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Physical Approach to Understand the Concepts of Mathematics

Seminar Paper*

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Abstract: From the Vedic period to the modern period in the field of mathematics there are so many progress. Most of the theories of physics are required mathematical approach for their proof, similarly most of the concepts of mathematics are required to understand by examples of physical theories like vector geometry, mechanics, cosmology, wavelets, relativity etc. So we discuss the importance of mathematical physics in our paper.

Keywords: Vector geometry, mechanics, cosmology, wavelets.

1. Introduction

In our paper we discuss different concepts related to vector geometry by example of physical theories. There are two part of mathematics-pure mathematics and applied mathematics. In pure mathematics like algebra analysis, all the concepts all the theories are required mathematical approach for their proof, while in the field of applied mathematics all the concept all the theories cannot be explained by mathematical approach, so we use physical approach to explain the concepts of applied mathematics.

2. Concept related to vector

Vector: a quantity that has magnitude as well as direction like velocity, acceleration.

Scalar: a quantity that has only magnitude like speed, temperature. Consider a m equation in n unknown variable

$$A_{1,1}x_1 + A_{1,2}x_2 + \cdots + A_{1,n}x_n = 0$$
$$\cdots$$
$$A_{m,1}x_1 + A_{m,2}x_2 + \cdots + A_{m,n}x_n = 0$$

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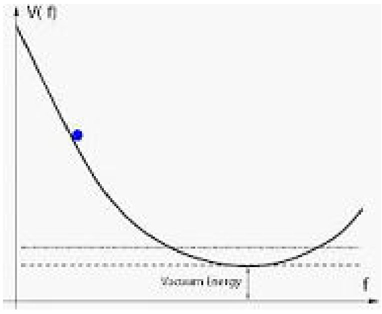
These equations can be written in matrix form such as

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{21} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{21} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix} \in \mathbb{R}^{m \times n}$$

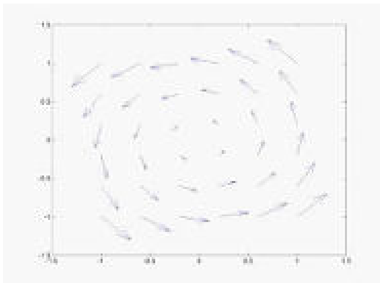
$$X = [X_1, X_2, X_3, \dots, X_n]$$

Then A is called scalar and X is called vector.

Scalar field: it is defined by a set of points of a region R and scalar point function (p). For example temperature distribution in any medium.



Vector field: it is defined by a set of points of a region R and vector point function $\Phi(p)$ at that point. For example velocity of moving liquid at a moment. **Gradient:** a rate of inclination. In physics the rate at which physical quantity



such as temperature changes in response to changes in a given variables especially distance. In mathematics a vector having coordinate components that are partial derivatives of a function with respect to its variable. The gradient symbol is usually an upside-down delta, and called "del"(this makes a bit of sensedelta indicates change in one variable, and the gradient is the change in for all variables). Taking our group of 3 derivatives above

$$grad\ F(x, y, z) = \nabla\ F(x, y, z) = \left(\frac{dF}{dx}, \frac{dF}{dy}, \frac{dF}{dz} \right)$$

Divergence: it measures how much a vector field spread out or diverges from a given point. In vector calculus, divergence is a vector operator that measures the magnitude of a vector field's source or sink at a given point, in terms of a signed scalar. More technically, the divergence represents the volume density of the outward flux of a vector field from an infinitesimal volume around a given point. The divergence of a continentally vector field $F = Ui + Vj + Wk$ is equal to the scalar -valued function:

$$div\ F = \nabla . F = \frac{\partial U}{\partial x} + \frac{\partial V}{\partial y} + \frac{\partial W}{\partial z}.$$

If $div\ F = 0$, then it is called solenoidal which are used in different branches of physics.

