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Generalised Form of Spherical Symmetry

Dr. Vidya Thakare (Gaikwad)
Department of Mathematics, Shri Shivaji Science College, Amravati

Abstract: Many authors studied on symmetry of different kinds like, Plane symmetry, axial symmetry, Spherical symmetry and many more. In this article an attempts have been made to generalise the idea of symmetry, which give rise to a power symmetry .The concept of lie derivative is used to get the mathematical formulation. Here I have not used any physical idea.
Keywords: Spherical Symmetry, Lie-derivative, Plane Symmetry, Axial Symmetry-Symmetry.

I. INTRODUCTION

Takeno in 1966 define Spherical Symmetric space-time through lie derivative, According to him a quantity is said to be spherically symmetric (SS) if and only if

$$L_V (G) = 0, \tag{1}$$

A space time V_4 is said to be spherically symmetric if and only if ,

$$L_V (g_{ij}) = 0 \tag{2}$$

Gaikwad worked on K-Symmetric space-times.A quantity is K-Symmetric of order P if it satisfy

$$L_V(GK^P) = 0 \tag{3}$$

Or a space time is K-Symmetric if

$$L_V (g_{ij}K^P) = 0 \tag{4}$$

K-Symmetry has close link with conformal transformations. Also in generalised spherical polar coordinate system if K is independent of ø then K-Symmetry is equivalent with Spherical Symmetry.

II. POWER SYMMETRY

To generalised the idea of K-Symmetry I define, "A space- time V_4 is said to be Power symmetric if and only if

$$L_V (g_{ij}Ke^{\alpha}) = 0, \tag{5}$$

Where K and α are functions of coordinates.

Here if α = 0 then the power symmetry reduces to K-Symmetry and if,

A = 0 and K = 1 then Power symmetry reduces to Spherical Symmetry.

Theorem1: e^{α} is power symmetric if and only if $e^{2\alpha}$ is k-Symmetric of order one.

Proof: Given e^{α} is power symmetric.

$$L_V (e^{\alpha} Ke^{\alpha}) = 0$$

$$L_V (Ke^{2\alpha}) = 0$$

Thus $e^{2\alpha}$ is K-Symmetric of order one.

Conversaly, if $e^{2\alpha}$ is K-Symmetric of order one then

$$L_V (Ke^{2\alpha}) = 0$$

$$L_V (e^{\alpha} Ke^{\alpha}) = 0,$$

Hence e^{α} is power Symmetric.

Theorem 2: Power Symmetry is independent of the nature of vector.

Proof: Let A^{ij} is a contra variant tensor of order two which is Power symmetric,

$$L_V (A^{ij} Ke^{\alpha}) = 0$$

Now $$L_V (A_{\alpha\beta} K e^{\alpha}) = L_V (g_{\alpha i}g_{\beta j}A^{ij} K e^{\alpha})$$

$$= g_{\alpha i}g_{\beta j} L_V (A^{ij} Ke^{\alpha}) + A^{ij} Ke^{\alpha}g_{\alpha i} L_V (g_{\beta j}) + A^{ij} Ke^{\alpha}g_{\beta j} L_V (g_{\alpha i})$$

$$\neq 0, \text{ in general.}$$

Hence $A_{\alpha\beta}$ is not power symmetric.

Theorem 3: The function f is K-Symmetric and e^{α} is Spherical Symmetric then f is Power symmetric.

Proof: Here f is K-Symmetric,

$$L_V(Kf) = 0 .$$

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Also e^{α} is Spherical symmetric,

$$L_V(e^{\alpha}) = 0$$

Now $$L_V(Kfe^{\alpha}) = Kf\, L_V(e^{\alpha}) + e^{\alpha} L_V(Kf)$$

$$= 0, \text{ using}$$

Thus f is power symmetric.

III. CONCLUSION

The power Symmetry is studied using the concept of spherical symmetry and it is observed that the power symmetry is the general form of K-symmetry. Some results have been given to study further physical behaviour of the model.

