MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
KHARKOV NATIONAL UNIVERSITY OF RADIOELECTRONICS

ISBN 966-659-113-8

Proceedings of IEEE East-West Design & Test Workshop
(EWDTW'05)

Copyright © *2005* by The Institute of Electrical and Electronics Engineers, Inc.

Odessa, Ukraine, September 15 – 19, 2005

CONTENTS

M. Renovell. Modelisation and Detection of Realistic Defects in CMOS Technology (Abstract)……………………………………………………………...8

Kaushik Roy. Leakage Power Analysis and Reduction for Nano-Scale Circuits………………9

Yervant Zorian. Design for Yield and Reliability (Abstract)…………………………………..14

Steve Burns. Research at Intel's Strategic CAD Labs (Abstract)………………………………14

Marina Brik, **Elena Fomina**, **Raimund Ubar**, A Proposal for Optimisation of Low-Powered FSM Testing…………………………………………………………………………………..15

Elena Fomina, Marina Brik, Roman Vasilyev, Alexander Sudnitson. A New Approach to State Encoding of Low Power FSM……………………………………………………………21

Nerijus Bagdanavičius, Pranciškus Balaišis, Danielius Eidukas, Andrius Žickis. Investigation of Integrated Systems Network Efficiency………………………………………27

Speranskiy D.V., Ukolova E.V. Test Synthesis for Linear Automata with Genetic Algorithms Application………………………………………………………………………………….....33

Fedeli, U. Rossi, F. Fummi, G. Pravadelli. SYMBAD: Formal Verification in System Level-based Design ……………………………………………………………………………..36

A.Yu. Matrosova, E.S. Loukovnikova. Test Patterns Generation For Single and Multiple Stuck-At Faults at the CLB Poles of a Combinational Circuit…………………………………..42

P. Tervydis, D. Eidukas, P. Balaisis. Statistical Modeling of Information Transmission over Electronic Networks………………………………………………………………………………48

Miroslaw Forczek, Sergiy Zaychenko. Assertions based verification for SystemC………….54

Drozd A., Lobachev M., Reza Kolahi. Effectiveness of On-Line Testing Methods in Approximate Data Processing……………………………………………………………………..62

Andrei Karatkevich. Verification of Implementaion of Parallel Automata (Testing Approach).66

Adamski M., Barkalov A., Bukowiec A. Structures of Mealy FSM Logic Circuits under Implementation of Verticalized Flow-Chart……………………………………………………70

Barkalov A.A., Titarenko L., Wisniewski R. Optimization of the Amount of Lut-Elements in Compositional Microprogram Control Unit with Mutual Memory…………………………75

Alexander Barkalov, Remigiusz Wisniewski. Implementation of Compositional Microprogram Control Unit On FPGAs……………………………………………………...80

A.A. Barkalov, A.A. Krasichkov, I.J. Zelenyova. Synthesis of Finite State Machines With Object's Codes Transformation……………………………………………………………...84

Romankevich A., Romankevich V., Kononova A., Rabah Al Shboul. GL-models of K(2,N) FTMpS………………………………………………………………………………….88

N. Kascheev, V. Beloborodov, Y. Bazhanov. Efficient Test Generation using Continuous Extensions of Boolean Functions………………………………………………….92

B. Sokol, V. N. Yarmolik. Memory Faults Detection Techniques with use of Degrees of Freedom in March Tests …………………………………………………………………...96

Saposhnikov V.V., Saposhnikov Vl.V., Urganskov D.I. Composite Structure Of Binary Counter of Ones Arbitrary Modulo…………………………………………………………102

Puczko M, Yarmolik V.N. Power Conscious Testing Issues In BIST………………………107

Rustinov V.A., Saatchyan A.G. Approach for Teaching of IP-Cores Design: An Example of AES Cryptoprocessor………………………………………………………111

Ryabtsev V.G., Andrienko V.A., Kolpakov I.A. A Lot Of The Versions For Diagnosing Microcircuits Memory Devices Of Critical Computer Control Systems…………………….....115

Ladyzhensky Y.V., Popoff Y.V. Software System For Distributed Event-Driven Logic Simulation……………………………………………………………………………...119

A.E. Yankovskaya, Y.R. Tsoy. Optimization Of A Set Of Tests Selection Satisfying The Criteria Prescribed Using Compensatory Genetic Algorithm……………………………123

Andrey U. Eltsov, Dmitry V. Ragozin. 3D pipeline workload for convergent DSP-CIL Processor………………………………………………………………………………127

