

**RESEARCH INSTITUTE  
FOR INTELLIGENT COMPUTER SYSTEMS**

**TERNOPIL NATIONAL ECONOMIC UNIVERSITY,  
MINISTRY OF EDUCATION AND SCIENCE, UKRAINE**

**V.M. GLUSHKOV INSTITUTE FOR CYBERNETICS,  
NATIONAL ACADEMY OF SCIENCES, UKRAINE**

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## FOREWORD

It is my pleasure to present the 2016 Annual Report of Research Institute for Intelligent Computer Systems (ICS), Ternopil National Economic University (TNEU) and the Glushkov Institute for Cybernetics, National Academy for Science, Ukraine. This report is the XIV one since the ICS was established in 2004 on the basis of the Branch Research Laboratory for Automated Systems and Networks (founded in 1984).

The ICS consists of the 14 research groups. During its history the ICS staff has received more than 150 invention certificates of the former USSR and 39 Ukrainian patents; in particular we got the nine patents and applications for the invention in 2016. There were published more than 1000 papers, and 131 in 2016. There were defended the 32 DSc and PhD theses, in particular the seven in 2016.

The high level of the ICS' research and development are confirmed by awarding the 18 international grants and followed projects within the INTAS, CRDF, NSF, NATO, STCU, FP7 and bilateral programs, in particular the three in 2017. In these projects the ICS collaborated with a huge number of worldwide universities as well as governmental institutions and private companies. Also we started to run in 2016 the Erasmus+ project ALIOT entitled Internet of Things: Emerging Curriculum for Industry and Human Applications, see details inside of of this report. Additional 14 projects have been completed with the funding from the Ministry for Education and Science, Ukraine, in particular the two projects have run in 2016. Regarding research project activities in 2016 I would like to pay attention to the achievements of the Research Group on Intelligent Cyber Security and Defense leading by Prof. Vladimir Golovko and Prof. Anatoliy Sachenko and noticeable activities of Dr Myroslav Komar.

The ICS is running the regular the IEEE International Conferences on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS), [www.idaacs.net](http://www.idaacs.net) every two years since 2001. In particular last one was held in Warsaw, Poland, 2015. Now we are preparing the 9<sup>th</sup> IEEE International Conferences on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS), <http://idaacs.net/2017> which will be held in Bucharest, Romania, 21-23 September 2017.

The ICS is taking a part in organization of International Symposium on Wireless Systems within the IDAACS Conference since 2012. The 3<sup>rd</sup> IEEE International Symposium on Wireless Systems within the IDAACS Conference (IDAACS-SWS'2016) held in Offenburg, Germany, 26-27 September 2016.

The ICS staff continues to keep good links with IEEE within the IEEE Student Branch at TNEU and the Instrumentation and Measurement / Computational Intelligence Joint Societies Chapter of IEEE Ukraine Section. A Chapter held the nine Technical Meetings in 2016, see details inside of this report.

The International Journal of Computing is issued quarterly in English language. The four regular issues have been published in 2016. Since November 2016 the IJC Journal is indexed by Scopus Elsevier. Also the Journal is indexed by Finnish publication forum, Norwegian Social Science Data Services, Google Scholar, and Index Copernicus International.

Finally, I would like to thank Mr. Taras Lendyuk and Ms Diana Zahorodnia and Dr Inna Shylinska and Mr Oleksandr Osolinsky for their help in preparing and editing and designing this report.

Enjoy,  
ICS Advisor



Prof. Anatoliy Sachenko

March 24, 2017

## 1. GENERAL INFORMATION

### ICS History

Research Institute for Intelligent Computer Systems (ICS) was established to begin preparations and improve the efficiency of the national and international research projects execution in the area of design and implementation of intelligent computer systems.

The Institute is located in the campus building #2 of Ternopil National Economic University (TNEU). The ICS frame has 14 problem-oriented research groups, in particular: Intelligent Distributed Systems Group, Intelligent Sensor Data Acquisition Group, Intelligent Robotic Systems Group, Neural Networks and Parallel Computing Group, Knowledge Bases and Ontologies Group, Information Technology and Specialized Computer Systems Group, Image Processing and Pattern Recognition Group, Wireless Systems Security Group, Project and Program Management on the base of Information Technologies and Knowledge Group, Cybernetics of Complex Systems Group, Information Security Group, Intelligent Cyber Security and Defense Group, Metrology of Information Measuring Systems Group, Simulation and Algoritmization of Complex Technological Processes Control Group.

The ICS was established in 2004 on the basis of Branch Research Laboratory of Automated Systems and Networks, which in turn inherited rights and experience of the Branch Research Laboratory of Automated Data Acquisition and Processing Systems, established in 1984 by joint order of the Ministry of Electronic Industry of the USSR and the Ministry of Higher and Specialized Secondary Education of the Ukrainian SSR. According to a trend for strengthening links between the Ministry of Education and Science and National Academy of Sciences of Ukraine the ICS is under joint supervision of the TNEU and the Glushkov Institute of Cybernetics, National Academy of Sciences of Ukraine since 2007.

High level of the ICS' research and development has been proved since 1997 by winning a number of international grants within the INTAS, CRDF, NSF, NATO, STCU, FP7 and bilateral programs. In these projects the ICS partners were the Universities of Thessaloniki (Greece), Calabria (Italy), Coruna (Spain), Mons (Belgium), Maine and New Jersey (USA), Kaunas (Lithuania), Minsk and Brest (Belarus) as well as the governmental research institutions. Additional 11 projects were executed during this period with funding from the Ministry of Education and Science of Ukraine. This active work of ICS staff enabled to push the research facilities and infrastructure of the Institute, in particular the Ternopil Information-Communication Center was created using NATO funds.

ICS researchers are founders of the IDAACS Charity Foundation, which supports organization of regular International Intelligent Data Acquisition and Advanced Computing Systems (IDAACS) Workshop since 2001 every two years under IEEE's support. In particular, the previous IDAACS Workshops were held in Foros, Crimea (2001), in Lviv (2003), in Sofia, Bulgaria (2005), Dortmund, Germany (2007), Rende (Cosenza), Italy (2009), Prague, Czech Republic (2011), and Berlin, Germany (2013), Warsaw, Poland (2015).

Two IEEE International Symposiums on Wireless Systems within the Conference on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS-SWS) were held in Offenburg, Germany, in 2012, 2014 and 2016 correspondingly.

The ICS researchers established the IEEE Student Branch at TNEU in 1998. The Instrumentation and Measurement / Computational Intelligence Joint Societies Chapter of IEEE Ukraine Section were created in 2005, and its activities were awarded with IEEE Outstanding Chapter Award for activities in 2007 and 2014 correspondingly. In 2002 the International Journal of Computing was founded, [www.computingonline.net](http://www.computingonline.net), which has a professional status in Ukraine, and it's distributed worldwide. The Journal is issued quarterly in English language. Since November 2016 the IJC Journal is indexed by Scopus Elsevier. Also the Journal is indexed by Finnish publication forum, Norwegian Social Science Data Services, Google Scholar, and Index Copernicus International.

## **ICS Management**

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Scientific Advisor – Prof. Anatoliy Sachenko  
Scientific Secretary – Dr. Myroslav Komar

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## **ICS Frame**

### **Intelligent Distributed Systems Group (IDS)**

Principal researcher – Prof. Anatoliy Sachenko

Group members:

- Pavlo Bykovyy
- Volodymyr Kochan
- Myroslav Komar
- Olexandr Osolinsky
- Vasyl Yatskiv

### **Intelligent Sensor Data Acquisition Group (ISDA)**

Principal researcher – Dr. Volodymyr Kochan

Group members:

- Zbyshek Dombrovsky
- Orest Kochan
- Ihor Maykiv
- Olexandr Osolinsky
- Oleksiy Roshchupkin
- Radislav Smid
- Iryna Turchenko
- Nadia Vasylykiv

### **Intelligent Robotic Systems Group (IRS)**

Co-Researchers, Principal researchers – Prof. Robert Hiromoto, Dr. Vasyl Koval

Group members:

- Oleh Adamiv
- Vladimir Golovko
- Kostyantyn Kovalok
- Alex Nykorak
- Anatoliy Sachenko

### **Neural Networks and Parallel Computing Group (NNPC)**

Principal researcher – Dr. Volodymyr Turchenko

Group members:

- Vitaliy Dorosh
- Volodymyr Kochan
- Anatoliy Sachenko

### **Knowledge Bases and Ontologies Group (KBO)**

Principal researcher – Prof. Sergey Rippa

Group members:

- Anatoliy Sachenko
- Taras Lendyuk
- Andriy Melnyk
- Serhiy Voznyak

### **Information Technology and Specialized Computer Systems Group (ITSCS)**

Principal researcher – Prof. Yaroslav Nykolaychuk

Group members:

- Orest Volynskyy
- Arthur Voronych
- Natalia Vozna
- Oleg Zastavnyy

### **Image Processing and Pattern Recognition Group (IPPR)**

Co-Heads, Principal researchers – Prof. Viktor Krylov, Dr. Ihor Paliy

Group members:

- Anatoliy Sachenko
- Diana Zagorodnya
- Kostyantyn Kovalok

### **Wireless Systems Security Group (WSS)**

Principal researcher – Dr. Vasyl Yatskiv

Group members:

- Robert Hiromoto
- Anatoliy Sachenko
- Jürgen Sieck
- Taras Tsavolyk
- Orest Volynskyy
- Natalia Yatskiv

### **Project and Program Management on the base of Information Technologies and Knowledge Group (PPMITK)**

Principal researcher – Prof. Sergey Bushuyev

Group members:

- Ninel Dobrovolska
- Mykhailo Dombrovsky
- Zbyshek Dombrovsky
- Oksana Dunets
- Grygoriy Gladiy
- Yuriy Ivanyshak
- Taras Lendyuk
- Oksana Lyashenko
- Volodymyr Neizzhalyi
- Sergey Rippa
- Anatoliy Sachenko
- Oleg Sachenko

**Cybernetics of Complex Systems Group (CCS)**

Principal researcher – Dr. Roman Pasichnyk

Group members:

