

DEVELOPMENT OF TEACHING METHODS IN NUMERICAL MATHEMATICS AT FACULTY OF AERONAUTICS TUKE

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Summary. Numerical Mathematics is the area of mathematics and computer science that creates, analyzes, and implements algorithms for solving numerically the problems of continuous mathematics.

This article describes development of teaching methods in Numerical Mathematics at faculty of Aeronautics, Technical University of Košice.

Keywords: Numerical methods; teaching methods

1. INTRODUCTION

It looks like the Numerical Mathematics is a summary of constructive methods. But it isn't true. For example, the proof of the existence or absence of a solution that leads to a logical case is not constructive method.

In the history of mathematics we can find literally constructive approach to the methods. The first of these methods have been used in astronomy to calculate the motion of celestial objects several hundred years ago. These methods were developed during the Leonard Eulers (1707-1781) life.

In the period after Euler the believe in the usefulness of some more complex algorithms gradually decreased and more and more mathematicians were leaning towards purely logical way of thinking. Ultimately, it led to the development of some new areas of mathematics such as theory of sets, theory of numbers, and so on. (Cantor, Dedekind and the others).

The further development of algorithms study was actually paused and waiting for existence and better support of computational tools.

Nowadays the computers are at the state of the art. It means that to process more complex algorithms is not a problem for them. So the Numerical Mathematics has all abilities for further development.

2. DEVELOPMENT OF TEACHING METHODS

We are teaching Numerical Mathematics during the course named Applied Mathematics in all study programs at Faculty of Aeronautics TUKE. During the lectures of Numerical methods we focus on methods which are necessary for further studying of vocational subjects.

The first we used a calculator as primary tool to solve simple problems. This hand calculation is important because it helps students to better understand each methods.

Then we used computers and software MATLAB. MATLAB is widely used for applied numerical analysis in engineering, computational finance, and computational biology. It provides a range of numerical methods for:

- Interpolation, extrapolation, and regression

- Differentiation and integration
- Linear systems of equations
- Eigenvalues and singular values
- Ordinary differential equations (ODEs)
- Partial differential equations (PDEs)

We can also perform fast Fourier transforms, quadrature, optimization, and linear programming with the MATLAB product family. In addition, we can create and implement our own numerical methods using the built-in support for vector and matrix operations in the MATLAB language.

Many students had a problem to use Matlab because of their lack of programming skills.

So we developed the software application the MATH for easier calculation numerical problems.

The Math application covers all methods needed by students for their further specialized studies. It provides so far these numerical methods for calculation and comparison [3] [4] [5]:

1) Nonlinear equation

- Bisection method
- Regula Falsi method
- Secant method
- Newton method
- Iteration method

2) Definite integration

- Rectangular method
- Trapezoid method
- Simpson's method
- Monte Carlo Hit of Miss method
- Monte Carlo Average method

3) Double definite integration (Monte Carlo method)

4) Numerical differentiation (up to 4. degree of differentiation)

5) System of linear equations

- Jacobi Iteration method

6) Matrix calculation (basic numerical operations, transpose, inverse, etc.)

7) The least mean square approximation (LMS)

The MATH application can be extended by additional Numerical methods since it is open source. The Math is used as an education tool on several faculties of Technical University of Kosice. There are still many numerical methods and graphical capabilities to be implemented in the close future.

Before publishing, a trial run with students from Technical University of Kosice was performed, using input data (problem to solve) from lectures of Applied Mathematics in order to test its usability and detect any bugs. All final results were compared and checked against the results from Matlab [2] to ensure the desired precision of all used methods, as Matlab includes many, more advanced methods with higher precision. With Matlab we performed test of all methods available in MATH, also for limit values that could cause problems based on the principle of individual algorithms. These tests verify that all methods work correctly with desired precision. Although, various limit cases were tested, there still may occur some bugs considering special cases. For such occasion, there is support available through e-mail or MATH website. The MATH can be downloaded from MATH website 0 or from MATH source code repository 0.

Now we use MATH in practice of Applied Mathematics course for controlling hand calculation problems. Because Math is available for free, students can use it at home to check their hand calculation. They can compare the calculations to find a mistake if any.

Another great advantage of MATH is that it is an open source, meaning that anybody can contribute and broaden the options and list of all numerical methods. In this way, students that are more advance, as it happens in every class, can program new methods right into MATH. This kind of contribution requires along with some programming skills, deeper understanding of that particular method and considering all limit situations that can be experienced.

To help the students with learning on how to use the application, there has been published a publication with examples from numerical mathematics using MATH as a tool **Chyba! Nenašiel sa žiaden zdroj odkazov..**

3. CONCLUSION

Implementation of the MATH into the education process, revealed a great potential in helping undergraduate and graduate students with numerical mathematics and improving their skills faster than with conventional methods in lecturing.

4. LITERATURE LIST

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