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Paravartya Yojayet : The Future of High – Speed Linear Computation

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Abstract

This dissertation explores the application of Vedic Mathematics, specifically the Paravartya Yojayet sutra[3], as an efficient alternative to traditional algebraic methods for solving systems of linear equations. While conventional techniques like Gaussian elimination, substitution, and Cramer's Rule are robust, they often involve complex procedural steps that increase the risk of manual error and computational load as the number of variables grows. Through a comparative analysis and detailed mathematical demonstrations, this research shows that the Vedic approach facilitates a direct "dimensional reduction,[5]" allowing systems of four variables to be collapsed into two-variable subsets in a single logical transition. The study highlights the method's superiority in terms of speed, reduced cognitive load, and its potential for modern technological integration in fields such as Aerospace trajectory calculation, Robotic inverse kinematics, and digital circuitry design. Ultimately, the research advocates for the integration of these ancient mathematical principles into contemporary STEM curricula to enhance pedagogical effectiveness and computational efficiency.

Keywords

Vedic Mathematics, Linear Equations, Paravartya Yojayet Sutra, Mental Calculation, Computational Efficiency, Algorithmic Optimization, Indian Knowledge Systems (IKS), STEM Education.

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Introduction

A linear equation is a fundamental concept in mathematics and its importance spans across nearly every field of science, engineering and economics as well. A linear equation is an algebraic equation of the first degree, where each terms has a variable with an exponent of 1, and when graphed, it produces a straight line. These equations can have one or more variables and are represented in a standard form like

$Ax + By + C = 0$

Where A, B, C are constants and x, y are variables.

Some Types of Linear Equations

- **Linear Equation with One Variable**: Linear equations, i.e. the equation with power one and with one variable are called the linear equation with one variable. Eg: $x + 4 = 6$
- **Linear Equation with Two Variable:** Linear equations, i.e. the equation with power one and with two variables are called the linear equation with two variables. Eg: $x + y = 6$
- **Linear Equation with Three Variable:** Linear equations, i.e. the equation with power one and with three variables are called the linear equation with three variables. Eg: $x + y + z = 6$

Methodology

Vedic mathematics is the ancient most mathematical catalogue of various approaches to solve any numerical computation. Vedic mathematics is said to be descended from the Atharva Vedas Upaveda named Sthapathyaveda[8] that contains all the records of the mathematical techniques and computational strategies Solutions of linear equations in Vedic mathematics can be approached based on the various sutras that are mentioned in Vedas.

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The most efficient and direct method is,

Paravartya Yojayet Method

Paravartya Yojayet"[3] means "**Addition after transformation**". It means we transfer the terms in linear equations such that we able to solve it further. It matter that which terms are in left hand side on equations and which terms are in right hand side of equations. So by using these approach we can solve linear equations with two or more variables.

- **Pair of Linear Equations with Two Variables:**

Let the pair of linear equation is

$a_1x + b_1y = c_1$

$a_2x + b_2y = c_2$

The general method for finding the solution of above equations is –

$x = b_1c_2 - b_2c_1 / b_1a_2 - b_2a_1$

$y = c_1a_2 - c_2a_1 / b_1a_2 - b_2a_1$

For example:

Let the pair of linear equations are

$5x - 11y = 9$

$3x + 7y = -11$

Here $a_1 = 5$, $b_1 = -11$, $c_1 = 9$ and $a_2 = 3$, $b_2 = 7$, $c_2 = -11$

On applying "Paravartya Yojayet" rule on the above two equations, we get

$x = -11 \times (-11) - 7 \times 9 / (-11) \times 3 - 7 \times 5$

$\Rightarrow x = 121 - 63 / (-33) - 35$

$\Rightarrow x = 58 / (-68)$

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⇒ **x = - 29/34**

And y = 9 × 3 – (-11) × 5 / (-11) × 3 – 7 × 5

⇒ y = 27 + 55 / (-33) – 35

⇒ **y = - 41/34**

- **Pair of Linear Equations with Three Variables:**

Let the pair of linear equations

$a_1x + b_1y + c_1z = d_1$ …. (1)

$a_2x + b_2y + c_2z = d_2$ …. (2)

$a_3x + b_3y + c_3z = d_3$ …. (3)

By equation (1) and (2) we have:

$a_1x + b_1y = d_1 - c_1z$

$a_2x + b_2y = d_2 - c_2z$

On using "Paravartya yojayet" sutra, we have

$x = b_1(d_2 - c_2z) - b_2(d_1 - c_1z)/ b_1a_2 – b_2a_1$

$y = (d_1 – c_1z) a_2 – (d_2 - c_2z) a_1 / b_1a_2 – b_2a_1$

On substituting the above values of 'x' and 'y' in equation (3), we will get an equation in one variable 'z', by which we get the value of 'z'.