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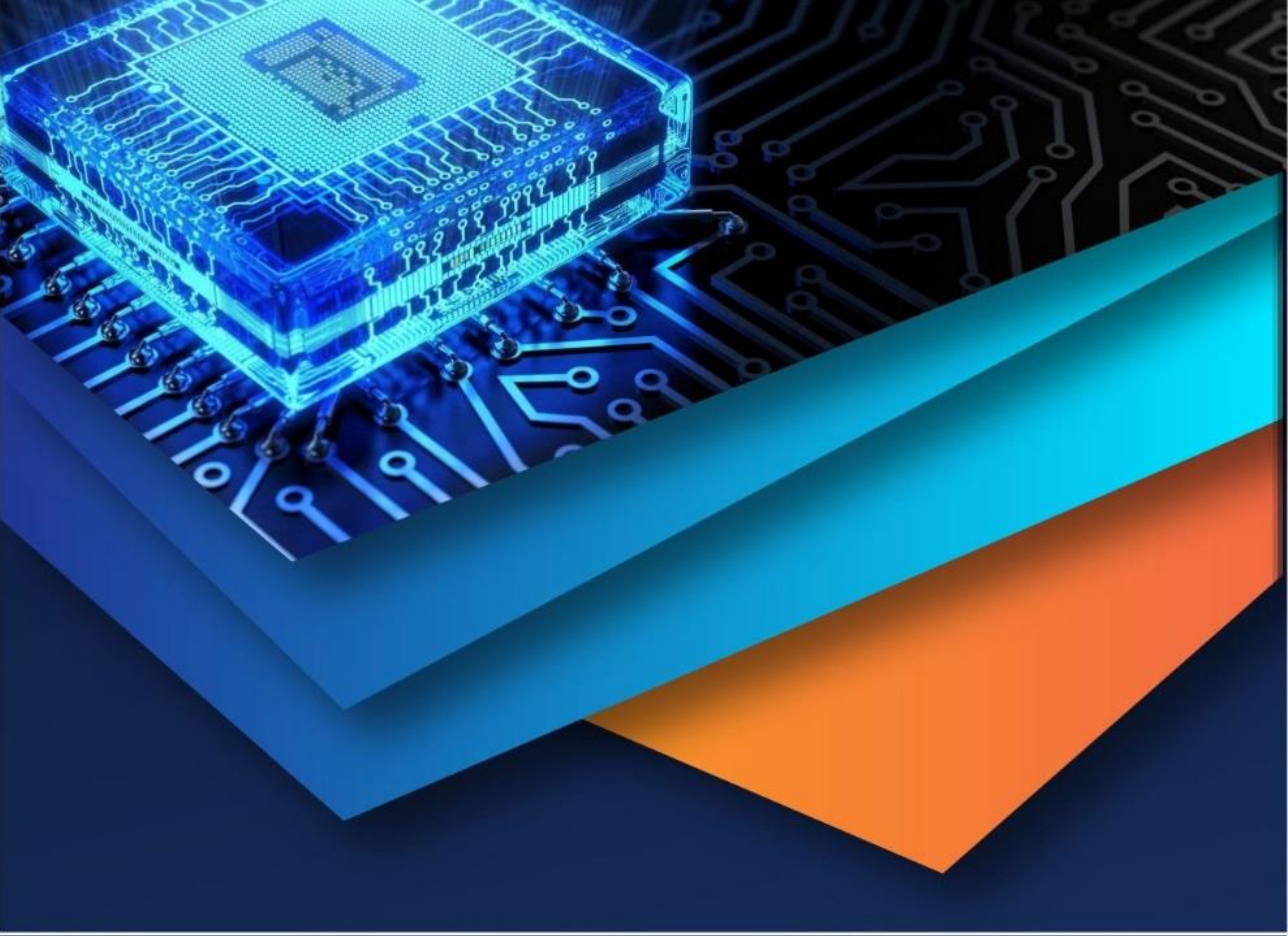

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