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The “Engineer” publishes the most significant results of scientific and applied research carried out in universities of transport profile, as well as other higher educational institutions, research institutes, and centers of the Republic of Uzbekistan and foreign countries.

The journal is published 4 times a year and contains publications in the following main areas:

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- General Engineering;
- Aerospace Engineering;
- Automotive Engineering;
- Civil and Structural Engineering;
- Computational Mechanics;
- Control and Systems Engineering;
- Electrical and Electronic Engineering;
- Industrial and Manufacturing Engineering;
- Mechanical Engineering;
- Mechanics of Materials;
- Safety, Risk, Reliability and Quality;
- Media Technology;
- Building and Construction;
- Architecture.

Tashkent State Transport University had the opportunity to publish the international scientific journal “Engineer” based on the **Certificate No. 1183** of the Information and Mass Communications Agency under the Administration of the President of the Republic of Uzbekistan. **ISSN 3030-3893.** Articles in the journal are published in English language.

The practical importance of the Maple software

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Abstract: In this article, the mapple program, designed for solving mathematical problems in various ways, calculation and graphic methods, its wide application in various fields, its advantages and conveniences is explained in detail.

Keywords: I Mathematical Computation, Visualization, Graphing, Data Analysis, engineering concepts, 2D and 3D graphs

1. Introduction

The Maple software, particularly suited for mathematical computations, can play a significant role in developing and enhancing Intellectual Transport Systems (ITS). Here's how Maple's capabilities could be useful in this field [1].

2. Research methodology

1.**Route Optimization**: Maple can model complex algorithms needed for calculating optimized routes for vehicles in real-time. By using its symbolic computation and data analysis capabilities, it can solve equations and algorithms that manage dynamic traffic conditions, weather patterns, and road obstacles.

2.**Traffic Flow Analysis**: ITS often requires accurate traffic forecasting and flow analysis to manage congestion. Maple's data analysis tools can process large datasets, allowing for real-time simulations and predictive modeling of traffic patterns, which helps in proactive congestion management. [2]

3.**Vehicle and Pedestrian Safety**: Using Maple, transport system developers can simulate scenarios to improve safety. This includes computations related to vehicle braking distances, acceleration in various conditions, and pedestrian crossing behavior. Maple's ability to handle high-level mathematics makes it possible to simulate these conditions accurately, providing safety insights for ITS design.

4.**Environmental Impact Assessment**: With Maple's computational abilities, ITS can incorporate models to assess and minimize environmental impacts. It can be used to optimize routes that reduce fuel consumption or calculate emissions for various traffic scenarios, supporting eco-friendly transport solutions.

5.**Integration with Machine Learning Models**: Maple can preprocess data for machine learning models that ITS often rely on. For example, ITS might use machine learning for predictive maintenance of transport infrastructure, where Maple can handle initial data manipulation and complex mathematical modeling. [3]

6.**Dynamic Toll Pricing**: Maple's mathematical toolkit allows for the creation of models that adjust toll prices based on demand, time, and congestion levels in real-time, which can reduce traffic bottlenecks and promote efficient road use.

Maple is a powerful software tool designed for mathematical computation, analysis, and visualization, widely used in academia, engineering, finance, and other fields requiring advanced mathematical modeling. Here's an overview of Maple's main capabilities:

1. Mathematical Computation

- **Symbolic Computation**: Maple excels in symbolic math, which allows it to manipulate algebraic expressions, solve equations symbolically, and perform calculus operations like differentiation and integration exactly (not approximations).
- **Numerical Computation**: It also handles high-precision numerical calculations, essential for engineering and scientific applications that require exact results. [4]

2. Visualization and Graphing

- Maple has extensive plotting capabilities, allowing users to create 2D and 3D graphs, visualize data, and even animate mathematical concepts.
- These visual tools make it easier to understand complex mathematical relationships and to present results in an accessible format. [5,7]

3. Data Analysis and Statistical Modeling

- **Data Manipulation**: Maple can process and analyze large datasets, making it useful for applications involving statistical modeling, data cleaning, and transformation.
- **Statistical Functions**: It includes a suite of statistical tools for hypothesis testing, regression analysis, and probability distributions, aiding fields like finance, research, and engineering. [6]

4. Interactive Document Environment

- Maple has an environment where users can create interactive documents, combining live computations, plots, and formatted text. This is helpful for creating educational resources, reports, and presentations that include dynamic elements.

5. Programming and Automation

- Maple's programming language allows users to automate repetitive tasks, write scripts, and develop custom mathematical tools. Its language is designed specifically for mathematical applications, making it user-friendly for those with a math background.
- The software also supports integration with other programming languages like Python, MATLAB, and R, enabling users to incorporate Maple into larger workflows or software systems.

6. Applications in Research and Industry

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- **Engineering and Physics**: Maple is used for modeling physical systems, solving differential equations, and performing complex computations related to mechanics, electronics, and thermodynamics.
- **Finance and Economics**: In finance, Maple helps with risk modeling, pricing of financial derivatives, and optimizing investment strategies by analyzing and solving equations related to financial markets.
- **Education**: Its interactive tools make it a popular choice for teaching mathematics and engineering concepts, as it allows students to experiment with real-time calculations and visualizations.[7]

7. Maple's Ecosystem and Resources

- **Extensive Documentation**: Maple includes comprehensive documentation, tutorials, and examples that support beginners and advanced users alike.
- **MapleCloud**: Users can share and access resources, applications, and tools created by the community, enhancing collaboration and sharing of best practices.
- **Toolboxes and Add-ons**: Maple has various add-ons for specific applications like MapleSim for physical modeling, Maple Flow for engineering calculations, and others tailored to niche industries.