- Grygoriy Gladiy
- Andriy Melnyk
- Yuriy Pigovskyy

**Information Security Group (IS)**

Principal researcher – Prof. Mykola Karpinsky

Group members:

- Pavlo Bykovyy
- Lesya Dubchak
- Myroslav Komar

**Intelligent Cyber Security and Defense Group (ICSD)**

Co-Heads, Principal researchers – Prof. Vladimir Golovko, Prof. Anatoliy Sachenko

Group members:

- Pavlo Bykovyy
- Myroslav Komar

**Metrology of Information Measuring Systems Group (MIMS)**

Co-heads, Principal researchers – Dr Roman Kochan, Dr Volodymyr Kochan

Group members:

- Orest Kochan
- Igor Maykiv
- Olexandr Osolinsky
- Nadia Vasylykiv

**Simulation and Algorithmization of Complex Technological Processes Control Group (SACTPC)**

Principal researcher – Dr Igor Dobrotvor

Group members:

- Dmytro Bodnar
- Anatoliy Sachenko
- Grygoriy Gladiy
- Diana Zagorodnya

## 2. ICS RESEARCH STAFF

### Senior Staff

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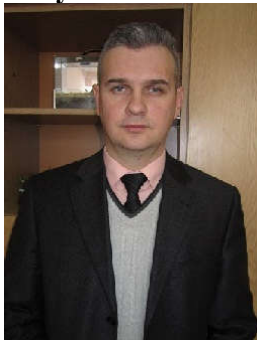
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### Olexandr Osolinsky



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### Ihor Paliy



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### Yuriy Pihovsky



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**Research interests:** mathematical modeling, algorithms.

**Sergey Rippa**

Specialist in Organizing Machine Processing of Economic Information (1979), Rostov-on-Don Institute of National Economy, Ph. D. in Economic-Mathematical Methods and Usage of Computer Engineering in National Economy Control (1985), D. Sc. In Economic-Mathematical Modelling (1998), Head of Department of Calculating-Information Technologies Development at Taxing Problems Research Center at Academy of Tax Service of Ukraine (1999), Prof. (1999), Department of Intelligent Information Technologies, Head of KBO Group (2008), PPMITK Group Member (2014).

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**Anatoliy Sachenko**

Specialist in Information Measurement Technology (1968), Ph.D. in Electrical Engineerings (1978), Scientific Advisor of Branch Research Laboratory for Automated Systems and Networks (1984), D. Sc. In Computer Engineering (1988), Prof. of Department for Information Computer Systems and Control (1991), Honored Inventor of Ukraine (1992), Full Member of Ukrainian Academy of Economics Cybernetics (1998) and New- York Academy of Sciences (1998), Member of Specialized Scientific Council in State University “Lviv Polytechnic” (1994), Chairman of Specialized Scientific Council K58.082.02 at TNEU (2002), Editor-in-Chief of International Journal of Computing, Doctoral Dissertations Chapter Editor in “IEEE I&M Magazine”, Head of Department for Information Computer Systems and Control, Dean of Institute for Computer Information Technologies (1994-2005), Scientific Advisor of the ICS (2004), IDAACS 2001-2013 Co-Chairman, Head of IDS Group (2004), Co-Head of ICSD (2014), NNPC Group Member (2004), KBO, WSS Groups Member (2008), IPPR, PPMITK and SACTPC Groups Member (2014).

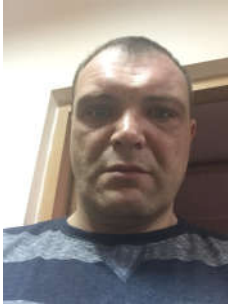
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**Research interests:** Artificial intelligent systems, distributed sensor networks, computational, intelligence, intelligent robotics systems, parallel computation systems, cybersecurity and safety systems, project management, wireless sensor networks.



### Oleg Sachenko



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### Radislav Smid



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### Iryna Turchenko



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**Research interests:** computer systems design, information theory and data decoding, lower computer networks.



### Orest Volynskyy



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**Research interests:** cordless optical connection channels, modular arithmetic based special processors development.

### Oleh Zastavny



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**Research interests:** systems and tools of artificial intelligence, control systems and processes, computer systems and components, information technologies, automation of control processes

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**Research interests:** wireless sensor networks, the system of residual classes.

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**Research interests:** images identification, images analysis algorithms for computer recognition systems.

### 3. RESEARCH PROJECTS

#### Current

#### [Project 1] Erasmus+ALIOT

Grantholder – Prof. Chris Phillips, Newcastle University, Newcastle, UK

National coordinator – Prof. Vyacheslav Kharchenko, National Aerospace University KhAI, Kharkiv

Partner and responsible executor from TNEU – Prof. Anatoliy Sachenko, Ternopil National Economic University

Duration: 2016 – 2018

**Objectives:** development and modernization of curricula for masters, graduate students and staff of industrial companies in the field of development, research and application of a new branch of Internet of Things (IoT) in accordance with the needs of modern society.

#### Main project results:

- An outing meeting in Stockholm for all project participants was held to resolve the project structure and direction of its development.
- The responsibilities are divided and teams organized for the development of courses, modules, lectures, laboratory works.
- Managers and co-managers of working groups have been appointed.
- A liability matrix has been developed according to the development courses and modules.
- The structure of courses and modules has been developed, their fullness has been discussed
- The structure of the work programs is determined
- Curricula developed
- Monitoring by the Erasmus + Commission from Kyiv is underway
- Stages for the completion and development of curricula were determined

#### Team:

- Anatoliy Sachenko;
- Myroslav Komar;
- Volodymyr Kochan;
- Vasyl Yatskiv;
- Vasyl Koval;
- Grygoriy Gladiy;
- Iryna Strubytska;
- Zbyshek Dombrovskiy;
- Oksana Dunets.

## **[Project 2]    Methods of Protection against Computer Attacks based on Neural Networks and Artificial Immune Systems**

Principal investigator of project – Prof. Anatoliy Sachenko;

Co-investigator – Dr Myroslav Komar.

Duration: 2016 – 2017

**Objectives:** The development of a new intelligent information technology based on the theory of artificial neural networks, fuzzy logic and artificial immune systems to increase the reliability of computer attacks detection and classification.

### **Main project results:**

- An analysis of known methods of protection against computer attacks has been carried out.
- A modified method for constructing a detection detector for computer attacks based on neural networks and artificial immune systems was developed.
- A method for reducing the amount of information based on neural networks of high trust with the use of multichannel neural network detectors for constructing a hierarchical classifier of computer attacks has been developed.
- A generalized architecture of intelligent computer-based protection system has been developed.
- Experimental studies of developed methods and algorithms have been carried out, which confirmed the reliability of detection and classification of computer attacks and improvement of the safety level.
- An approach is proposed to increase the security of the system against computer attacks by implementing neural network detectors on the FPGA and introducing a subsystem of decision-making based on the rules of the fuzzy output of Mamdani.

### **Team:**

- Anatoliy Sachenko;
- Myrolav Komar;
- Volodymyr Kochan;
- Vladimir Golovko;
- Vasyl Yatskiv;
- Lesia Dubchak;
- Pavlo Bykovyy;
- Diana Zahorodnia;
- Vitaliy Dorosh;
- Taras Tsavolyk;
- Stepan Ivasiev;
- Grygoriy Sapozhnyk;
- Andriy Karachka.



## Completed

### [Project 3]     **Distributed Sensor Networks with Computing Nodes Reconfiguration**

Principal investigator: Prof. Anatoliy Sachenko

Co-investigator: Dr. Igor Maykiv

**Foreign partner:** Technical University of Moldova, Moldova

**Duration:** 2014 – 2015

**Objectives:** Development of methods for structural synthesis of universal modules with the reconfiguration possibility.

#### **Main project results:**

- On the basis of morphological analysis and synthesis technique of structural synthesis of universal modules comprising functional analysis, the structural synthesis was carried out. The technique combines lexicographical criterion advantages (L-criterion) for the selection of electronic components during functional analysis and absolute criterion of preference (optimality Pareto,  $\pi$ -criterion) during the search of the set of optimal solutions that are considered in the literature as alternative methods to find optimal solutions. The combination of L- and  $\pi$ -criteria to reduce the number of alternatives synthesized during structural synthesis. A formalized discrete optimization solution is versatile for a wide range of problems of optimal structural synthesis of computing systems.
- A new universal module structure with improved functional properties through a separate process execution processing and data sharing capabilities as well as reconfiguration of hardware and software through the use of programmable logic integrated circuits (FPGAs) was designed.
- A 4-level model, that graphically displays, was developed. Between different processes of receiving and transmitting messages to the controller serial interfaces and it is an effective tool in their implementation both at the functional analysis and structural synthesis.
- An experimental model of network application processor with the possibility of reconfiguring the methodology and its testing was created.

#### **Team:**

- Anatoliy Sachenko;
- Igor Maykiv;
- Volodymyr Kochan;
- Nadia Vasylykiv;
- Oleksiy Roshchupkin;
- Diana Zahorodnia;
- Yuriy Ivanyshak;
- Olexandr Osolinsky;
- Taras Lendyuk;
- Oksana Dunets.

**[Project 4]    Wireless Multimedia Sensor Networks on the Base of Modular Arithmetics and Galois Codes for Videomonitoring Systems**

Principal investigator: Prof. Anatoliy Sachenko

Co-investigator: Dr. Vasyl Yatskiv

**Foreign partner:** Pedagogical University Huazhong, China.

**Duration:** 2013 – 2014

**Objectives:** developing of improved methods for training of artificial neural networks on heterogeneous parallel computing systems consisting of grid, providing high efficiency of parallelization and development of grid-based library functions for paralel training of artificial neural networks.

