Innovational Approach to the Mathematics Teaching at the Technical Universities

Alena Vagaská
Technical University in Košice, Faculty of Manufacturing Technologies with the seat in Prešov, Department of Mathematics, Informatics and Cybernetics
e-mail: alena. vagaska @tuke.sk

1. Introduction

Therefore, a common effort of mathematicians at technical universities within a newly created European academic space is to lead students towards realizing the importance of mathematics and its key role in technical subjects, to search for more effective methods and approaches to the study of mathematics, to utilize the mathematical knowledge in their branch of study more purposefully and effectively and to be able to apply the CAS programs to the solution of complex applicative problems as well as to the mathematical modelling in technical practice. Teaching of mathematics, physics and professional subjects, however, at many faculties of technical universities of the Slovak Republic and the Czech Republic is mutually isolated (Fulier,2001; Čizmár, 2001). As a result of a reduced time devoted to the teaching of mathematics due to the introduction of a structured study, there is a lack of motivational and applicative tasks as well as the tasks requiring a non-specific transfer: problem-solving and creative tasks. This conclusion was affirmed by the results of the research carried out in 2003 and focused on the evaluation of the current state in mathematics education at the FVT TU in Košice. (Vagaská, 2004). Elimination of such problems in mathematics teaching can be reached only through widening and deepening of applicative character of mathematics in specific fields of technology which can be considered as one of important aspects of mathematics teaching modernization. (Fulier,2001; ,Čizmár,2001). The intention of the article is to present the possibilities of MS Excel utilisation with applications of a selected type of differential equations, thus contributing to the above mentioned aim.

2. Design of Mathematical Model of the Given Problem in the Form of Differential Equation

In order to increase the motivation level and to eliminate the absence of applicable tasks, we recommend to solve the following task (Fulier, 2001) at practical classes of mathematical analysis or the so called computing practical classes of numerical mathematics:
When blowing through the forest, wind loses its velocity due to the resistance of the trees. It was validated experimentally that the loss of a wind velocity is proportional to the length of this path and the magnitude of a wind velocity. Find the wind velocity heading to inwards the forest at a distance of 150 m from the edge of the forest, if the wind initial velocity at the edge of the forest was $v_0 = 12\,\mathrm{ms}^{-1}$ *and at a distance of* $10\,\mathrm{m}$ *from the edge of the forest the wind velocity reduced to the value* $v_1 = 9{,}85\,\mathrm{ms}^{-1}$.
A mathematical model of this applicable task is an ordinary differential equation

$$\frac{dv}{ds} = -k.v \tag{1}$$

with the initial condition $v(0) = 12$ and with a supplementary condition $v(10) = 9{,}85$. Taking

into consideration (1) and the constants C and k for the given situation, we will obtain a differential equation of the wind velocity reduction in the form:

$$\frac{dv}{ds} = \frac{1}{10} \ln \frac{9{,}85}{12} . v \tag{2}$$

The artical presents the possibilities of MS Excel utilisation in numerical solution of the equation (2). For an approximate solution, Euler's method and the 2nd order Runge-Kutta method with the step $h = 10$ was used. According to the algorithm of Euler's method of the differential equation $v'(s) = f(s, v)$ solution within the interval $\langle s_0, s_0 + n.h \rangle$ with the step h and the initial condition $v(s_0) = v_0$ we write into Excel cells the required relations. The record of the right side of the differential equation (2) in the form $v'(s) = \frac{1}{10} ln \frac{9{,}85}{12} . v$ after being rewritten into Excel looks as follows: =(1/10)*LN(9,85/12)*B3. Velocity v_1 in the distance $s_1 = 10\,\mathrm{m}$ is expressed according to the algorithm of Euler's method $v_1 = s_0 + h.v'(s_0) = s_0 + h.f(s_0, v_0)$ by the formula: =B3+C3*D3. Other approximated values v_i of velocity v will be obtained by copying. Algorithm of the solution of the differential equation (2) according to the 2nd order Runge-Kutta method can be expressed in a simplified form that can be seen in table 1 (in the full CD-ROM text). If we utilise the relations of the mentioned algorithm and rewrite them into Excel cells, we will obtain a discrete solution to the equation (2), i.e. approximated values of velocity v_i at the distance s_i (see fig. 2 in the full CD-ROM text).

3. Conclusion

When verifying the effectiveness of MS Excel utilisation as a software support with the applications of differential equations, for example within numerical mathematics teaching, MS Excel program in general proved as a suitable means. Based on experience, the following procedure has been approved - a classical explanation, a given task solution, verification if the students cope with the algorithm, utilization of a computing technique with a suitable mathematical software.

References

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