Dmitry V. Ragozin, Maxim O. Shuralev, Maxim A. Sokolov, Dmitry K. Mordivinov. DSP Core for Hardware Based CIL Machine………………………………………………131

Zaychenko A.N., Krotenko A.G., Pavelko A.V. The Viterbi Algorithm Modification……..137

Asadov Hikmat Hamid. Principle Of Implicit Dimension Lowering For Optimization of Information Systems. Application for Information Location Systems………………………141

Valérie-Anne Nicolas, Bertrand Gilles, Laurent Lemarchand, Lionel Marcé, Bruno Castel. A Maintenance-Oriented Board Testing Approach…………………………...143

Petrenko A., Vetrova M., Yevtushenko N. Adaptive Test Generation for Nondeterministic Networks……………………………………………………………………………………148

Yeliseyev V.V., Largin V.A. Program-Technical System (PTS) Diagnosis on The Basis of Microprocessor Monitoring And Control Subsystem…………………………………………152

Pavlo Tymoshchuk, Mykhaylo Lobur. Optimization of WTA Neural Network by Genetic Algorithms……………………………………………………………………...156

Gladkikh T.V., Leonov S. Yu. Models of Computer's Elements in CAD Based on the K-Value Differential Calculus………………………………………………………160

A.V. Kolomeets, M.L. Gromov, S.V. Zharikova, D.D. Popov. Digital Controller for Multiphase Inverters……………………………………………………………………………...165

Sharshunov S.G., Belkin V.V., Rudnitskaya V.P. Detecting Malfunctions of Current Processor Control Hardware……………………………………………………………...169

Michail F. Karavay. Fault-Tolerant Design For Hamiltonian Target Graphs………………..175

Scobtsov Y.A., Ermolenko M.L. The Test-Programs Generation of Microprocessor Systems on the Basis of Genetic Programming………………………………………………181

Yu.Yu. Zavizistup, A.A. Kovalenko, S.A. Partyka, A.V. Babich. TCP VEGAS against TCP RENO: Throughput Comparison And Simulation Results……………………………………186

A.V. Babich, O.B. Skvortsova, A.A. Krasovskaya, A.A. Kovalenko. Method of Implicit Defects and Bottlenecks Location Based on Active Experiment Planning……………………189

Gennadiy Kryvulya, Yevgeniya Syrevitch, Andrey Karasyov, Denis Cheglikov. Test Generation for VHDL Descriptions Verification………………………………………...191

O. Gavrilenko, A. Kulik, O. Luchenko. The Adaptive Approach to Active Fault Tolerance Maintenance of Automatic Control Systems…………………………………………………..195

Gorbachov V.A., Adamenko N.N. The Two-Level Method of Describing Semantic Database Model……………………………………………………………………………..201

V.A. Gorbachov, J.S. Leshchenko. Deadlock problem in distributed information systems, possible ways of improvement of its searching and resolving……………………………...203