**Main project results:**

- New methods of data coding and transmitting based on modular arithmetic were developed, which enable increased efficiency of wireless multimedia sensor networks (WMSN). Methods were designed for devices with limited hardware resources and autonomous power supply.
- Method of network coding is based on data system of residual classes. The overall bandwidth of wireless sensor networks was investigated as well as the scope of data distribution schemes for different residues.
- Method of coding and redundancy reducing of multimedia data without loss in system of residual classes, which provides 2-3 times reducing of image processing time by division of the image on the modules of residual classes system and parallel encoding of obtained residues was developed. Application of Huffman codes for residues compressing provides lossless compression ratio depending on the class of images: 1,6 – 4 – for photo-realistic images; 4 – 8 – for images with large areas of the same color.
- Method of improving of data reliability based on modified correcting code system of residual classes, which is characterized by a lower computational complexity and allows about 5 times increasing of encoding speed versus R – source code RNS and Reed – Solomon RS (127, 87) was developed.

**Team:**

- Anatoliy Sachenko
- Yaroslav Nykolaychuk
- Natalia Yatskiv
- Vasyl Yatskiv
- Orest Volynskyy
- Petro Humenyy



**[Project 5] Neural network method for improving the accuracy of information-measurement systems of ultraviolet radiation**

Principal investigator and project executor: Prof. Anatoliy Sachenko

Project is executed within interuniversity network Erasmus Mundus together with partners from Alaxender Ioan Kuza University, Iassi, Romania.

Duration: 01.01.2013-31.12.2014

**Goal:** development of new neural network method for improving the accuracy of information measuring systems for measurement of ultraviolet radiation.

**Research purpose:** neural network methods and means of accuracy improving of the information-measuring systems for measurement of ultraviolet radiation.

**Research methods:** structural and functional analysis (error analysis of measuring systems for measuring of UV radiation level and UV sensors); methods of neural networks theory, the method of gradient ascent in the space of weight coefficients and neurons thresholds of (for NN training); simulation methods (for experimental research of developed methods); technique of primary transformer investigation.

**Current project results:**

- The methods of signal processing of multiparameter sensors were proposed. Simulations were conducted in MathLab.
- The software for modeling of the real multiparameter sensors behavior was developed. The software allows to build the model random and systematic errors, and identify the limits of the proposed methods.
- Application for Ukrainian patent and for useful model was made.

**Team:**

- Anatoliy Sachenko
- Oleksiy Roshchupkin
- Volodymyr Kochan

**[Project 6]    Methods and Tools of Wireless Multimedia Sensor Networks Based on Modular Arithmetic.**

Principal investigator – Prof. Yaroslav Nykolaychuk

Duration: 01.01.2013 – 31.12.2014

**Goal:** development of methods and tools for data encoding and transmitting in wireless multimedia sensor networks aimed at improving the reliability of their operation and functionality.

**Abstract:** The project developed new methods and algorithms for data encoding and transmitting using mathematical tools of modular arithmetic, aimed at improving the performance of wireless multimedia sensor networks (WMSM). A Verilog – encoder model for noise-immune data encryption using modified correcting codes is designed.

**Main results:**

- The method of adaptive coding and transmission of multimedia data based on modular arithmetic and multipath routing using adaptive distribution packages and their transfer from multipath routing, providing efficient use of the total bandwidth of wireless sensor networks.
- The method of network data coding based on a system of residual classes (SRC), which would reduce the data volume by 50%, including the retransmission of packets that needs to restore messages. The proposed method of packages selecting of relatively simple modules, where modules are selected a bit different, because remnants of the bit transmitted by the common route is approximately equal to the bit residues on specific routes. The method of network coding improves overall network capacity by about 60%.
- A modified correcting code system of residual classes, characterized by the formation of the simplified procedure of check symbols, providing increased performance encoding is about 5 times as compared with other correcting codes. Using modified correcting codes RNS in wireless sensor networks will improve the reliability and overall network capacity by reducing the number of retransmissions.

**Team:**

- Yaroslav Nykolaychuk
- Anatoliy Sachenko
- Vasyl Yatskiv
- Natalia Yatskiv
- Natalia Vozna
- Petro Humenny
- Orest Volynsky

**[Project 7] Neural Network Methods for Evaluation of Microprocessors in Power Consumption of Instructions**

Principal investigator: Dr. Zbyshek Dombrovsky

**Duration:** 2010 – 2012

**Objectives:** development of hardware-software complex, which will allow to built mathematical models of processor cores power consumption.

**Main tasks:**

- development of appropriate specialized hardware, which allows to evaluate power consumption of instruction in normal microprocessor operation mode;
- development of testing methods (calibration) of created hardware;
- using of artificial neural networks for prediction of power consumption of those instruction modes (addressing, conditions and etc.) which was not completely tested experimentally;
- using of experiment planning methods for the additional decreasing of experiments volume.

**Team:**

- Anatoliy Sachenko
- Volodymyr Kochan
- Andrii Borovyi
- Oleh Havryshok
- Ihor Maykiv
- Orest Volynskyy

**Published results:**

1. A. Borovyi, V. Kochan, Th. Laopoulos, Sachenko A. Improved Sorting Methodology of Data-processing Instructions, International Journal of Computing, vol. 10, issue 1, 2011, pp. 50-55.
2. A. Borovyi, I. Maykiv, R. Kochan, Z. Dombrovskyy, V. Kochan. The Unit of Measurement of Consumers Pulse Energy, Patent of Ukraine 90922 UA, MPK (2009) G05F 5/00 G01K 17/00, no. A2008 06325 ; applied 13. 05. 2008; published 10. 06. 2010, Bulletin no. 11.
3. Time-domain analysis of ARM7TDMI core instructions [Text] / A. Borovyi, V. Kochan, Th. Laopoulos, A. Sachenko // Proceedings of the 6th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS'2011). – Vol. 2. – [S. L. : s. N.], 2011. – September 15-17. – P. 785 –790.

**[Project 8] Parallel Grid-aware Library for Neural Networks Training – PaGaLiNNeT**

Principal investigator: Dr. Volodymyr Turchenko

Scientific advisor: Prof. Anatoliy Sachenko

Partners: Prof. Lucio Grandinetti, Center of Excellence on High Performance Computing, Department of Electronics, Computer Science and Systems, University of Calabria, Italy.

Grant No FP7 MC IIF 221524 – 908524 according to the 7<sup>th</sup> EU Frame Programme, Grant of Marie Curie for researches from the third countries (International Incoming Fellowships – IIF), return phase

**Duration:** 2011 – 2012

**Objectives:**

Development of enhanced training methods for artificial neural networks in heterogeneous parallel computing systems within the Grid; providing the high efficiency of parallelization and development of the Grid-based library for parallel neural networks training.

**Main results:**

- As a part of the project design three levels of grid-based library are created: (i) at the level of a single supercomputer / cluster homogeneous computing nodes, (ii) at the heterogeneous computing nodes within a cluster, (iii) at the grid of computing system with heterogeneous hosts and heterogeneous communication channels between them. A parallel version of the library for the level (i) was installed on parallel machines with ccNuma architecture. A strategy for resource brokering based on Pareto optimization [1] is implemented in C programming language and included in the library. The developed library for the level (i) which includes the routines for parallel training of multilayer perceptron [2] and recurrent neural network was used for the prediction of the stock price for financial markets. The results are published in [6]. A parallel version of the library for the level (ii) was developed and installed on the computing cluster of heterogeneous architectures. The resource brokering sub-routine based on Pareto optimization [1] is called from the code of resource broker separately before executing the main task. The performance analysis of computing nodes of the cluster is based on a modified BSP-based model with improved computational complexity of parallel training algorithm for multilayer perceptron [2]. The results are published in [5];
- Within the application of parallel algorithms for neural network training to speed up the execution of practical tasks, an application task of convolution neural network for the detection of the number of micronucleus in the human lymphocytes is considered. The accurate detection of the number of micronucleus in the human lymphocytes can be used as biological dosimeter in order to relieve the presence and the action of carcinogenic factors and could enhance the correctness of the final medical response. It was proven the application of convolution NN for the development of this task because this NN model provides good detection properties and showed good detection results of the more complicated task of human face detection. The human lymphocyte images were acquired by the image flow cytometer which causes the different types of noise that influence on the acquired image. We have tested the CNN for the images altered by a zoom factor. The CNN provides no false alarms for each zoom factor. The number of false negative detections is much lower in comparison with the pattern matching method, implemented as a LABVIEW routine (IMAQ Match Pattern method) inside the flow cytometer. The detection rate of 87.5% provided by the CNN is much higher than 25% of detection rate by the IMAQ Match Pattern method on the considered example images. The results are published in [3, 4].

**Published results:**

1. Turchenko V.O. Brokering methodology of Grid-resources using Pareto-optimality // Measuring and Computing Technologies Equipment in Technological Processes. – 2011. # 1. – pp. 312-318.
2. Turchenko V.O. Efficiency Comparison of Multilayer Perceptron Group Training on Parallel Computer and Computation Cluster // Transactions KPI. Informatics, management and computing technology: Proceedings – Kyiv: Vek+. – 2011. – No. 54. – pp. 130-138.
3. Paliy I., Lamonaca F., Turchenko V., Grimaldi D., Sachenko A. Detection of Micro Nucleus in Human Lymphocytes Altered by Gaussian Noise Using Convolution Neural Network, Proceedings of 2011 IEEE International Instrumentation and Measurement Technology Conference (I2MTC 2011), 2011, Binjiang, Hangzhou, China, pp. 1097-1102.
4. Lamonaca F., Turchenko V., Grimaldi D. Aspetti innovativi della progettazione hardware e software di citofluorimetro ad immagini, Atti del XXVIII Congresso Nazionale Gruppo Misure Elettriche ed Elettroniche, 2011, Genova, Italy, pp. 289-290.
5. Turchenko V., Puhol T., Sachenko A., Grandinetti L. Cluster-Based Implementation of Resource Brokering Strategy for Parallel Training of Neural Networks, Proceedings of the 6<sup>th</sup> IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems IDAACS2011, Sep 15-17, 2011, Prague, Czech Republic, pp. 212-217.
6. Turchenko V., Beraldi P., De Simone F., Grandinetti L. Short-term Stock Price Prediction Using MLP in Moving Simulation Mode, Proceedings of the 6<sup>th</sup> IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems IDAACS2011, Sep 15-17, 2011, Prague, Czech Republic, pp. 666-671.
7. Turchenko V. Efficiency Comparison of Batch Pattern Training Algorithm of Multilayer Perceptron on Parallel Computer and Computational Cluster, Scientific Journal of National Technical University of Ukraine “Kyiv Polytechnic Institute”, Kyiv, 2011, No 54, pp. 130-138 (in Ukrainian).
8. Sachenko A., Kulakov Yu., Kochan V., Turchenko V., Bykovvy P., Borovyy A. Computer Networks: A Tutorial, Ternopil, Ekonomichna dumka, 2012, 476 p. // Chapter 15. Grid-computations based on network technologies, pp. 416-439 (in Ukrainian).
9. Turchenko V., Grandinetti L., Sachenko A. Parallel Batch Pattern Training of Neural Networks on Computational Clusters, Proceedings of the 2012 International Conference on High Performance Computing & Simulation (HPCS 2012), July 2 – 6, 2012, Madrid, Spain, pp. 202-208.
10. Turchenko V., Golovko V., Sachenko A. Parallel Batch Pattern Training of Recirculation Neural Network, Proceedings of the 9<sup>th</sup> International Conference on Informatics in Control, Automation and Robotics (ICINCO 2012), July 28 – 31, 2012, Rome, Italy, pp. 644-650.
11. Turchenko V., Golovko V., Sachenko A. Parallel Training Algorithm for Radial Basis Function Neural Network, 7<sup>th</sup> International Conference on Neural Networks and Artificial Intelligence (ICNNAI'2012), October 10-12, 2012, Minsk, Belarus, pp. 47-51.

