



Series: BOUNDARY FIELD PROBLEMS AND COMPUTERS. 40-
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ENVIRONMENT MODELLING TECHNOLOGIES

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The Riga Technical University (before 1990 - the Riga Polytechnical Institute) has been publishing periodically international collections of scientific articles "Boundary Field Problems and Computers" since 1966. This collection is the 40-th issue of the series.

Its first part incorporates articles about the modelling and technology data processing in the following fields: light reflection from the sea surface, optical cables, the analysis of the quality of groundwater and evaluation of its reserves, the transport of contaminants and evaluation of their quantity, as well as the problems of signal processing.

In part 2, the editor of the first 10 collections L.Niceckis and the editor of the subsequent issues A.Spalvins review the collections of articles and their content. The lists of all 497 published articles and their authors are given.

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

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Part 1

Z. Otremba. COMMENTS ON THE IMPACT RESULTING FROM VARYING PARAMETERS OF OIL FILMS ON UPWARD LIGHT FIELD FORMATION IN NATURAL CONDITIONS IN THE GULF OF RIGA.

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Summary: This paper presents selected results of light radiation modelling over the wavy sea surface when polluted with a thin layer (5 m) of oil. The software allowed the determination of angular distribution of photon quantities, both reflected from the sea surface and transmitted through the sea water into a half-sphere over the sea. Wind speed, sun altitude, oil layer thickness, oil properties, optical properties of sea water, and depth were chosen. The results indicate substantial changes of light field over the oil-polluted sea area, especially over shallow areas (up to 5 m of depth in the Gulf of Riga). The investigations demonstrate that smudges of oil appear darker or lighter from the non-polluted sea surface depending on the angle of observation. At a certain angle of observation oil films become invisible. (pp. 5-11)

S.Sujecki¹), M.Nouredine²), A.Majewski¹), P.Sewell²), C.J.Smart²), T.M.Benson²), P.C.Kendall²). FINITE DIFFERENCE ANALYSIS OF OPTICAL WAVEGUIDES USING A NEW EFFICIENT MATRIX EIGENVALUE PROBLEM SOLVER.

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Summary: We have used an efficient eigenvalue problem solver, based on numerical iterative procedures, in the finite difference analysis of optical waveguides. This allows us to use dense meshes in the calculation of propagation constants and field distributions of guided modes.

Consequently accurate results are obtained. The method has been utilised for both scalar and polarised calculations. The structures analysed are the buried rectangular waveguide and SOI and GaAs rib waveguides which are representative of the main waveguide technologies used in integrated optics. The results obtained compare favourably with those calculated by other methods. (pp. 12-17)

A.Majewski and A.Karczewski. PROPAGATION OF PULSES IN THE TAPERED NONLINEAR OPTICAL FIBER.

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Summary: Numerical analysis of the tapered nonlinear optical fiber using the coupled mode theory and the split-step Fourier method is described. Some results of computations for electric field distribution and propagation characteristics of the tapered nonlinear optical fiber in the case of ultra short pulses are also presented. (pp. 18-23)

A.Majewski and A.Przedziecki. PAIRS OF SOLITONS : NUMERICAL ANALYSIS.

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Summary: The beam propagation method has been applied to determine the behaviour of ultrashort optical pulses in the lossy guides. The influence of pulse separation and different amplitude ratios for soliton propagation is described. (pp. 24-27)

A.Zuzevicius. MODELS IN THE HYDROSPHERE MONITORING SYSTEM OF THE KARST REGION IN LITHUANIA.

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Summary: The mathematical model based on the method of finite differences is devoted to the evaluation of formation regularities of ground water resources and quality in the part (about 3400 km²) of North Lithuanian karst region on the grounds of information of rare monitoring posts. The model is sensitive to hydrodynamic boundaries characterized by complex seasonal regime (rivers, lakes, recharge) and to changeable parameters. The ground water forms about 12 percent of common rivers runoff in the region; most intensively it drains in the confluence of Mūža and Lėvuo rivers, in the zone of Smardonė springs, where the recent karst phenomena are most frequent. In the springs of Smardonė rivulet slopes the ground water formed in the basins of neighbouring rivers (Pošėmio rivulet, Apažėia) drains. (pp. 28-37)

M.Gregorauskas, A.Klimas and S.Sleinius. A COMPUTER ANALYSIS OF GROUNDWATER QUALITY AND ITS PREDICTION UNDER COMPLICATED BOUNDARY CONDITIONS - JONAVA WELLFIELD, LITHUANIA.