Ami Gorodetsky. Contactless Mixed-Signal In-Circuit Testing..207
Yakymets Nataliya, Kharchenko Vyacheslav, Ushakov Andrey. Projects diversification of fault-tolerant digital systems with programmed logic using genetic algorithms…………...208
V.S. Kharchenko, I.V. Lysenko, V.V. Sklyar, O.D. Herasimenko. Safety and reliability assessment and choice of the redundant structures of control safety systems………………...212
V. Kharchenko, O. Tarasyuk, A. Gorbenko, N. Khilchenko. A Metric-Probabilistic Assessment of Software Reliability: Method, Tool and Application…………………………219
Ushakov A.A., Kharchenko V.S., Golovir V.A. Self-repairing FPGA-systems using multi-parametrical adaptation to cluster faults………………………………………………...225
A. Čitavičius, M. Knyva. Investigation of Measuring Device Software Functionality………231
K.S. Smelyakov, I.V. Ruban, S.V. Smelyakov, A.I. Tymochko. Segmentation of Small-sized Irregular Images………………………………………………………………235
Dmitriy Elchaninov, Sergey Matorin. A perspective approach to structural design automation……………………………………………………………………………...242
Vyacheslav Evgrafov. Throughput Evaluation of MIN in Case of Hot Spot Traffic With Arbitrary Number of Hot Spots……………………………………………………………..246
Belous Natalie, Kobzar Gleb, Evseev Alexander. Contour based technique for person recognition by hand geometry identifier……………………………………………………251
Irina Hahanova, Volodymyr Obrizan, Wade Ghribi, Vladimir Yeliseev, Hassan Ktiaman, Olesya Guz. Hierarchical hybrid approach to complex digital systems testing………………254
Stanley Hyduke, Eugene Kamenuka, Irina Pobezhenko, Olga Melnikova. Emulation Processor Network for Gate-Level Digital Systems………………………………257
Vladimir Hahanov, Oleksandr Yegorov, Sergiy Zaychenko, Alexander Parfeniy, Maryna Kaminska, Anna Kiyaschenko. Assertions-based mechanism for the functional verification of the digital designs………………………………………………………...261
Karina Mostovaya, Oleksandr Yegorov, Le Viet Huy. Software Test Strategies…………266
Sergey G. Mosin. Design-for-Testability of Analog and Mixed-Signal Electronic Circuits (Abstract)…………………………………………………………………………………268
Sergey G. Mosin. Extraction of Essential Characteristics of Analog Circuits' Output Responses Required for Signature Analysis……………………………………..269
Olga Melnikova, Dmitriy Melnik, Yaroslav Miroshnychenko. IP core and testbench generator for CORDIC algorithm……………………………………...271
Shabanov-Kushnarenko Yu., Klimushev V., Lukashenko O., Nabatova S., Obrizan V., Protsay N. Brainlike Computing……………………………………………..274
Eugene Kovalyov, Olga Skvortsova, Alexandr Babaev, Yaroslav Miroshnichenko, Konstantin Kolesnikov. ASFTEST – Testbench generator for Extended Finite State Machines………………………………………………………………………………280
Eugene Kovalyov, Evgeniya Syrevitch, Elvira Kulak, Evgeniya Grankova. High level FSM design transformation using state splitting…………………………………..282
A. Chatterjee. Conformal Built-in Test and Self-calibration/Tuning of RF/MULTI-GHz circuits (Abstract)…………………………………………………………………………...284
Chumachenko S.V., Chugurov I.N., Chugurova V.V. Verification And Testing RKHS Series Summation Method For Modelling Radio-Electronic Devices………………………...285

VERIFICATION AND TESTING RKHS SERIES SUMMATION METHOD FOR MODELLING RADIO ELECTRONIC DEVICES

Chumachenko S.V., Chugurov I.N., Chugurova V.V.
Kharkov National University of Radio Electronics,
Ukraine, 61166, Kharkov, Lenin Avenue, 14, Phone: (+380)-57-7021-326, e-mail: ri@kture.kharkov.ua

Abstract. Reproducing Kernel Hilbert Space (RKHS) for Series Summation that allows analytically obtaining alternative representations for series in the finite form is developed.

Keywords: Hilbert space, reproducing kernel, RKHS, series summation method.

Introduction. To increase efficiency of solving of computational tasks there are used mathematical co-processors, which implement most efficient ways of computing equations, integrals, differential coefficients, ets. It is obvious that after discovering of new methods of increasing computation accuracy and decreasing computation time it is necessary to re-implement mathematical co-processors or use new generation of IP-cores in PLD, Gate Array, ASIC designs. The method of reduction of computation of certain types of series to exact function that is widely used during calculation of parameters of high radio frequency devices was presented in [1-4]. This method decrease computation time of such tasks in tens and hundred times and its inaccuracy is equals to zero.

The purpose of the investigation is verification and testing Series Summation Method in RKHS for modelling radio electronic devices.

Investigation Essential. Using Theorem 3 from [1] we can prove the new identity:

$$\sum_{k=1}^{\infty}(-1)^k\frac{k\cos kx}{a^2-k^2}=\frac{\pi}{2}\frac{\cos ax}{\sin \pi a}, \qquad (1)$$

$$-\pi<x<\pi,\ a>0,\ a\neq 1,2,3,\dots .$$

Also we can check the correctness of this equality numerically. Figs. 1 and 2 show graphical comparison and uncertainty respectively.