## **[Project 9] Efficient Parallel Batch and Single Pattern Neural Network Training Algorithms Using Open MPI and GPU-computing**

Principal investigator: Dr. Volodymyr Turchenko

Partners: Prof. Jack Dongarra, Innovative Computing Lab, University of Tennessee, Knoxville, TN, USA.

Grant: Fulbright Scholar Program 2012/13

**Duration:** 09/2012 – 06/2013

### **Objectives:**

1. test enhanced batch pattern parallel algorithm for NN training by changing the parameters of the internal algorithms of MPI collective functions on different parallel architectures;
2. develop GPU-based versions of the parallel batch and single pattern algorithms for NN training;
3. test experimentally the efficiency of improvement of the GPU-based version of the algorithms in comparison with their Open MPI implementations.

### **Main results:**

1. The parallelization efficiency of the neural network training algorithm on the example of the recirculation neural network model has been researched. The Open MPI, OpenMP and CUDA-based versions of the parallel batch pattern training algorithm for recirculation neural network were implemented using C language. The parallelization efficiency of the developed algorithms has been researched on many-core parallel machine with 48 AMD Opteron 6180 SE processors, on computational cluster with 48 Intel Xeon E5520 processors, on 60-core Intel GPU Xeon Phi Coprocessor 5110P card and Nvidia Tesla C2050 GPU card using its 64 cores only (total is 1024). The experimental research of the developed algorithm using Open MPI technology showed the parallelization efficiency of 75% on 48 processors of the many-core system, 60% on 48 processors of the cluster, 70% on 60 processors of the Intel GPU Xeon Phi card. The experimental research of the developed algorithm using OpenMP technology showed lower figures, 40% of parallelization efficiency on 48 processors of the many-core system. The experimental research of the developed algorithm using CUDA technology showed 14-times speedup on one Nvidia Tesla GPU card. The developed algorithms are included to the developing library PaGaLiNNeT capable to speed-up scientific computations based on neural networks on general-purpose and hybrid (CPU+GPU) high performance computing systems.
2. The research project entitled “An Adaptive End-to-End Approach for Terabit Data Movement Optimization” was investigated. The goal of this project is to develop a novel architecture and related approaches to the end-to-end optimization of terabyte size data movement on next-generation networking and storage system technologies. The moving scientific data sets at terabits per second transfer rates over wide-area networks between geographically dispersed data centers were modeled. The set of events which describe a drop of the bandwidth in the communication network was obtained. A predictive model based on artificial neural networks to predict the duration of the event and the value of the maximum bandwidth drop was developed. I have used the developed library for parallel neural network training PaGaLiNNeT (developed by me within my previous project) and the model of a multi-layer perceptron. The experimental researches showed that the modeled events have stochastic nature and therefore it is necessary to tune the neural network model to provide desirable prediction results. This scientific collaboration with the host institution will be continued in the future.

### **Published results:**

4. Turchenko V., Bosilca G., Bouteiller A. and Dongarra J. “Efficient Parallelization of Batch Pattern Training Algorithm on Many-core and Cluster Architectures”, Proceedings of the 7<sup>th</sup> IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems, Sep 12-14, 2013, Berlin, Germany, pp. 692-698.

## **[Project 10] Human Biometric Identification in Video Surveillance Systems**

**Foreign partner:** Technical University of Sofia, Bulgaria

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Bulgaria: Dr. Ognian Bumbarov

**Duration:** 2009 – 2010

**Objectives:** design of intelligent biometrical sub-system for detection and recognition of human faces in the video surveillance systems for monitoring of public places, database support of staff or factory's visitors etc.

**Main tasks:**

- development of methods and algorithms for movement detection on the captured videoframes;
- development of methods and algorithms of videoframes preliminary processing by skin color;
- improvement of methods and algorithms of detection and tracing of human face;
- development of methods and algorithms of face recognition.

**Team:**

- Anatoliy Sachenko
- Ihor Paliy
- Yuriy Kurylyak
- Taras Leshko

**Published results:**

1. Ihor Paliy, Anatoliy Sachenko, Yuriy Kurylyak, Ognian Boumbarov, Strahil Sokolov. Combined Approach to Face Detection for Biometric Identification Systems // Proceedings of 5<sup>th</sup> IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications, 21-23 September 2009, Rende (Cosenza), Italy, pp. 425-429.
2. Ognian Boumbarov, Strahil Sokolov, Plamen Petrov, Anatoliy Sachenko, Yuriy Kurylyak. Kernel-based Face Detection and Tracking with Adaptive Control by Kalman Filtering // Proceedings of 5<sup>th</sup> IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications, 21-23 September 2009, Rende (Cosenza), Italy, pp.434-439.
3. Y. Kurylyak, I. Paliy, A. Sachenko, A. Chohra, K. Madani. Face Detection on Grayscale and Color Images using Combined Cascade of Classifiers // International Journal of Computing. – Ternopil (Ukraine). – 2009. – Vol. 8, Issue 1. – pp. 61-71.
4. Y. Kurylyak A Real-Time Motion Detection for Video Surveillance System // Proceedings of 5<sup>th</sup> IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS2009). – Rende (Cosenza), Italy, 2009. – pp.386-389.
5. Paliy I.O. Methods of Face Detection in Systems of Computer Recognizing on the Base of Combined Cascade of Neural Network Classifiers. – PhD Thesis, Ternopil National Economic University. – Ternopil. – 2009.

## **[Project 11] Development of Intelligent Video Surveillance Systems**

Principal investigator: Dr. Volodymyr Kochan

Project executed together with V.M. Glushkov Institute for Cybernetics, Prof. Vitaliy Boyun.

**Duration:** 2009 – 2010

**Objectives:** development of highspeed and relevant video surveillance system on the base of intelligent videocamera, which allows to decrease information streams between camera and workstation central processor, as well as to read and process large images with high frame rate.

**Main tasks:**

- increasing of efficiency for communication channels between intelligent videocamera and personal computer;
- development of methods and algorithms of videoframes preliminary processing by skin color and movement;
- development of methods and algorithms of human face recognition on the base of combined cascades classifiers, classifiers training paralleling, and improvement of neural network training method in frame of combined cascade;
- development of algorithms of faces tracing;
- development of software and highlevel programme interface for interaction with intelligent camera; coding of developed algorithms in processor computer code for digital processing of intelligent videocamera images.

**Team:**

- Anatoliy Sachenko
- Ihor Paliy
- Yuriy Kurylyak

**Published results:**

1. Kurylyak Y.O., Sachenko A.O. Method of background image renewal for movement segmentation // Proceedings of 10-th International Conference “Modern Information and Electronic Technologies” (SIET’2009). – Odessa (Ukraine), 2009. – Vol. 1. – pp. 44.
2. Paliy I.O. Training of neural network classifiers with combined cascade for face detection // Proceedings of 10-th International Conference “Modern Information and Electronic Technologies” (SIET’2009). – Odessa (Ukraine), 2009. – Vol. 1. – pp. 42.
3. Paliy I. Face detection on grayscale and color images using combined cascade of classifiers // International Journal of Computing. – 2009. – Vol. 8. – Issue 1. – pp.61-71.



## **[Project 12] Development of 3D Localization Methods for Navigation of Mobile robot**

**Foreign partner:** Kaunas Technical University, Lithuania

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Lithuania: Prof. Rimvydas Simutis

**Duration:** 2009 – 2010

**Objectives:** the main aim of project is development of the unified structure for autonomous mobile robot control and providing of 3D localization and navigation in non-structured environment with dynamical objects by using of new methods and means, which allow to get the possibility to give for mobile robots improved navigation characteristics and get new application of known methods.

### **Main tasks:**

- 1) Analysis of known methods for design of control structure system for mobile robots (MR) and development of unified structure for autonomous MR control.
- 2) Development of Dataflow Diagram (DFD) for robot control system and analysis of time characteristics of DFD main modules. Setting of requirements for main MR modules.
- 3) Development of improved methods and means of MR control system:
  - a) Development of new method of acquisition and processing of sensor data;
  - b) Development of MR 3D localization methods.
- 4) Development of hardware and software for autonomous MR.
- 5) MR composing according to the requirements set in point 2, taking into account applied needs and MR hardware/software means developed in points 3-4.
- 6) Verification and testing of MR prototype functioning.

