Stabilitätspakt für Südosteuropa
Gefördert durch Deutschland
Stability Pact for South Eastern Europe
Sponsored by Germany

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Computational Electromagnetics and Technical Applications

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PREFACE

The Federal Government of Germany took up the initiative to create the Stability Pact for South Eastern Europe (SEE) in 1999, as an innovative instrument in the field of peacekeeping and crisis prevention. It was, from the very beginning, a key component in Germany's foreign policy and the Stability Pact has since then contributed decisively to the process of peacemaking and reconciliation in South Eastern Europe as well as to the region's reconstruction and convergence towards the Euro-Atlantic structures. In the year 2000 was established the program "Academic Development in South Eastern Europe". Thanks to the support of the German Foreign Office its overall budget to date amounts approx. 19 Mio €.

With its Special Programme "Academic Restoration in South Eastern Europe", the German Academic Exchange Service (DAAD) very quickly and with great dedication reacted to the challenges which face Germany's foreign cultural and education policy in the South Eastern European area. Now we can look back on six years of intensive work. German universities foster 39 networking projects in SEE. Universities from different SEE countries or regions are involved in each project. With more than 23 international partnership projects only in engineering and natural sciences, involving a total of 160 and more institutions from Germany and particularly South Eastern Europe, the DAAD funds and promotes sustainable improvements to the quality of education and training provided at universities in the region and the establishment of regional teaching and research cooperation. Thus, it contributes excellently to the goals of the Stability Pact.

Together the partners have developed joint teaching modules and courses, qualified young scientists according to international standards and set up regional teaching and research centres in subjects with special relevance for the infrastructure development, such as engineering and computer sciences, law, economy, agronomy, health etc. In 2005 alone some 1.000 students and faculty from SEE went to neighbouring countries to teach, study, research and to design new teaching modules and curricula.

Since August 2000 one of those partnership projects was established successfully under the leadership of Ilmenau University of Technology. After starting the collaboration between the Universities of Niš, the Technical University of Sofia and the University of Technology Ilmenau, the partnership could be further extended. In 2003 was included the University of Banja Luka, and with the prolongation of the Special Programme for 2004 to 2005 we could welcome the University of Skopje, the University of Tirana and the University of Kragujevac (Technical faculty of Čačak), as new partners in our network of collaboration, the Joint Project "Electrical Engineering".

A main aspect of our Joint Project is the dedication to the academic qualification of students in South Eastern Europe. Therefore, it was initiated the Summer school *"Modern Aspects of Theoretical Electrical Engineering"* which was held twice, in 2001 and 2002, at Sozopol, Bulgaria, organized by the Technical University of Sofia. An International PhD-Seminar was first time organized in September 2004. The seminar was entitled with *"Computation of Electromagnetic Fields"* and was held in Budva, Montenegro, organized by the University of Niš. In September 2005 the 2nd International PhD-Seminar took place at Ohrid, Macedonia. It was organized by the University of Skopje and was devoted to problems of *"Numerical Field Computation and Optimization in Electrical Engineering"*.

Regular paper

NUMERICAL SOLVING OF ELECTROSTATIC PROBLEMS OF TWO WIRE LINES

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Abstract: In this paper we have presented a numerical method for determination of electrostatic values of two wire lines, which represents a mixture of charge simulation method.

Keywords: Conform mapping, Electric field intensity, charge density, Charge simulation method.

METHOD DESCRIPTION

In order to get the results as accurete as possible for the field itensity in the close area near the sharp edges of a conductor as well as on its edges, the author of this paper got an idea to use the charge simulation method and conform mappingof the isolated electrodes. That method, which has is the essential part of the combined method, has been presented i the author's master theisis. Firstly, mapping of the conductor's field of an outer part of a unit circle is done, in a way which was presented in the theisis. The contour which limits the cross-section of the conductor does the mapping in a unit circle. Then, we apply the method of charge simulation method in the same way as it is usually done, and we determine the values of fictive charge. Since the complex function of mapping has been determined, it is used for mapping of the points $\underline{z}_k$ where fictive charge can be found in the inner part of the second conductor into the points $\underline{w}_k$. Thus, we can get an equivalent electrostatic system in $\underline{w}-$plane which is made of a very long conductive cilinder with a circular unit circular cross-section and a stack of paralel conductors which are charged with loads per unit lengths put into the points $\underline{w}_k$. For the given system, according to the theory of reflection in a cilindral mirror, it is very easy to determine a complex potential and based on it, other values which are needed. This method gives very stable results for a field intensity and surface charge intensity on the surface of the conductor. That is firstly for the sharp edges where you can choose a point through which a contour is set, as a boundary of a cross-section f the conductor. The stability of the results is easily seen since the method does not change if the number of the used fictive sources changes. Thus, we have evaded the bad conditioning of the linear systems of the equations which always occurs with the method.

In the figure 1. we have presented a cross-section of a two wire line whose conductors are of a rectangular shape. The way of positioning of the fictive sources is also shown. Firstly, we make the sharp edges of a line rounded so that the radius of the edges is $r_0 > 0$. Secondly, the fictive sources are set in the inner space of the conductor which is drawn in the figure and presented by dashes.

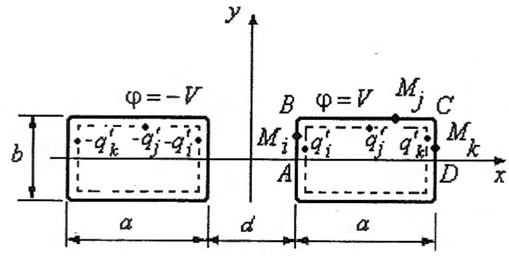

Fig.1. *Two wire line in* $\underline{z}-$*plane.*

The potential in the area of the wire line is

$$\varphi = \sum_{i_1=1}^{I} q'_{i_1} G(r,r'_i) + \sum_{j_1=1}^{J} q'_{j_1} G(r,r'_j) + \sum_{k_1=1}^{K} q'_{k_1} G(r,r'_k) , \qquad (1)$$

where $G(r,r'_i)$, $G(r,r'_j)$, $G(r,r'_k)$ are Green's functions.

After we give the boundary conditions for potential on the upper part of the right conductor in $I+J+K+2$ because of the symmetry, we can calculate the point of the adjustment where we have taken into account points A and B, and thus we get a system of linear equations. By solving them we get the unknown fictive charge. Then, the other needed values can be calculated in a standard manner. However, the systems of equations are always badly conditioned which causes many problems with systems with more unknown values. The results tell us that the solution for the capacity per unit length is relatively stable since we are dealing with the integral values, while the solutions for the field intensity on sharp edges are not stable, i.e. they depend on the number of the used fictive sources. So, we do the following procedure:

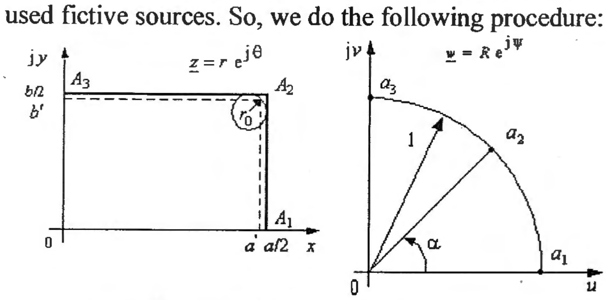

Fig. 2. *Mapping of a rectangle into a unit circle.*

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