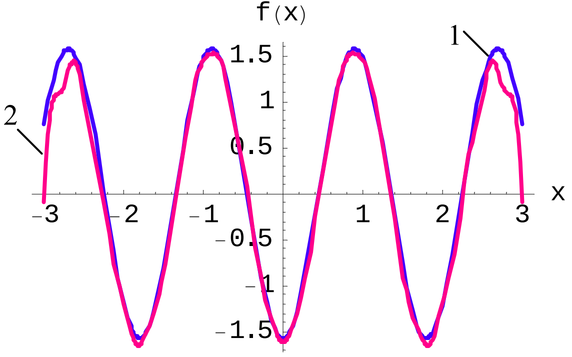

Fig. 1. Results of comparison for eq. (1) at a=3,5: curve 1 – the exact result, curve 2 – series summation

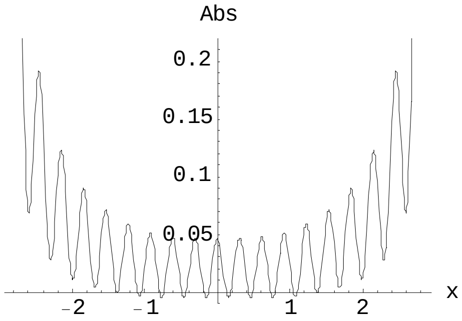

Fig. 2. Absolute uncertainty (error) of eq. (1)

For alternating series, the following relations are satisfied [5]

$$\sum_{k=1}^{\infty}(-1)^k\frac{kF(k)}{a^n-k^n}=$$

$$=\begin{cases}\dfrac{\pi aF(a)}{\sin\pi a}, & n=1;\\[2ex] \dfrac{\pi F(a)}{2pa^{2p-2}\sin\pi a}, & n=2p, p=1,2,3,\dots;\\[2ex] \dfrac{\pi F(a)}{(2p-1)a^p\sin\pi a}, & n=2p-1, p=2,3,\dots .\end{cases} \qquad (2)$$

for any $F(x)$ from RKHS, $a>0$, $a\neq 1,2,3,\dots$.

To prove of the following identity

$$\sum_{k=1}^{\infty}(-1)^k\frac{k\cos kx}{a^4-k^4}=\frac{\pi\cos ax}{4a^2\sin\pi a}, \qquad (3)$$

we can apply (2). Also we can illustrate this result numerically (see figs. 3, 4). Fig. 3 shows two overlapped curves for the parameter $a=2{,}5$. The graph of the function on the right-hand side of (3) is depicted with the bold curve and that of the left-hand side with the thin curve. Fig. 4 demonstrates the absolute uncertainty.

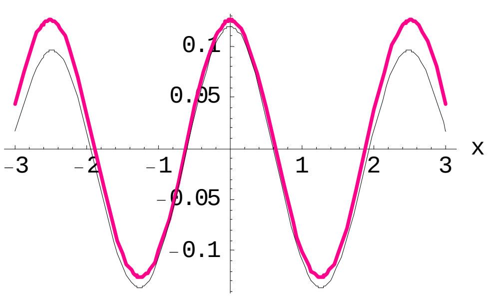

Fig. 3. Results of comparison for formula (3) at $a=2{,}5$: bold curve – the exact result, thin curve – series summation

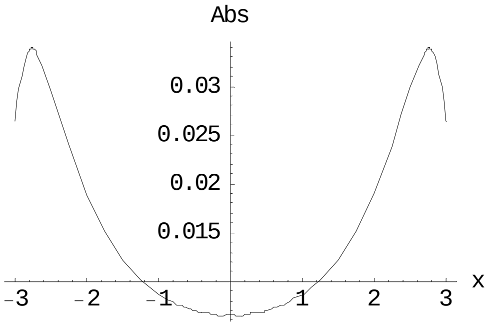

Fig. 4. Absolute error

There is the following formula for alternating series in RKHS

$$\sum_{k=1}^{\infty} \frac{(-1)^k k^3 F(k)}{(a_1^2-k^2)(a_2^2-k^2)} = -\frac{\pi}{4}\frac{a_1^2+a_2^2}{a_1^2-a_2^2}\left(\frac{F(a_1)}{\sin \pi a_1}-\frac{F(a_2)}{\sin \pi a_2}\right)-\frac{\pi}{4}\left(\frac{F(a_1)}{\sin \pi a_1}+\frac{F(a_2)}{\sin \pi a_2}\right)$$

$$a_1 > 0,\ a_2 > 0,\ a_1, a_2 \neq 0, 1, 2, \ldots \qquad (4)$$

Let's represent a numerical proving of the formula (4) at $F(k) = J_k(x)$, $a_1 = 6{,}5$, $a_2 = 3{,}5$. Fig. 5 shows exact values of function and the approached values of series which are received by the formula (4). The diagram of an absolute error is resulted on fig. 6.