### **Team:**

- Anatoliy Sachenko
- Vasyl Koval
- Oleh Adamiv
- Viktor Kapura

### **Published results:**

1. Roth H., Sachenko A., Koval V., Chanim J., Adamiv O., Kapura V. The 3D Mapping Preparation using 2D/3D Cameras for Mobile Robot Control // Artificial Intelligence journal, Donetsk, Ukraine. – 2008. – Vol. 4. – pp. 512-521.
2. Adamiv O., Sachenko A., Kapura V. Gradient Method for Autonomous Robot Navigation // Proceedings of the Ninth International Conference “Modern Problems of Radio Engineering, Telecommunications and Computer Science” (TCSET’2008). – Lviv-Slavsko (Ukraine), 2008. – pp. 640-642.
3. O. Adamiv, V. Koval, V. Dorosh, G. Sapozhnyk, V. Kapura Mobile Robot Navigation Method for Environment with Dynamical Obstacles // Proceedings of the 5-th IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS’2009). – Rende (Cosenza), Italy, 2009. – pp.515-518.
4. O. Adamiv, A. Lipnickas, A. Knyš. A stereovision system for autonomous robot navigation in 3-D // Proceedings of 10-th International Conference “Modern Information and Electronic Technologies” (SIET’2009). – Odessa (Ukraine), 2009. – Vol. 1. – pp. 28.

## **[Project 13] Development of Stereovision Methods and Devices for Autonomous Navigation of Mobile Robots**

**Foreign partner:** University of Sigen, Germany

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Germany: Prof. Hubert Roth

**Duration:** 2008 – 2009

**Objectives:** Development of stereovision methods for autonomous navigation of mobile robots.

### **Main tasks:**

- Development of stereo camera preliminary data processing methods for future integration with a mobile robot;
- Methods of generation of stereo images;
- Image filtering and analysis methods.
- Development of stereo image fusion and mobile robot environment 3D map generation methods:
- Image description methods;
- Stereo image corresponding points search and 3D map of environment generation methods.
- Development and implementation of sensor data fusion algorithms.
- Verification and testing of the developed methods using a mobile robot.

### **Team:**

- Anatoliy Sachenko
- Vasyl Koval
- Oleh Adamiv
- Viktor Kapura

### **Published results:**

1. Roth H., Sachenko A., Koval V., Chanim J., Adamiv O., Kapura V. The 3D Mapping Preparation using 2D/3D Cameras for Mobile Robot Control // Artificial Intelligence journal, Donetsk, Ukraine. – 2008. – Vol. 4. – pp. 512-521.
2. Adamiv O., Sachenko A., Kapura V. Gradient Method for Autonomous Robot Navigation // Proceedings of the Ninth International Conference “Modern Problems of Radio Engineering, Telecommunications and Computer Science” (TCSET’2008). – Lviv-Slavsko (Ukraine), 2008. – pp. 640-642.
3. H. Roth, A. Sachenko, V. Koval, O. Adamiv, V. Kapura Evaluation of Camera Calibration Methods for Computer Vision System of Autonomous Mobile Robot // Proceedings of 10-th International Conference “Modern Information and Electronic Technologies” (SIET’2009). – Odessa (Ukraine), 2009. – Vol. 1. – pp. 29.

## **[Project 14] Development of Design and Optimization Methods of Early Intrusion Detection Systems**

**Foreign partner:** Institute of Technology, Gebze, Turkey

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Turkey: Dr Serkan Aksoy

**Duration:** 2008 – 2009

**Objectives:** development of a Computer Aided Design (CAD) system for development of perimeter security systems optimized for quality-price, reliability-price criteria and further testing of the CAD system on real security systems.

### **Main tasks:**

- Analysis of existing solutions and creation of a set of criteria and limitations for functional and cost analysis of security systems. Development of improved components and database for security systems.
- Development of methods and algorithms for structural synthesis and multi-criteria optimization of security systems. Development of a CAD system for security systems design based on the developed methods and algorithms.
- Development of a pilot security system with the use of the developed CAD. Testing of the pilot system.
- Carrying out a comparative analysis of the developed pilot system against existing systems. Introduction of necessary changes to the CAD system based on the conducted analysis.
- Carrying out the pilot security system testing to measure risks of undetected intrusions and risks of false alarms. Introduction of necessary changes to the pilot security system based on the conducted tests.
- Testing of the CAD system.

### **Team:**

- Anatoliy Sachenko
- Volodymyr Kochan
- Volodymyr Turchenko
- Pavlo Bykovyy

### **Published results:**

1. Bykovyy P. Design optimization of distributed technical security systems using a genetic algorithm // Visnyk of Vinnitsa Polytechnic Institute. – 2008, Issue #6, pp 28-34.
2. Bykovyy P., Pigovsky Yu., Kochan V., Sachenko A., Markowsky G., Aksoy S. Genetic Algorithm Implementation for Distributed Security Systems Optimization // Proceedings of the IEEE International Conference on Computational Intelligence for Measurement Systems and Applications (CIMSAS 2008), 14-16 July 2008. – Istanbul, Turkey. – pp. 120-124.
3. Bykovyy P.Ye., Kochan V.V. Cryptographically secure protocol for networks of security sensors // Proceedings of 10-th International Conference “Modern Information and Electronic Technologies” (SIET’2009). – Odessa (Ukraine), 2009. – Vol. 1. – pp. 189.
4. Bykovyy P.Ye. Distributed sensor network for security systems // International journal of Computing. – Ternopil (Ukraine). – 2009. Vol. 8, Issue 2. – pp. 157-164.
5. P. Bykovyy, V. Kochan, Y. Kinakh, A. Sachenko, O. Roshchupkin, S. Aksoy, G. Markowsky. Data Communication Crypto Protocol for Security Systems Sensor Networks // Proceedings of 5<sup>th</sup> IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS’2009). – Rende (Cosenza), Italy, 2009. – pp. 375-379.
6. P. Bykovyy, Y. Pigovsky, A. Sachenko, A. Banasik. Fuzzy Inference System for Vulnerability Risk Estimation of Perimeter Security // Proceedings of 5<sup>th</sup> IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS’2009). – Rende (Cosenza), Italy, 2009. – pp. 380-384.

## **[Project 15] Computer Telecommunication System Based on Noise Signals**

Principal investigator: Prof. Yaroslav Nikolaychuk

Project is executed together with JSC Ternopil Radio Plant 'Orion', chief designer Volodymyr Kordyak.

**Duration:** 2007 – 2009

**Objectives:** to increase noise-immunity and active range of radio stations, produced by the Orion plant; introduction of a mode of code based on division of transmission channels; development of computerized system of data acquisition based on autonomous sensors.

**Project tasks:**

- Design of a noise-signal based radio station with low range of operation for construction companies;
- Analysis of possible application areas for 2D noise signals;
- Analysis of possible application areas and prospective customers of computer systems based on autonomous sensors.
- Preparation of project solutions related to radio system serving and construction areas.

**Team:**

- Yaroslav Nykolaychuk
- Oleh Zastavnyy
- Nazar Krutskevych

**Published results:**

1. Nykolaychuk Y., Krutskevych N., Zastavniy O. Multibases Processors of Two-dimensional Correlation for Noise Immunity of Transfer Information // Proc. Of the IEEE International Workshop on Intelligent Data Acquisition and Advancing Computing Systems (IDAACS'2007). – 2007. – Dortmund (Germany). – pp. 315-317.

**[Project 16] Dynamically Reprogrammable Network Capable Application Processor with Internet Capability**

**Foreign partner:** Esensors Inc., USA

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from USA: Dr Darold Wobschall, PhD

**Grant** #UE2-2534-TE-07.

**Duration:** 2007 – 2009

**Objectives:** to enter the US smart sensors market with the Network Capable Application Processor (NCAP) developed within the project CRDF #UE2-2534-TE-03 – device oriented on software data processing in smart distributed measurement and control systems which uses adaptive software reconfiguration for intelligent functions execution (self-adapting and self-training). The developed NCAP will have the following features:

- ability to work in distributed measurement control systems utilizing the Internet;
- online remote reprogramming of user application software;
- support of a wide set of network interfaces;

**Main tasks:**

- the minimal set of the design documentation sufficient for production of a prototype NCAP has been developed;
- two prototype NCAP devices have been developed and undergo testing;
- testing of certain NCAP modules is performed, the NCAP software is being developed as well.

**Team:**

- Anatoliy Sachenko
- Volodymyr Kochan
- Roman Kochan
- Andrew Stepanenko
- Ihor Maykiv
- Iryna Turchenko
- Natalia Vozna

**Published results:**

1. Maykiv I., Stepanenko A., Wobschall D., Kochan R., Kochan V., Sachenko A., Vasylyuk N. Remote Reprogrammable NCAPs: Issues and Approaches // Proc. Of the IEEE International Workshop on Intelligent Data Acquisition and Advancing Computing Systems (IDAACS'2007). – 2007. – Dortmund (Germany). – pp. 109-113.
2. Maykiv I.M., Kochan V.V., Bilousov I.A. Project analysis of methods of serial interfaces controllers realization // Transactions of Ternopil State technical University. – 2009. – No. 1. – pp. 110-115.
3. Maykiv I.M. Investigation of I2C interface controllers realizations method on the programmed logical matrix // Proceedings of 5-th International Youth Conference “Modern Problems of Radiotechnics and Telecommunication”. – Sevastopol (Ukraine), 2009. – pp. 284.
4. Maykiv I.M., Kochan V.V. Software-hardware controller of consecutive interfaces in network nodes of data acquisition // Proceedings of 10-th International Conference “Modern Information and Electronic Technologies” (SIET'2009). – Odessa (Ukraine), 2009. – Vol. 1. – pp. 138.

