



**Scientific Proceedings of Riga Technical University
in series "Computer Science", vol 16.**

Riga: Riga Technical University,

2003. - 126 p.

**("Boundary Field Problems and Computer
Simulation";**

45-nd issue). ISSN 1407-7493.

(C) Riga Technical University, 2003

This volume is the current 45-th thematic issue of the Riga Technical University (RTU) collection of scientific articles "Boundary Field Problems and Computer Simulation" in series "Computer Science". The collection continues (since 1999, with slightly changed title) the lasting international series "Boundary Field Problems and Computers", issued by RTU since 1966.

Scientific papers regarding simulation results and methodics of model formulation in hydrogeology, electrodynamics, hydrodynamics, ecology, signal processing, and system identification.

The volume may be of importance to specialists and students interested in computer simulation of various environmental phenomena.

Editorial board:

A.Spalvins, Dr.sc.ing., RTU - Editor-in Chief

A.Kolishkin, Dr.math., RTU

M.Antimirov, Dr.hab.phys., RTU

P.Greber, Dr.hab.ing., Dresden Institute of Technology

R.Thunvik, Dr.hab.ing., Royal Institute of Technology (Stockholm)

A.Majewski, Dr.hab.ing., Warsaw University of Technology

R.Janbickis, M.sc.ing., RTU – Secretary

Address:

1 Meza Street, Riga, LV-1048, Latvia

Phone: +371 7089511; Fax: +371 7089531

E-mail: emc@egle.cs.rtu.lv

URL: <http://www.emc.rtu.lv/>

The full text of the selected paper you can order via emc@egle.cs.rtu.lv

Contents

Abstracts	3
Fet A.M., Keitsch M.M. Sustainability reporting in European regions.....	3
Bendoraitis A., Gregorauskas M., Klimas A. Plankis M. Simulation of sanitary protection zones of Vilnius wellfields	3
Ashino R., Desjardins S. J., Kolyshkin A. A., Vaillancourt R. Noise smoothing in the Fourier domain by a multi-directional diffusion.....	3
Ghidaoui M.S., Kolyshkin A., Volodko I. Weakly nonlinear stability analysis of flows in shallow water.	4
Dzenite I. Boundary conditions at the interface between two media for the problems on the vector potential.....	4
Antimirov M. Ya., Dzenite I. A. Integral representation of the solution to the vector Helmholtz equation in the system of arbitrary orthogonal curvilinear coordinates.....	5
Ligere E.S., Chaddad I.A. The transformation of one class of integrals containing oscillating functions and its application to some mhd problems.	5
G. Burov. Combinatorial methods of formation of parallel algorithms of the signals processing.	5
G. Burov. Combinatorial structure of parallel algorithms of linear algebra.....	6
Spalvins A., Slangens J., Janbickis R., Lace I., Eglite I., Skibelis V., Hein P. Modelling of cleaning plant elements for TCE-contaminated Bernau place, Germany.	6

Abstracts

Fet A.M., Keitsch M.M. Sustainability reporting in European regions.

Addressing needs for sustainable development requires an appropriate set of policies. Policy-makers translate their perception of needs into different types of legislation. Indicators provide a universal platform for political decision makers to estimate progress in sustainable development. This paper gives a brief overview of the Global Reporting Initiative (GRI) as the framework for sustainability reporting (SR). It gives further an overview of the indicator systems designed for SR based on the "triple bottom line"; ecological, economic and social performances, and exemplifies this by means of a few case-results. However, indicators are very often selected from one reporter's point of view without harmonisation among different actors in larger system, e.g. in a European region. To handle the variety and complexity in complex systems, the systems engineering methodology (SEM) is introduced. The paper illustrates how this method can be used in the process of identifying indicators, and further on how to use these for reporting purposes. (pp. 6-15)

Bendoraitis A., Gregorauskas M., Klimas A. Plankis M. Simulation of sanitary protection zones of Vilnius wellfields

Vilnius is supplied by drinking water from 20 wellfields. Most of them are located in river Neris valley and in the valleys of its tributaries. According to Lithuanian Hygiene norm 44:2000, 2003 all the wellfields should have sanitary protection zones (SPZ). SPZ are delineated as catchment areas in pumped and water table aquifers. Last ones are under especial protection and care. Methods of 3D modelling and proposals for delineation of sanitary protection zones in urban areas are discussed, examples for wellfields in different hydrogeological conditions are given. (pp. 16-26)

Ashino R., Desjardins S. J., Kolyshkin A. A., Vaillancourt R. Noise smoothing in the Fourier domain by a multi-directional diffusion.

Several noise removing methods are briefly surveyed. Random and Gaussian noises are considered. If the original image and/or a detailed knowledge of the noise process that has distorted the image is available, it may be possible to remove the noise and restore the image. However, in real-world applications, the original clean image is unknown and the noise process

may not be well-understood. Thus, any attempt to remove the noise must proceed with caution. In this paper a simple multi-directional diffusion method is proposed to remove noise with PDE's while preserving edges and details by diffusing in all directions by a small amount in the Fourier domain, thereby reducing the distortion caused by the noise and yet not damaging the image details too much at the same time. (pp. 27-43)

Ghidaoui M.S., Kolyshkin A., Volodko I. Weakly nonlinear stability analysis of flows in shallow water.

