,y,z).

Reference:-

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