5. Maykiv I.M. Methodology of structural synthesis of network capable application processors // Proceedings of National Conference in Ternopil Ivan Pul'uj State Technical University. – Ternopil (Ukraine), 2009. – pp. 176.
6. Maykiv I.M. Software-hardware method of sequential interfaces controllers realization // Proceedings of 11-th International Conference “System Analysis and Information Technologies” (SAIT-2009). – Kyiv (Ukraine), 2009. – pp. 437.
7. Maykiv I.M. Network capable application processor for distributed measuring-control systems // Transaction “Problems of Informatization and Control”, Kyiv (Ukraine). – 2009. – No. 2 (28). – pp. 187-191.
8. Maykiv I.M. Universal control of serial interfaces // Transactions of Chernivtsi University. Series: Physics. Electronics, Chernivtsi (Ukraine). – 2009. – No. 3 (186). – pp. 130-135.
9. Maykiv I.M., Stepanenko A.V., Wobschall D. A method for structural synthesis of network capable application processors. // International Journal of Computing – Ternopil (Ukraine). – 2009. – Vol. 8. – Issue 2. – pp.126-138.
10. I. Maykiv, D. Wobschall, A. Stepanenko, R. Kochan, A. Sachenko, V. Kochan. Multi-port Serial NCAP using IEEE1451 Smart Transducer Standard // Proceedings of IEEE Sensor Application Symposium (SAS-2009). – New Orleans, LA, (USA), 2009. – pp. 293-297.
11. I. Maykiv, A. Stepanenko, D. Wobschall, R. Kochan, V. Kochan, A. Sachenko. Universal Controller of Serial Interfaces // Proceedings of the 5-th IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS'2009). – Rende (Cosenza), Italy, 2009. – pp. 121-125.
12. Iryna Turchenko. Methods for Improving Efficiency of Data Processing Obtained from Multi-parameter Sensors in Distributed Computer Systems. Ph. D. Thesis on speciality 05.13.05 – Computer Systems and Components.- Ternopil National Economic University.- Ternopil.- 2008.- 200 p. (in Ukrainian)
13. Natalia Vozna. Forming and Organizing of Structured Data Movement in Multilevel Distributed Computer Systems. Ph. D. Thesis on speciality 05.13.05 – Computer Systems and Components.- Ternopil National Economic University. – Ternopil. – 2009. (in Ukrainian)

## **[Project 17] Ternopil Education Communication Center**

**Foreign partner:** University of Maine, USA

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from USA: Prof. George Markowsky

Project is granted by NATO Program of Security through Science Network Infrastructure Grant, and performed together with the University of Maine, USA.

**Duration:** 2006 – 2009

**Objectives:** Make common communication center for universities of Ternopil, agree and integrate educational networks of Ternopil Universities, introduce high-speed network for educational and research exchange.

**Main tasks:**

- Connect educative institutions of Ternopil to Internet through Ternopil Education Communication Center;
- Make basis for cooperation of all universities of Ternopil;
- Make basis for educative and research cooperation between universities of Ternopil and University of Maine and other researchers;
- Provide high-speed access to UARNET and GEANT networks;
- Provide abilities for holding video-conferences between Ternopil and other cities;
- Develop prototype of system, that can be implemented in other areas of Ukraine;
- Implement 16 processor cluster for GRID-processing that will be used in universities – project members;
- Create on-line library;
- Create Wi-Fi service for universities of Ternopil.

**Team:**

- Anatoliy Sachenko
- Serhiy Voznyak
- Ihor Romanets'
- Roman Romanyak

**Published results:**

1. Sachenko A. Ternopil Education Communication Center // Innovation and Communication Security (ICS) Panel Meeting. – 2006. – Kyiv (Ukraine).
2. G. Markowsky, A. Sachenko, S. Voznyak, V. Spilchuk, R. Romanyak, V. Turchenko, I. Romanets. The Ternopil Educational Communication Center – A NATO Project to Integrate Regional Information Technology Resources. Computing, 2008, Vol. 7, Issue 1.
3. Palagin O., Alishov N., Markowsky G., Sachenko A., Turchenko V. Security Tools for GRID-systems // Proceedings of the 2007 International Conference on Security and Management. - 2007. Las Vegas, NV (USA).

## **[Project 18] Instruction Parameters Analysis for Power Modeling of Embedded Microprocessors**

**Foreign partner:** Aristotle University of Thessaloniki, Thessaloniki, Greece

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Greece: Prof. Theodore Laopoulos

Project is granted by Ministry of Education and Science of Ukraine and Greek Government (agreement #M/85-2006), and performed together with the Aristotle University of Thessaloniki, Greece.

**Duration:** 2006 – 03.2008

Principal investigator from Ukraine: Main aim of the project is determining power consumption of each parameter of instruction: determining number and value of registers, immediate values, values and addresses of operands, address of command call, pipeline panel and substitution, examination and analysis of correlation of instructions' parameters in power consumption of instructions; examination and analysis of each parameter in power consumption of instructions; developing of accurate power models for execution level of ARM7TDMI core's instructions.

### **Main tasks:**

Additional investigating of instructions' parameters power consumptions and developing of measurement methodology using existing measurement setup; developing new approach in measurement methodology that can determine processor's configuration. Due to this approach it is possible to measure and analyze correlation of instructions' power consumptions according to instruction's parameters; determine power consumptions; analyze and process power consumption values; develop power models for instructions; experimentally prove achieved theoretical results.

### **Team:**

- Anatoliy Sachenko
- Volodymyr Kochan
- Volodymyr Turchenko
- Andrii Borovyi

### **Published results:**

1. Borovyi A., Kostandakos V., Kochan V., Sachenko A., Yaskilka V. Analysis of CPU's Instructions Energy Consumption Device Circuits // Proceedings of Fourth IEEE International Workshop on Intelligent Data Acquisition and Advancing Computing Systems (IDAACS'2007). – 2007. – Dortmund (Germany). – pp. 42-46.
2. Borovyi A., Kochan V. Analysis of Microcontroller Instructions Power Consumption Measurement Circuits. Visnyk of Khmelnytsky National University. – 2007. – Vol. 1. – #2. – pp. 105-109.
3. Borovyi A.M., Kochan V.V., Turchenko V.O. Stand for investigation of current moment value consumed by microprocessor // Transaction of Ternopil State Technical University. – 2009. – No. 1. – pp. 131-137.
4. Borovyi A.M. Analysis of power consumption by ARM7TDMI processor kernel // Proceedings of National Conference in Ternopil Ivan Pul'uj State Technical University. – Ternopil (Ukraine), 2009. – pp. 101.
5. A. Borovyi, V. Kochan, Z. Dombrovskyy, V. Turchenko, A. Sachenko Device for Measuring Instant Current Values of CPU's Energy Consumption // Proceedings of the 5-th IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS'2009). – Rende (Cosenza), Italy, 2009. – pp.126-130.



## **[Project 19] Financial Analytics Method with Applications of Knowledge Bases**

Principal multisensory from ICS: Prof. Anatoliy Sachenko

This is a joint project between National University of the State Taxation Department of Ukraine, Irpin, Ukraine and Research Institute for Intelligent Computer Systems, Ternopil, Ukraine.

**Duration:** 09.2008 – 11.2008

**Objectives:** evaluation of the present state and selection of priority directions for implementation of intelligent information technologies of financial analytics and knowledge bases in governmental resource management processes.

**Main tasks:**

- evaluation of the present state and investigation of theoretical research in information technologies for financial analytics with application of knowledge bases in management of governmental institutions;
- investigation of possible intelligent computer technologies application in the domain of financial analytics ontologies in governmental management;
- evaluation of the state and perspectives of ontology intelligent tools using in methods of financial analytics;
- development of technologies in area of intellectulazation of information-analytical processes and creation of financial analytics knowledge bases in governmental management;
- the conducted activity enabled to provide functional completeness of solutions to the defined research tasks and creation of documentation as per the Requirements Specification;
- research and creation of the output documentation were performed on the basis of a systematic approach, conceptual completeness of results and consistency;
- the conducted work follows the principal of minimal implementation costs for the proposed solutions.

**Team:**

- Anatoliy Sachenko
- Taras Lendyuk

**Published results:**

1. Palagin A., Rippa S. and Sachenko A. Conceptualization and problems of ontologies // Journal of Artificial Intelligence, 2008 Vol. 3, pp 374-379.

## **[Project 20] Development of Effective GRID-technologies for Ecology Monitoring Using Satellite Data**

Principal investigator from ICS: Prof. Anatoliy Sachenko

Principal investigator NSAU: Prof. Nataliya Kussul

Collaborative project of Scientific-Technologic Centre in Ukraine and National Sciences Academy of Ukraine has been performed together with the Space Research Institute of National Sciences Academy of Ukraine and National Aerospace Agency of Ukraine, Kyiv.

**Grant** STCU #3872

**Duration:** 12.2005 – 12.2007

**Objectives:** Development of an effective distributed computations techniques that provide simple and transparent solutions to the computationally-complicated tasks in different areas, especially associated with space data processing.

### **Main tasks:**

- developing methodology for constructing temporal interpolation earth atmosphere photographs;
- developing methodology for predicting solar activity and corresponding algorithms for holding parallel computations;
- developing parallel implementation modeling methods algorithms for dynamics of main processes in multi-component ground environments with the corresponding cluster.
- developing GRID-service for monitoring and control tasks' solutions process in system;
- developing GRID-service for balancing system loading;
- developing GRID-service for visualization of computational results;
- developing GRID-service for granting users' access to system;
- developing service for system security purposes;
- uniting some clusters or computational networks into one complex for working under solution for the same task.

### **Team:**

- Anatoliy Sachenko
- Volodymyr Turchenko
- Viktor Demchuk

### **Published results:**

1. Turchenko V., Demchuk V., Sachenko A. Interplanetary Shock Arrival Time Prediction Using Multi-Layer Perceptron // Proceedings of the 4<sup>th</sup> IEEE Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications IDAACS'2007. – 2007. – Dortmund (Germany). – pp. 185-190.
2. Turchenko V. An Approach to IP Shock Arrival Time Prediction Using Approximating Neural Network // International Journal of Information Technology and Intelligent Computing. – 2007. – No. 4. – Vol. 1.
3. V. Turchenko, V. Demchuk, A. Sachenko, Y. Veremeyenko. An Approach to Interplanetary Shocks Prediction Using Single ACE/EPAM Channel Data // Proceedings of the Fourth International Conference on Neural Networks and Artificial Intelligence ICNNAI'2006. – 2006. – Brest (Belarus). – pp. 140-144.

**[Project 21] Development of Web Ontologies as Data Exchange and Decision Support Tools to Facilitate Economic Cooperation between Ukraine and USA**

**Foreign partner:** New Jersey Institute of Technology, USA

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from USA: Dr. Yefim Kats

Project had been performed according to Research program of the US National Science Foundation.