Maple is known for its versatility in handling both basic and highly specialized mathematical tasks. This makes it valuable for anyone working with math-intensive problems across different industries and disciplines. [7]

We can see the working process of the mapple program with the help of the following examples

Calculation of fuel consumption of a car for 100 km

$$Q_s = \frac{K_n * K_N * g_{eN} * (N_\varphi + N_W)}{36 * \rho_e * \eta_{k.y} * V_a}, \frac{1}{100} km$$

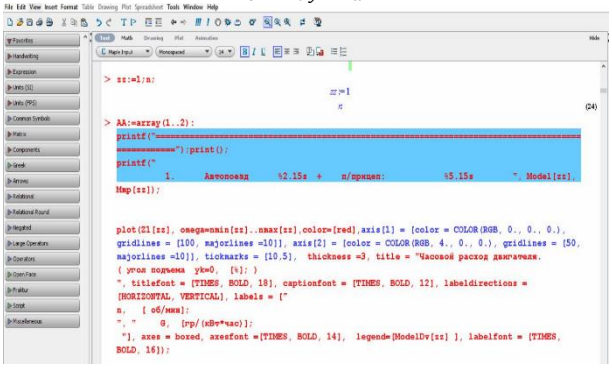

Figure 1. Calculation of the hourly consumption of the engine through the Maple program

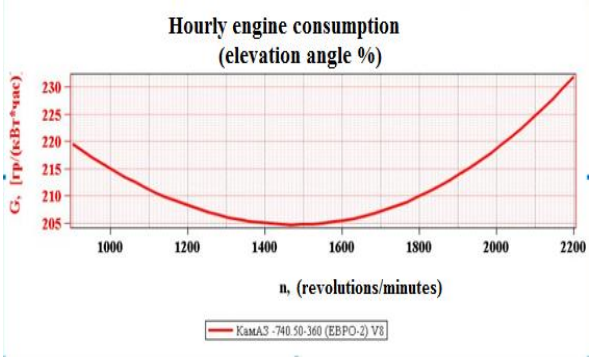

Figure 2. Graphical representation of the engine's hourly consumption at 0 percent height

Apart from these, Maple has ample opportunities to carry out analytical transformations of mathematical formulas. To them include operations such as bringing similar ones, factoring, opening parentheses, bringing a rational fraction to normal appearance and many others. [8, 9]

In addition, the maple program includes several different procedures.

The move procedure is universal and can be used to study the motion of a longing with any given equations of motion. For example, let's calculate the characteristics of the movement of a point whose laws of coordinate changes have the following form [10]

$> x := \cos(t/3)$ $\quad x \coloneqq cos\left(\frac{1}{3}t\right)$

$> y := \frac{3}{2} * \sin(t/2)/2$ $\quad y \coloneqq \frac{3}{4}\sin\left(\frac{1}{2}t\right)$

$> move\ (x, y, t3.5, 0.2 - 0.25 - 0.5 - 0.75 - 1,002, 0.02)$

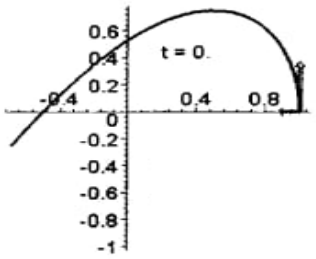

Figure 3. a) For the case where the point's movement starts at the (x,y) coordinate w<0

$v(x, y) = [0, \quad 375]$

$w(x, y) = [-1, \quad -0]$

$w(tau, p) = [0, \quad 1]$

$ro = 1{,}26$

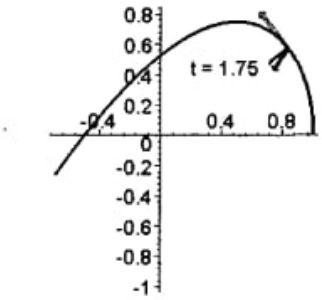

Figure 3. b) (x,y) position of point movement starting from t=1.75 second acceleration

$v(x, y) = [-1.84, \quad 240]$

$w(x, y) = [-928e - 1, \quad -144]$

$w(tau, p) = [-583e - 1, \quad 161]$

$ro = 570$

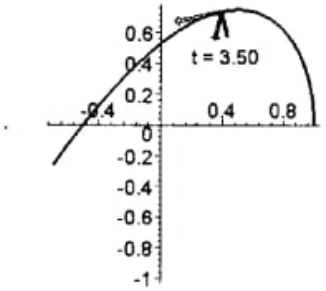

Figure 3. c) The graph of the movement of the point in the (x,y) coordinate, reaching the highest point at t=3.5 seconds and then decreasing again

$$v(x,y) = [-307, \quad 668e-1]$$
$$w(x,y) = [-433e-1, \quad -184]$$
$$w(tau,p) = [-816e-1, \quad 172]$$
$$ro = 575$$

3. Conclusion

As mentioned in this article using examples, the Mapple program is characterized by its ease of use in solving mathematical problems, mathematical modeling and many similar areas of the industry**.** Maple software is a convenient tool widely used for solving mathematical problems, which combines calculation and graphical methods. The program effectively helps in solving algebraic expressions, differential equations, optimization problems and many other mathematical functions. Maple's advantages include its high-precision computing power, visualization capabilities, and wide application in various fields, including physics, economics, engineering, and other scientific fields. It simplifies mathematical calculations and allows users to solve complex problems quickly and accurately.

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