Curl: the curl is a vector operator that describes the infinitesimal rotation of a 3-dimensional vector field. At every point in the field, the curl of that point is represented by a vector. The direction of the curl is the axis of rotation and magnitude of curl is the magnitude of rotation.

In Cartesian coordinates $\nabla \times F$ is, for F composed of $[F_x, F_y, F_z]$:

$$\begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ F_x & F_y & F_z \end{vmatrix}$$

Where i, j, and k are the unit vectors for the x, y and z-axes, respectively. This expands as follows:

$$\left(\frac{\partial F_z}{\partial y} - \frac{\partial F_y}{\partial z}\right) i + \left(\frac{\partial F_x}{\partial z} - \frac{\partial F_z}{\partial x}\right) j + \left(\frac{\partial F_y}{\partial x} - \frac{\partial F_x}{\partial y}\right) k$$

3. Theorems Related to Vector

Line integral: the integration about line is called line integration The function to be integrated may be a scalar field or a vector field. For a vector field $F : U \subseteq R^n \to R^n$, the line integral along a piecewise continuous curve $C \subset U$, in the direction of r, is defined as

$$\int_C F(r) \cdot dr = \int_a^b F(r(t)) \cdot r'(t) dt.$$

Surface integral: integration along surface is called surface integration. For a scalar function f over a surface parameterized by u and v, the surface integral is given by

$$\Phi = \int_S f da \tag{1}$$
$$= \int_S f(u, v) |T_u \times T_v| du dv \tag{2}$$

where T_u and T_v are tangent vectors and $a \times b$ is the cross product. For a vector function over a surface, the surface integral is given by

$$\Phi = \int_S F \cdot da \tag{3}$$
$$= \int_S (F.\hat{n}) da \tag{4}$$
$$= \int_S f_x dydz + f_y dzdx + f_z dxdy \tag{5}$$

where $a \cdot b$ is a dot product and $\hat{n}$ is a unit normal vector.

Volume integral: a volume integral refers to an integral over a 3-dimensional domain A triple integral over three coordinates giving the volume within some region G,

$$V = \int\int_G\int dxdydz.$$

Gauss divergence theorem: the surface integral of vector point function is equal to the volume integral of divergence of vector function. Suppose V is a subset of $\mathbb{R}^n$ (in the case of $n = 3$, V represents a volume in 3D space S). If F is a continuously differentiable vector field defined on a neighborhood of V, then we have [6]

$$\int\int_V\int (\nabla \cdot F) dV = \oint\oint_S (F \cdot n) dS.$$

Let a volume V enclosed a surface S of any arbitrary shape. Let a small volume element dV lies within surface S . As we know that flux diverging per unit volume per second is given by div Ai therefore, for volume element dV the flux diverging will be div AdV. If V be the volume enclosed by the surface S, then the total flux diverging through volume V will be equal to the volume integral.

$$\int\int_{V}\int divAdV$$

Now consider a surface element dS and n a unit vector normal to dS. Let θ be the angle between A and iz at dS, then AdS will give the flux through the surface element dS. Where $dS = ndS =$ area vector along n. Therefore, the total flux passing through the surface S may be obtained by the integral.

$$\int\int_{S} A \cdot ndS = \int\int SA \cdot dS$$

But the total flux through the entire surface S must be equal to the total flux diverging from the volume V enclosed by surface S and therefore

$$\int\int_{V}\int divAD_{V} = \int\int SA \cdot D_{S}$$

Stokes theorem: line integral of vector point function along closed curve c is equal to surface integral to .curlF ie.

$$\int_{S} (\nabla \times F) \cdot da = \int_{\partial S} F \cdot ds$$

Consider a closed surface s.divide surfase into squars and meshes which are not square.consider vector along squares whose directions are apposit , these vectors are calcelled by each oter,only those vector remains which are along line.

4. Conclusion

we just take a concept of mathematics and we try to understand this concept by physical example. Hence there are so many branches of mathematics at which we require physical approach .

References

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