**Grant #** NSF-04-12

**Duration:** 2004 – 2007

**Objectives:** develop Web-ontologies as data exchange and decision making instrument for promotion of economic partnership between Ukraine and USA.

**Main tasks:**

- Standard ontology dictionary used in economical interchange, including dictionaries for typical e-commerce models, identification.
- Identifying objects as classes or relations with adequate limiting interpretation.
- Identifying specific ontology relations for (intelligence) agents based on automated processing.
- Developing Windows object library compatible apparatus for measuring possible ontology errors.

**Team:**

- Anatoliy Sachenko
- Roman Pasichnyk
- Yuriy Pihovsky
- Andrii Melnyk

**Published results:**

1. Pasichnyk R., Sachenko A. Semantic WEB-Search Developing by Problem-Oriented Ontology Means // Proceedings of the IEEE International Workshop IDAACS'2007. – 2007. – Dortmund (Germany). – pp. 445-448.
2. Hrusha V. Specifics of Ontologies Design and Application in proceedings of the 11<sup>th</sup> scientific conference of Ternopil State Technical University. – 2007. – Ternopil: TSTU. – pp. 78.
3. R. Pasichnyk, A. Sachenko, A. Melnyk “Formalization of ontology creation process using base classes” in proceedings of the 13<sup>th</sup> national conference “Modern problems of applied mathematics and informatics”, Lviv, October 3-5 2006, P.162-163.
4. Master thesis by Andrii Melnyk was defended in 2006.
5. Course thesis by Andrii Melnyk was defended in 2005.
6. Master thesis by Vitaliy Kharchuk was defended in 2004.

## **[Project 22] Dynamically Reprogrammable Network Capable Application Processor with Internet Capability**

Principal investigator: Prof. Anatoliy Sachenko

The project is funded under the Ministry of Education and Science of Ukraine

**Grant** #0107U005985.

**Duration:** 08.2007 – 12.2007

**Objectives:** to enter the US smart sensors market with the Network Capable Application Processor (NCAP) developed within the project CRDF #UE2-2534-TE-03 – device oriented on software data processing in smart distributed measurement and control systems which uses adaptive software reconfiguration for intelligent functions execution (self-adapting and self-training). The developed NCAP will have the following features:

- ability to work in distributed measurement control systems utilizing the Internet;
- online remote reprogramming of user application software;
- support of a wide set of network interfaces.

### **Main tasks:**

- a minimal set of the design documentation sufficient for production of a prototype NCAP had been developed, which allowed to choose its elemental basis and embodiment;
- there was developed a package of structural documentation;
- there was developed software for interface microcontroller, which provides software support of hardware drivers for supported interfaces – data link layer, IP protocol (Internet Protocol) – network layer, TCP protocol (Transport Control Protocol) – transport layer, HTTP protocol (Hypertext Transfer Protocol) – session layer, dynamical HTML-page, where the data is presented and gets on all supported interfaces and can be read – presentation layer;
- two prototype NCAP devices had been developed and underwent testing that allows to debug application software of its microcontrollers and their interaction between each other, as well as with the server and measuring-control modules in real time.

### **Team:**

- Anatoliy Sachenko
- Volodymyr Kochan
- Roman Kochan
- Andrew Stepanenko
- Ihor Maykiv
- Pavlo Bykovyy

### **Published results:**

1. Maykiv I., Stepanenko A., Wobschall D., Kochan R., Kochan V., Sachenko A., Vasylyuk N. Remote Reprogrammable NCAPs: Issues and Approaches // Proc. Of the IEEE International Workshop on Intelligent Data Acquisition and Advancing Computing Systems (IDAACS'2007). – 2007. – Dortmund (Germany). – pp. 109-113.
2. Stepanenko A., Maykiv I., Wobschall D., Kochan R., Kochan V., Sachenko A. Multi-port Serial NCAP Using IEEE1451 Smart Transducer Standard // Proceedings of the IEEE Sensor Application Symposium SAS'2009, 17-19 February, 2009, New Orleans, USA, pp. 293-297.

**[Project 23] Investigation of the Intelligent Properties of Re-Configurable Network Capable Application Processor in Adaptive Distributed Instrumentation and Control Systems**

**Foreign partner:** Sensors Development and Applications Group, National Institute Standards and Technologies, USA

Principal investigator from Ukraine: Dr. Volodymyr Kochan

Principal investigator from USA: Kang Lee

This project has been performed within US Civilian Research and Development Foundation (Cooperative Grant Program).

**Grant #** CRDF.CGP. UE2-2534-TE-03

**Duration:** 2005 – 2006

**Objectives:** Development of the IEEE-1451 standard compatible Network Capable Application Processor (NCAP) with dynamic software and hardware reconfiguration and investigation of its self-adaptive and intelligent properties in information-measurement systems.

**Main tasks:**

- Investigation of the NCAP's intelligent properties to be used with smart sensors, deployed in distributed information measurement systems with different architectures and functional requirements.
- Extension of the NCAP's functional features compatible with the IEEE1451 standard to support dynamic online reprogramming of software and a set of network interfaces.
- Development and investigation of the prototype NCAP and its programming methodology.

**Team:**

- Volodymyr Kochan
- Anatoliy Sachenko
- Roman Kochan
- Oleh Adamiv
- Iryna Turchenko
- Andriy Stepanenko

**Published results:**

1. Kochan V., Lee K., Kochan R., Sachenko A. Approach to Improving Network Capable Application Processor Based on IEEE 1451 Standard // Computer Standards & Interfaces. – 2005. – Vol. 28. – Issue2. – pp. 141-149.
2. Stepanenko A., Lee K., Kochan R., Kochan V., Sachenko A. Development of a Minimal IEEE1451.1 Model for 8051-Compatible Microcontrollers // Proc. Of the 2006 IEEE Sensors Applications Symposium. – 2006. – Houston, Texas (USA). – pp. 88-93.
3. Kochan R., Kochan V., Sachenko A., Maykiv I., Turchenko V., Markowsky G. Interface and Reprogramming Controller for Dynamically Reprogrammable Network Capable Application Processor (NCAP). // Proc. Of 3-th IEEE International workshop on Intelligent Data Acquisition and Advancing Computing Systems (IDAACS'2005). – 2005. – Sofia (Bulgaria). – pp. 639-642.
4. Kochan R., Kochan V., Sachenko A., Maykiv I. NCAP Based on FPGA // Proc. Of the IEEE Instrumentation and Measurement Technology Conference IMTC/2005. – 2005. – Ottawa, Ontario (Canada). – pp. 813-817.
5. Kochan R., Lee K., Kochan V., Sachenko A. Development of a Dynamically Reprogrammable NCAP // Proc. Of the IEEE Instrumentation and Measurement Technology Conference IMTC/2004. – 2004. – Como (Italy). – pp. 1188-1193.
6. Roman Kochan. Improvement of components of precision distributed information control systems: Ph.D. Theses on speciality 05.11.16 / Ternopil Academy of National economy. – Ternopil, 2005. – 193 p.

## **[Project 24] Methods and Algorithms for Face Detection and Recognition for Real Time Video Surveillance Systems**

**Foreign partner:** Belarus State University of Informatics and Radio Electronics, Belarus

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Belarus: Prof. Rauf Sadykov

This project has been performed in frames of State fund of fundamental research programs, Ministry of Education and Science of Ukraine order #356 dated to 14.06.05.

**Duration:** 2005 – 2006

**Objectives:** Development of algorithms for preliminary processing of images based on segmentations and development of algorithms and software for face detection in static vision conditions.

**Main tasks:**

- Development of effective algorithms and software for capturing face images in video stream;
- Development of approximate 3-dimension face models;
- Development of algorithms for selection of informative features and classification of images according to modified syntactical discriminator functions;
- conducting experimental diagnosis and configuration of proposed algorithms for achieving maximum results of program model;
- development of a software system which implements the designed recognition schema.

**Team:**

- Anatoliy Sachenko
- Vasyl Koval
- Ihor Paliy
- Yuriy Kurylyak
- Victor Kapura

**Published results:**

1. Y. Kurylyak. System of Face Detection at Static Images. – 2006. – 83p.
2. Y. Kurylyak, Ihor Paliy, Vasyl Koval, Anatoliy Sachenko. Improved Method of ace Detection Using Color Images // Proceedings of the International Conference “Modern Problems of Radio Engineering, Telecommunications and Computer Science” TCSET’2006. – Feb’28 – Mar’4, 2006. – Lviv-Slavske, Ukraine. – pp. 186-188.
3. A. Sachenko, V. Koval, I. Paliy, Y. Kurylyak. Approach to Face Recognition Using Neural Networks // Proceedings of the IEEE Second International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications IDAACS’2005, Sofia, Bulgaria, September 5-7, 2005, pp. 112-115.

**[Project 25] Development of Methods and Tools for Improvement of Robot Navigation in a non-Structured Environment**

**Foreign partner:** Kaunas Technical University, Lithuania

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Lithuania: Dr Arunas Raudis

This project has been performed in frames of State Fund for Fundamental Research Programs, Ministry of Education and Science of Ukraine order #174 dated by 23.03.05.

**Duration:** 2005 – 2006

**Objectives:** Development of methods and tools for improvement of mobile robot navigation in non-structured environment.

**Main tasks:**

- Development of methodology for creation of a mobile robot management system, which reflects schemes for conforming mobile robot subsystems for ensuring unobstructed navigation in non-structured environment.
- Development and implementation of main concepts for processing sensor data and creating environmental local map to improve robot navigation in non-structured environment with the help of artificial neural networks.
- Development and implementation of effective and self-adaptive methods for robot navigation and pathway planning.
- Research of experimental methods (with the use of imitation modeling and neural network resources).

**Team:**

- Anatoliy Sachenko
- Vasyl Koval
- Oleh Adamiv
- Yuriy Kurylyak
- Maxym Lunochkin
- Serhiy Maystrenko

**Published results:**

1. Koval V., Adamiv O. The Software Structure Development for Mobile Robot Control // Proceedings of the IEEE Second International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications IDAACS'2005. – 2005. – Sofia (Bulgaria). – pp. 120-124.
2. Oleh Adamiv. Models and Intelligent Means of Autonomous Mobile Robot Adaptive Control: Ph.D. Theses on speciality: 05.13.23 / Ternopil National Economic University. – Ternopil, 2007. – 166 p.

