

Laplace equation in EXCEL VBA

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Abstract This paper deals with the application of EXCEL VBA in teaching the electromagnetic field.

Keywords Laplace equation, EXCEL, VBA, Finite-difference method, Numeric relaxation.

I. INTRODUCTION

This paper points to the possibility of solving the Laplace equation for the electrical potential in two dimensions:

$$\frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2} = 0 \quad (1)$$

using an Excel spreadsheet with VBA programming environment. It also shows the use of the embedded graphic processor for presenting results.

II. METHODS AND CALCULATIONS

Partial derivatives in Laplace equation (1) are replaced by finite differences approximations in a square grid, thereby yielding the so-called "five-point scheme" to calculate the potential at a given point (0) of the grid in terms of the nearest neighbors potentials (1-4), as depicted in Fig. 1:

$$\varphi(0) = \frac{\varphi(1) + \varphi(2) + \varphi(3) + \varphi(4)}{4} \quad (2)$$

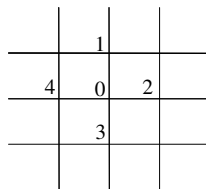


Fig. 1. Five - point scheme

EXCELs ability to perform calculations with circular references (iterations) greatly simplifies the whole process.

III. REALIZATION

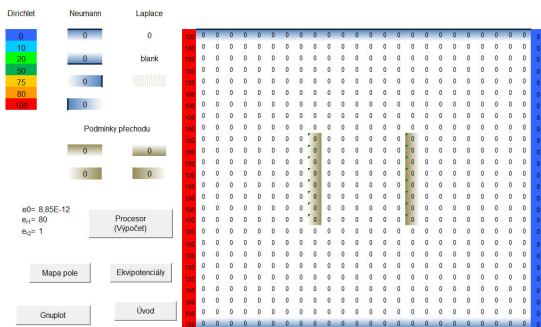


Fig. 2. Sheet Model

Implementation takes place in the worksheet model, (see Fig. 2) where formula (2) is used iteratively in each cell to calculate the potential. Each cell represents one point in the grid. Border conditions are enforced in border cells and a predefined schema will be used for the first time iteration. When the iterations converge to their final values, the table is filled by the calculated values with an included color-coding.

By means of Excel's graphic processor options a map of the electric field and the course of the equipotential lines may be obtained (Fig. 3):

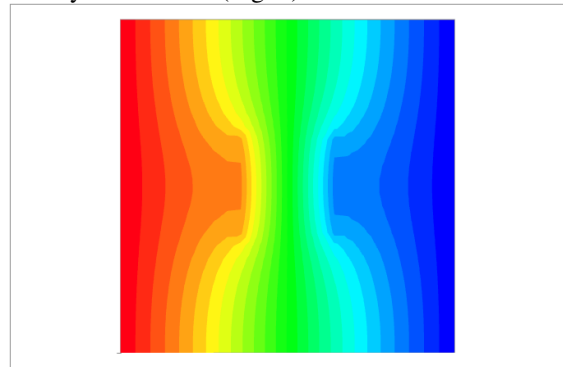


Fig. 3. Map of field

IV. CONCLUSIONS

The possibility of calculating and graphing two-dimensional electric potentials and fields in simple cases by using EXCEL spreadsheets has been shown.

This procedure is especially useful in the classroom. Students can easily get out acceptably accurate information about the investigated electric fields, without the need for special and costly software (EXCEL is readily available). An example spreadsheet with VBA macros embedded may be downloaded from <http://am.vsb.cz/henzl>.

V. REFERENCES

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