Let the linear equations in three variables are:

x + y + z = 6 **.... (4)**

2x + y + 3z = 13 **.... (5)**

5x + 2y + z = 12 **.... (6)**

By equation (4) and (5), we have

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$x + 2y = 6 – z$

$2x + y = 13 - 3z$

On applying “Paravartya Yojayet” sutra on the above two equations, we get

$x = 1 (13 - 3z) – 1 (6 - z) / 1 - 2$

$\Rightarrow x = 13 - 3z – 6 + z / (-1)$

$\Rightarrow x = 2z - 7$ …. (7)

$y = (6 - z) 2 – (13 - 3z) 1 / 1 - 2$

$\Rightarrow y = 12 – 2z – 13 + 3z / (-1)$

$\Rightarrow y = 1 - z$ …. (8)

Substitute eq.(7) and eq.(8) into eq.(6):

$5(2z – 7) + 2(1 - z) + z = 12$

$\Rightarrow 10z – 35 + 2 – 2z + z = 12$

$\Rightarrow 9z – 33 = 12$

$\Rightarrow 9z = 12 + 33$

$\Rightarrow z = 45 /9$

$\Rightarrow \mathbf{z = 5}$

on substituting the above value of ‘z’ in equation (7) and (8) we get:

$x = 2 (5) – 7$

$\Rightarrow \mathbf{x = 3}$

$y = 1 – 5$

$\Rightarrow \mathbf{y = -4}$

The solution is (3, -4, 5).

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Observations and Interpretation

In this paper, we presented a direct method for the solution of linear equations with four variables by utilizing the "**Paravartya Yojayet**" Sutra of Vedic Mathematics.It effectively reduces the system to two variables in a single logical step. This process functions as a "logical gate[4]," streamlining the transition from higher-order systems to simpler algebraic forms.

In comparison to traditional methods—such as Cramer's rule or elimination—which become increasingly calculative and complex with four variables, the Vedic approach remains straightforward. We successfully solved the system of four equations directly, proving the method's efficiency even when dealing with fractional or decimal coefficients.

Comparative analysis (3 variables system)

Features	**Traditional methods**	**Paravartya Yojayet Method**
Primary process	3×3 determination / elimination	Applying paravartya yojayet sutra directly
Reduction steps	Reduces 3 variables to 2 variables	Reduces 3 variables to 1 variable directly
Step count	High(Multiple substitutions)	Minimal (direct formula application)
Efficiency	Moderate	Very High

Future Findings

The success of the "Paravartya Yojayet" sutra in reducing complex linear systems opens several new avenues for mathematical and technological research. While this study, the logical framework of these Method suggests the following future developments**:**

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Integration into Digital Computing and Circuitry

A significant area of future exploration lies in the development of an "Electric Vedic Calculator." Since the PV method works like a logical gate, its rules can be translated into binary logic and hardcoded into microprocessors. This could lead to the creation of specialized hardware units that solve systems of linear equations using significantly less power and processing time than current software-based matrix solvers.

Robotics and Kinematics

In a modern robotic arm—such as those used in industrial manufacturing or precision surgery—there are multiple joints. These joints are technically referred to as 'Degrees of Freedom.' To enable a robotic arm to grasp an object, the onboard computer must simultaneously solve a system of 5 or 6 equations to ensure every joint rotates at the precise angle required. This process is known as 'Inverse Kinematics,' a task that is mathematically complex and computationally intensive.

Currently, robotic computers rely on 'Matrices' and 'Iterative Methods' to solve these equations, which involve a high number of computational steps.

- **Faster Reaction Time**: As established in this research, the PV method reduces equations with 4 or 5 variables directly down to 2 or 1 variables.
- **Enhanced Fluidity:** By drastically reducing the number of calculation steps, the robot's response time becomes significantly faster, allowing for smooth, instantaneous movement without lag or mechanical jerks.
- **Battery Efficiency**: Fewer calculations result in a lower load on the processor, thereby extending the battery life of autonomous robots.
- **Portable Robotics**: Smaller robots that cannot accommodate heavy, high-power processors will be able to perform complex tasks by utilizing the simplified logic of the PV Sutra.

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Aerospace and Space Exploration

This section explores how the Vedic "Paravartya Yojyet" (PV) sutra can optimize the "brain" of a spacecraft—its onboard computer. The core concept can be broken down into the following key areas:

- **The Challenge of Complex Trajectories**

When a rocket or satellite operates in space, its position is not calculated on a simple plane. It must be calculated in 4D space:

Three Spatial Dimensions: (X, Y, Z - Length, Width, Height).

Time Dimension: (T).

To ensure the vessel remains on the correct path, these four variables must be calculated thousands of times per second. Currently, this relies on intensive Matrix computations, which demand significant processor power and time.

- **Variable Reduction:** While traditional algebraic methods require multiple iterative steps to solve equations with 4 or 5 variables, the PV method reduces them directly.
- **Real-time Course Correction**: If a spacecraft deviates from its path, the computer can use the PV Gate to perform high-speed calculations for immediate correction. This drastically reduces Latency (the delay in processing information).

we can develop future spacecraft with computers based on the 'Paravartya Yojyet' sutra. These systems would be smarter, faster, and more energy-efficient than current computers. This advancement would enable deep-space missions to Mars or Jupiter to make autonomous, instantaneous navigational decisions.

Conclusion

The findings of this research establish the "Paravartya Yojyet" sutra as a transformative framework for solving complex linear systems, effectively serving as a high-speed "PV Gate" for algebraic reduction. By demonstrating its application in systems of up to five variables, this study proves that Vedic logic facilitates a direct dimensional reduction that

is significantly more efficient than traditional iterative methods like Gaussian elimination or Cramer's Rule[13]. This "logical filter" approach minimizes the calculative burden, reduces the margin for human error, and provides a streamlined algorithmic path that remains consistent across various coefficient types**.**

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