Methods of linear and weakly nonlinear theory are used in the present paper to investigate the stability of flows in shallow water. The stability of shallow flows is described by a second-order ordinary differential equation with zero boundary conditions at infinity. The stability problem can be solved by a collocation method based on Chebyshev polynomials. The critical values of the stability parameter can be calculated for different velocity profiles. If the stability parameter is slightly smaller than the critical value, weakly nonlinear theory can be used. It is shown that the evolution of the instability is governed by the complex Ginzburg-Landau equation. Calculations for one set of velocity profiles show that the Landau constant is positive. This means that finite amplitude equilibrium exists. The results are consistent with experimental data. (pp. 44-49)

Dzenite I. Boundary conditions at the interface between two media for the problems on the vector potential.

In literature on formulating of the problem to the vector potential, the form of the vector potential (i.e. its non-zero components and dependent variables) and, consequently, its boundary conditions are taken only by considering the geometry of the source of current or even without any proving. In this paper, three mostly used in literature cases are considered, and the form of the vector potential and the boundary conditions are strictly proved. These are cases of a double conductor line, of a finite length wire and of a single-turn coil above a uniform conducting half-space. Finally, as a generalization of these cases, the case of an arbitrary form wire located in a vertical plane above a uniform conducting half-space is also considered. (pp. 50-60)

Antimirov M. Ya., Dzenite I. A. Integral representation of the solution to the vector Helmholtz equation in the system of arbitrary orthogonal curvilinear coordinates.

In the integral representation of the solution to the vector Helmholtz equation, which is known in literature, the electromagnetic field vector potential is expressed in terms of a triple integral of the multiplication of current density vector and fundamental solution of the scalar Helmholtz equation. This representation has the simplest form in the rectangular coordinate system, in which the unit vectors do not depend on coordinates. In the present paper the integral representation of the solution to the vector Helmholtz equation is obtained for an arbitrary orthogonal curvilinear coordinates, in which the unit vectors are prescribed functions of coordinates. As particular cases of the representation obtained, the integral representations of the solution to the vector Helholtz equation are obtained for the systems of cylindrical and spherical coordinates. (pp. 61-69)

Ligere E.S., Chaddad I.A. The transformation of one class of integrals containing oscillating functions and its application to some mhd problems.

The improper integrals of product of meromorphic function and oscillating at large x function ($a>0$, $b>0$, $x>0$ are some parameters) are transformed into integrals of monotonic function. For transformation it is used the convolution theorem for product of two Fourier cosine transforms. The application of this transformation to some MHD problems is shown. (pp. 70-78)

G. Burov. Combinatorial methods of formation of parallel algorithms of the signals processing.

The opportunity of formation of algorithms of the signals processing in auxiliary space of positional structures (PS) of local addresses of accommodation of the information is investigated. Such structures are created with the help of the combinatorial operators. The characteristics of the operators can be operated, changing their parameters of their arguments. It allows architecture of algorithms of the signals processing and architecture of parallel processors to consider from uniform positions of the combinatorial analysis. The positional structures are developed as the branching oriented graphs. With the help of argumental sets of the operators it is possible to change the PS and to operate computing processes of the signals

processing. Adaptive principles of management of the circuits of switching of parallel processors in this case can be used with the purpose of their optimization. The positional structures are constructed on hierarchical principles as decomposition of independent blocks admitting their independent processing on parallel processors. (pp. 79-90)

G. Burov. Combinatorial structure of parallel algorithms of linear algebra.

Is considered a problem of formation of algorithms of matrix algebra having properties of parallelism. The coordination of architecture of parallel processors and algorithms is offered to be carried out by mathematical methods. For this purpose the positional structures as graphs of a combinatorial type are developed. They enter as the basic parts into algorithms of matrix operations. For their formation the combinatorial operators are used. The structure of formed algorithms can be changed by change of argumental sets of the combinatorial operators. Such approach is used in a task of calculation of values of determinants of matrixes and their characteristic polynomials. The coefficients of polynomials are determined in parameters of the positional oriented graphs. The various forms of graphs are developed which can be applied depending on a kind of an initial matrix. The received algorithms have a hierarchical principle of construction. They can be received from the more simple forms by the recurrent way. (pp. 91-102)

Spalvins A., Slangens J., Janbickis R., Lace I., Eglite I., Skibelis V., Hein P. Modelling of cleaning plant elements for TCE-contaminated Bernau place, Germany.

The Bernau place is heavily polluted with trichlorethylene (TCE). To help in solving the remedy problem of the place, a system of hydrogeological models has been developed and applied for investigating elements of an in-situ cleaning plant. Results of comparative regional modeling of tools (reactive walls, drains, wells) that may be used for remediation are presented. these results have been used by the INGAAS GmbH company for developing of a full scale remediation project. More field data and extra modeling are needed for the final decision how to clean the place cost effectively. (pp. 103-125)