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Summary: A 3-D model of riverbank wellfield which is working under complicated boundary conditions confirmed that 30-40 of its groundwater resources come from vertical flow from above of which one half is river water infiltration and other half is shallow groundwater flow.

Consequently, the concentrations of the unoxidised organic substances in a pumped aquifer are higher on the banks of the river with a permanganate oxidation value of up to 4-6 mgO₂/l. This source is an original "biochemical reactor" formed along the river bank in the

water table aquifer where, due to the oxidation of pyrite and other reactions, concentrations of sulphate, iron and ammonia are significantly higher in the abstraction wells. As a result, in some of the production wells the "bioreactor" increases the concentration of ammonia by up to 1.19 mg/l. Simulation data has predicted that groundwater quality changes in the future will be not dramatic because

an increased abstraction will cause a loss of the hydraulic connection between the shallow groundwater and river water, and the increased abstraction will be compensated by a relatively fresh water flow from the distant boundaries of abstracted aquifers themselves. (pp. 38-49)

A.Spalvins and I.Lace. ESTIMATING OF FREE AND TRAPPED OIL VOLUMES FOR LIGHT HYDROCARBON PLUMES IN GROUNDWATER.

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Summary: The task of estimating immiscible light oil product volumes in groundwater is a rather tricky one because the result obtained is very sensitive on various uncertain factors: the soil and oil properties, the polluted soil wetting history etc. Two different approaches are explained: 1) using soil sample analysis, 2) applying the analytical van Genuchten's capillary model which has been used by the ARMOS code. The VOF code was developed by the Environment Modelling Centre (EMC) team of the Riga Technical University in order to compensate for some drawbacks of the ARMOS module responsible for computing the free and trapped oil volumes. (pp. 50-59)

A. Spalvins¹), J.Slangens¹), R.Janbickis¹), I.Lace¹), A.Zilans²), J.Gobins²), I.Selivanovs²). EXPERIMENTS WITH THE ARMOS CODE ON MODELLING RUMBULA AND ILUKSTE OIL CONTAMINATED PLACES.

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Summary: Two rather different cases are discussed regarding oil contamination problems at the former Rumbula airbase and at the Ilukste oil storage terminal where the ARMOS code has been applied for modelling oil transportation processes. Advantages and drawbacks of ARMOS are discussed and some important simulation results reported. A brief description of the oil migration mathematical background is provided. (pp. 60-84)

R. Janbickis and I.Lace. DATA PROCESSING TECHNOLOGIES FOR THE REGIONAL HYDROGEOLOGICAL MODEL.

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Summary: Main components of the REMO (REgional Hydrogeological MOdel "Large Riga") software and arrangements of data treatment in preprocessor, simulation and postprocessor stages are described. Innovations of the REMO software are presented. (pp. 85-96)

J.Bleiers¹⁾ and N.Veselis²⁾. PARALLEL RESOURCES FOR SOLVING OF TELECOMMUNICATION PROBLEMS IN A WIRELESS LOOP SYSTEM.

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Summary: In this paper, multiprocessor DSP resources environment oriented to the wireless loop system is considered. To achieve the high performance, the master-slave organization and data exchange with master controller through global memory in fixed time are proposed. Parallel data input or output and signal processing are ensured by using the buffered serial ports. For testing and debugging of the multiprocessor system the JTAG interface is implemented. (pp. 97-110)

R. Stasha. AVERAGING OF PERIODIC SIGNALS IN THE FREQUENCY DOMAIN.

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Summary: Complete and combination averaging in the frequency domain and coherent filtering are proposed to improve the signal to noise ratio for periodic signals. It is shown that combination averaging allows to eliminate the defective part of the signal record during the averaging process. The gain is illustrated by the computer simulation and some experimental results.