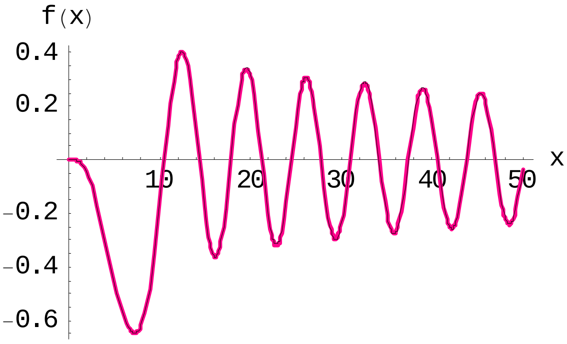

Fig. 5. Results comparison for (4) at $F(k) = J_k(x)$

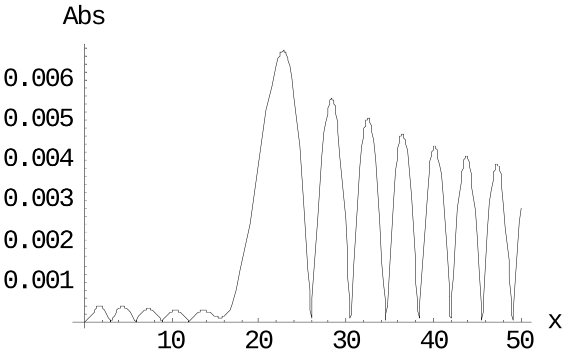

Fig. 6. Absolute error by (4) at $F(k) = J_k(x)$

Let's represent a numerical proving of the formula (4) at $F(k) = \sin(kx)$, $a_1 = 2{,}5$, $a_2 = 3{,}5$, $-\pi < x < \pi$. Fig. 7 shows exact values of function (bold curve) and the approached values of series (thin curve) which are obtained by the formula (4). The diagram of an absolute error is demonstrated on fig. 8.

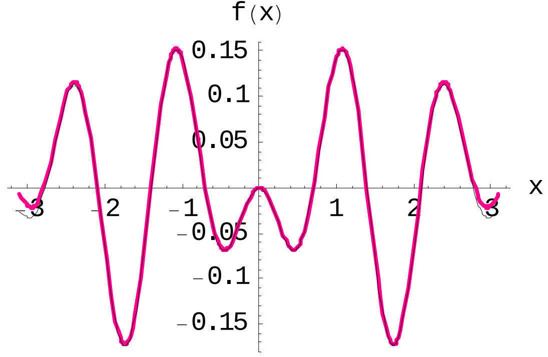

Fig. 7. Results comparison for (4) at $F(k) = \sin(kx)$

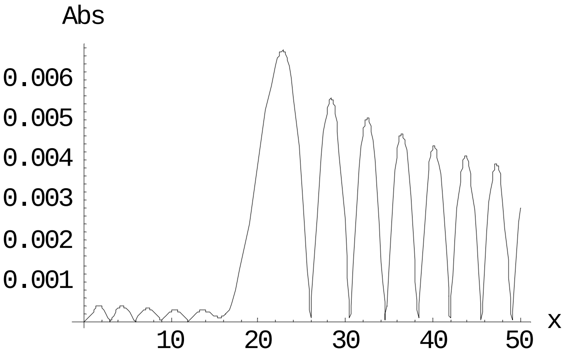

Fig. 8. Absolute error by (4) at $F(k) = \sin(kx)$

Note: for periodic functions a sine and cosine all considered formulas are true in interval $-\pi < x < \pi$. Further it is necessary to take into account its periodicity.

Let's consider the formula (4) at $F(k) = \sin(kx)$, $a_1 = 2{,}5$, $a_2 = 3{,}5$, $-\pi < x < 3\pi$. In this case we can use (4) at $-\pi < x < \pi$, but right-hand side of (4) should be multiplied by (-1) at $\pi < x < 3\pi$, namely:

$$\sum_{k=1}^{\infty} (-1)^k \frac{kF(k)}{(a_1^2-k^2)(a_2^2-k^2)} = -\frac{\pi}{2(a_2^2-a_1^2)}\left(\frac{F(a_1)}{\sin \pi a_1}-\frac{F(a_2)}{\sin \pi a_2}\right), \qquad (5)$$

$$\pi < x < 3\pi .$$

Fig. 9 shows exact values of function (bold curve) and the approached values of series (thin curve) which are obtained by the formula (5). The diagram of an absolute error is demonstrated on Fig. 10.

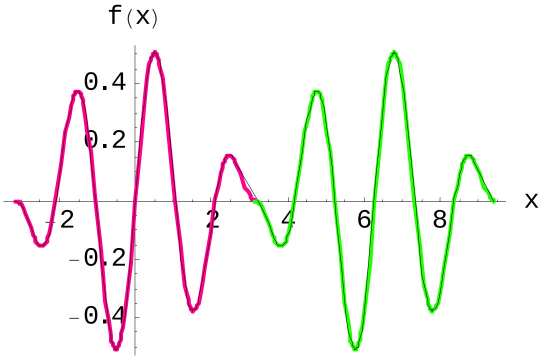

Fig. 9. Results comparison for (5) at $F(k) = \sin(kx)$, $a_1 = 2{,}5$, $a_2 = 3{,}5$, $-\pi < x < 3\pi$

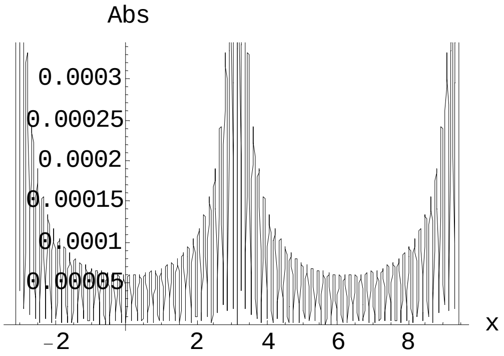

Fig. 10. Absolute error by (5)

Conclusion

Thus, it was obtained numerical results that show the correctness of suggested method.

We can direct the following *areas* for applications of Series Summation Method in RKHS:

– exact summation of series;

– solving summatory equations and its systems;

– solving integral equations and its systems;

– solving integral-summatory equations and systems of complex form;

– proving integral identities.

Mentioned areas can be used at solving some problems of: antenna theory; diffraction theory; electrodynamics and can be useful at Software/Hardware implementations.

- *Advantages of this method* consist of:

— application of equivalent transformations to the common member of a series, that enables to obtain the *analytical solution* for smaller quantity of steps;

— in absence of necessity to use the tables of integral transformations and to use the integration in complex area.

- The application of obtained results of RKHS-theory for *solving the boundary electrodynamics problems* gives possibility *to simplify known methods* and to receive on their basis the *analytical solutions*, that is represented as essential for the further numerical experiment;
- New mathematical results for solving the summatory and integral equations are obtained by proving some theorems.
- The obtained results can be included into the reference mathematical library and implemented into Mathematics program products, MathCAD, Math Lab means. It can be useful for scientists, engineers, mathematics at solving the different problems [5, 6].

References:

1.*Chumachenko S.V.* Summation method of selected series for IP-core design // Radioelectronics and Informatics. 2003. N3. C. 197-203.

2. *Svetlana Chumachenko, Vladimir Hahanov.* Reproducing Transformations method for IP-core of summatory and integral equations solving // Proc. of DSD 2004 EUROMICRO SYMPOSIUM ON DIGITAL SYSTEM DESIGN: Architectures, Methods and Tools. August 31 - September 3, 2004, Rennes – France (Work in progress).

3. *Chumachenko S.V., Gowher Malik, Khawar Parvez.* Reproducing Kernel Hilbert Space Methods FOR CAD Tools // Proc. EWDTW, 2004. Yalta-Alushta, September 23-26. PP. 247-250.

4. *Chumachenko S.V.* Solving Electrodynamics Problems by Reproducing Transformations Method // Proc. BEC 2004. Tallinn. October 3-6, 2004. PP. 319-322.

5. *Chumachenko S., Kirichenko L.* RKHS-Methods at Series Summation for Software implementation // International Conferences on Information Theories and Applications. Proc. of Third International Conference “Information research, applications, and education”. Varna-Sofia, Bulgaria. June, 2005. P. 124-129.

6. *Chumachenko S.V., Hahanov V.I., Melnikova O.V.* RKHS-Methods at Solving Some Radiophysics Problems // Elektonika ir Elektrotechnika. Kaunas University of technology. 2005. №6 (62). P. 5-8.

Camera-ready was prepared in Kharkov National University of Radio Electronics
by Dr. Svetlana Chumachenko and Volodymyr Obrizan
Lenin ave, 14, KNURE, Kharkov, 61166, Ukraine

Approved for publication: 05.09.2005. Format 60×841/8.
Relative printer’s sheets: 33,4. Order: without cash transfer. Circulation: 100 copies.
Published by SPD FL Stepanov V.V.
Ukraine, 61168, Kharkov, Ak. Pavlova st., 311