G.Burovs and J.Vilders. RESTITUTION OF THE CHARACTERISTIC EQUATION OF ANALOG OBJECT AT PROCESSING TIME SERIES.

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Summary: Peculiarities of process of decipher of dynamic time series, generated by analog dynamic object, are considered. Parameters of object, describing frequency of fluctuations and power of attenuation of target signals, are estimated. The information on them is carried by coefficients of a characteristic polynomial of analog gear function. However, the reception of their estimations by results of discrete measurements of a target signal requires (demands) application of mathematical transformations, the computing stability of which can vary over a wide range. It depends on period of quantization of signals

in time and from power of a dynamics of signals and can strongly influence on an error of an estimation of a characteristic

polynomial of object. (pp. 111-119)

G.Burovs and K.Andersons. RESTITUTION OF ANALOGUE OBJECTS TRANSFERS FUNCTION FROM ITS FREQUENCY CHARACTERISTICS.

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Summary: The significant quantity of the diagnostic information about analogue object contains its peak - frequency and phase - frequency characteristics. However in general is difficult to describe their feed - back with constructional parameters of the object. It complicates decipher of the diagnostic information. This problem is easier to solve, transforming an estimation of analogue objects transfer function in its frequent characteristics. Transfer function restitution algorithm accuracy and computing stability must be increased with method of diagnosing reliability increase. (pp. 120-127)

G.Burovs¹⁾ and A.Varšlavs²⁾. COMPUTING STABILITY OF DECIPHERING OF THE DIFFERENCE REGRESSIVE EQUATIONS WHILE PROCESSING ANALOG SIGNALS.

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Summary: The initial estimations of the condition of an analog dynamic object appear as coefficients of gear functions of simulation digital models. With their help the suppression of errors of quantisation of signals in time occurs. The problems of computing stability of algorithms of deciphering the coefficients of the difference regressive equations, formed on the basis of such digital models, are considered. The connection of errors of deciphering with

size of period of quantisation of signals and computing stability of algorithms, formed on the basis of the inverse Z- transformation operationing is investigated. An aproximate method of its estimation with the use of weight function of an analog object is developed. The errors deciphering size is influenced also bythe power of linear dependence, arising between coefficients of the regressive equations. It amplifies in accordance with the reduction of period of quantisation.

Specific problems are discussed using concrete samples. (pp. 127-1137)

Part 2

L.Niceckis. THE FIRST TEN ISSUES' EDITOR'S VIEW.

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Summary: The first ten issues were edited by At first, they were designed as the Computer Science and Computer Engineering faculty of RTU collections of scientific publications prepared by faculty teams of the Electronic Simulation Research Laboratory and the Department of Computer Engineering. The main purpose was to publish, as soon as possible, current research results approved by the scientific seminar. The circle of authors and the scope of interests gradually widened, because many people became interested in the seminar providing a chance of fast publishing. The main institutions involved were: other departments of the Computer Science and

Computer Engineering Faculty, the Faculty of Radio Engineering and Telecommunications of RTU, the Latvian Academy of Sciences, the Latvian State University and other high schools of Riga. The issues enabled the mentioned groups to follow a dynamic development of scientific ideas and results recently obtained. (pp. 138-139)

A.Spalvins WHY IS THE INTERNATIONAL SERIES : "BOUNDARY FIELD PROBLEMS AND COMPUTERS" STILL LIVING ? EDITOR'S NOTE.

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Summary: The international series: "Boundary Field Problems and Computers" have been issued by RTU since 1966. During 31 years, 40 books were prepared and the 40-th one contains some materials which enable to overview the publishing activities of the Series: indexes of collections, articles, authors and countries presented by authors. Since 1966, nearly 500 (497 !) papers have been published by 315 authors from 11 countries (the former USSR and the German Democratic Republic are included). Up till 1991, the official language of the Series was Russian. Since 1992 (from the 33-rd issue), Russian, Latvian and English are used. (pp. 140-141)