## **[Project 26] Development of Parallel Neural Networks Training Algorithms on Advanced High Performance Systems**

**Foreign partner:** Parallel Computing Laboratory, Department of Electronics, Computer Science and Systems, University of Calabria, Italy

Principal investigator from Ukraine: Dr. Volodymyr Turchenko

Principal investigator from Italy: Prof. Lucio Grandinetti

**Grant #** INTAS YSF 03-55-2493

**Duration:** 2004 – 2006

### **Main tasks:**

- Develop a parallel algorithm of enhanced data integration method using C programming language and MPI parallelization technology.
- Design and implement in C programming language and MPI parallelization technology two new methods of coarse-grain neural network parallelization which provides high efficiency of parallelization at the certain training parameters of neural networks and dynamic mapping method, which is more universal than static and shows better efficiency at different initial parameters of neural networks and provides parallelization. A series of on-line computational experiments of the above mentioned algorithms of the parallel machines SGI Origin 300, NEC TX-7 is performed and the computational grid consists of the cluster of double-processor Compaq personal computers under Linux operation system and Globus middleware package.
- Develop and implement in C programming language using MPI and MPE libraries the fine-grain parallel training algorithm of multilayer perceptron with parallelization of the outputs of hidden layer neurons at the initial stage of information processing inside neural network module.
- Compare the advantages and disadvantages of middleware technologies, in particular Globus, in a case of coarse-grain parallelization algorithm of Integrating Historical Data Neural Networks with dynamic mapping on the parallel computer Origin 300 without using middleware package and on the computational grid operated by Globus middleware package.

### **Published results:**

1. V. Turchenko. Parallel Algorithm of Dynamic Mapping of Integrating Historical Data Neural Networks, Information Technologies and Systems, 2004, Vol. 7, No. 1, pp. 45-52, ISSN: 0135-5465, <http://www.tanet.edu.te.ua/iics/vtu/B7.pdf>.
2. V. Turchenko, V. Demchuk. Efficiency Analysis of Parallel Routine Using Processor Time Visualization, International Scientific Journal of Computing, 2005, Vol. 4, Issue 1, pp. 12-18, ISSN: 1727-6209, <http://www.tanet.edu.te.ua/computing/Computing2005Vol4Issue1-12-18.pdf>.
3. V. Turchenko. Computational Grid vs. Parallel Computer for Coarse-Grain Parallelization of Neural Networks Training, Lecture Notes in Computing Science LNCS 3762, Edited by Robert Meersman, Zahir Tari, Pilar Herrero, Berlin, Heidelberg, New York, Springer-Verlag, 2005, pp. 357-366, ISSN: 0302-9743, [http://dx.doi.org/10.1007/11575863\\_55](http://dx.doi.org/10.1007/11575863_55).
4. V. Turchenko, C. Triki, L. Grandinetti, A. Sachenko. Efficiency Estimation of Parallel Algorithm of Enhanced Historical Data Integration on Computational Grid, International Scientific Journal of Computing, 2005, Vol. 4, Issue 3, pp. 9-19, ISSN: 1727-6209, <http://www.tanet.edu.te.ua/computing/Computing2005Vol4Issue3-9-19.pdf>.
5. V. Turchenko. Fine-Grain Approach to Development of Parallel Training Algorithm of Multi-Layer Perceptron, Artificial Intelligence, 2006, Vol. 1, pp. 94-102, ISSN 1561-5359, <http://www.tanet.edu.te.ua/iics/vtu/B1.pdf>.



## **[Project 27] Development of a Web-based Measurement System with Distributed Intelligence**

**Foreign partner:** Laboratory of Signal Processing and Information Measurement University of Sannio, Benevento, Italy

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Italy: Prof. Pasquale Daponte

Project was performed under the Ministry of Education and Science of Ukraine order #M/79-2004, state registration #0104U006975.

**Duration:** 2004 – 2006

**Objectives:** to create a distributed measurement system (based on Intranet and Internet technologies), that can provide high accuracy sensor data processing by the use of artificial neural networks. The system's feature is remote units working in real time mode during long delays in data link layer, and costs decrease is achieved by shifting of some intelligent functions to a main server.

### **Main tasks:**

- Development of distributed measurement system architecture with either Internet- or Intranet-technologies.
- Research and design of networked software structures. Development of software for distributed system using Web-technologies.
- Testing and verification of the developed software for distributed measurement system.

### **Team:**

- Anatoliy Sachenko
- Volodymyr Turchenko
- Volodymyr Kochan
- Roman Kochan
- Iryna Turchenko
- Volodymyr Hrusha
- Olexandr Osolinskiy

### **Published results:**

1. V. Hrusha, O. Osolinskiy, P. Daponte, D. Grimaldi, R. Kochan, A. Sachenko, I. Turchenko. Distributed Web-based Measurement System // IEEE Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications. 5-7 September 2005, Sofia, Bulgaria – pp. 355 -358.
2. V. Hrusha, O. Osolinskiy, R. Kochan, G. Sapojnyk Development of Web-based instrumentation, Proc. Of the International Conference “Modern Problems of Radio-Engineering, Telecommunications and Computer Science” TCSET’2006, February 28 – March 4, 2006, Lviv-Slavsko, Ukraine – pp. 199-201.
3. V. Hrusha, O. Osolinskiy, P. Daponte, D. Grimaldi, R. Kochan, A. Sachenko, I. Turchenko. Distributed Web-based Measurement System // IEEE Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications. 5-7 September 2005, Sofia, Bulgaria – pp. 355 -358.
4. I. Turchenko, V. Kochan, A. Sachenko, R. Kochan, A. Stepanenko, P.Daponte D. Grimaldi “Simulation Modeling of Neural-Based Method of Multi-Sensor Output Signal Recognition” in Proceedings of 2006 IEEE Instrumentation and Measurement Technology Conference IMTC/06. – April 24-27, 2006. – Sorrento (Italy). – pp. 1530-1535.

## **[Project 28] Design of Distributed Sensor Network for Ayers Island Security Using Value Analysis Technology**

**Foreign partner:** Department of Computer Science, University of Maine, USA

Projects investigator from Ukraine: Prof. Anatoliy Sachenko

Projects investigator from USA: Prof. George Markowsky

Project had been performed within the frames of the First Steps to Market program of the US Civilian Research and Development Foundation.

**Grant #** CRDF FSTM UM2-5012-TE-03

**Duration:** 2003 – 2005

**Objectives:** investigating possibilities for developing distributed sensor network with defined features for providing security Ayers Island, Orono, ME, USA.

### **Main tasks:**

- Analyze component and perimeter security systems vendors, examine well-known perimeter security systems.
- Propose algorithm for defining key functional indicators for perimeter security distributed systems components that can optimize preparing procedure for CAD, appointed for design and optimization according to functional-price characteristics security system. This algorithm usage filled DB with functional-price characteristics for perimeter area security systems components that are unified and eligible for creating CAD.
- Morphological matrix method was proposed for optimization according to functional-price characteristics of designed security systems and selecting variants of DSN that create Pareto boundaries for all alternative variants according to two key functional characteristics.
- CAD software module was developed, functions for all modules were described, and major requirements to perimeter area security systems CAD were established. Proposed CAD allows to design projects perimeter area security systems, using perimeter area security systems components database.
- Demonstrate CAD version that was used for developing perimeter area security systems for Ayers island in Orono, ME according to quality, reliability and price characteristics.

### **Team:**

- Anatoliy Sachenko
- Volodymyr Turchenko
- Volodymyr Kochan
- Pavlo Bykovyy

### **Published results:**

1. Bykovyy P. Choosing of Technical & Economic Indices for Knowledge Base of Perimeter Security Systems // Proceedings of the 2004 IEEE International Conference on Intelligent Systems 3. – 2004. Bulgaria. – pp. 54-57.
2. I. Turchenko, V. Turchenko, V. Kochan, P. Bykovyy, A. Sachenko and G. Markowsky. “Database Design for CAD System Optimizing Distributed Sensor Networks for Perimeter Security.” Proceedings of the 8<sup>th</sup> IASTED International Conference on Software Engineering and Applications SEA’2004 (2004): 59-64. (USA)
3. R. Kochan, V. Kochan, A. Sachenko, I. Maykiv, I. Turchenko and G. Markowsky. “Network Capable Application Processor based on FPGA.” Proceedings of the 22<sup>nd</sup> IEEE Instrumentation and Measurement Technology Conference IMTC 2005 II (2005): 813-817. (Canada)
4. P. Bykovyy, I. Maykiv, I. Turchenko, O. Kochan, V. Yatskiv and G. Markowsky. “A Low-Cost Network Controller for Security Systems.” Proceedings of the 3<sup>rd</sup> IEEE International Workshop on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications IDAACS’05 (2005): 388-391. (Bulgaria)

## **[Project 29] Development of Intelligent Precision System for Thermal Objects Control**

**Foreign partner:** Department of Automatics, the University of Mons, Belgium

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Belgium: Prof. Marcel Remy

The project had been performed under the NATO (Cooperative Science & Technology Sub-Program).

**Grant** NATO PST.CLG.977647

**Duration:** 2002 – 2004

**Objectives:** development precision and self-adaptive temperature control system for temperature objects with multi-zone linked control.

### **Main tasks:**

- Analysis of precision thermal objects and their control systems;
- Analysis of error control system components and ways for reducing their influence on general system error.
- Development of constructive-technological and structural-algorithmic methods for improving accuracy of measuring channels and control channels for multi-zone thermal objects.
- Development of result processing methods for defining thermal objects parameters.
- Adaptation of random small perturbation method for thermal objects with multi-zone linked control.

### **Team:**

- Anatoliy Sachenko
- Roman Pasichnyk
- Volodymyr Kochan
- Volodymyr Turchenko
- Roman Kochan
- Nadia Vasylykiv
- Yuriy Pihovsky
- Mykola Derlytsya

### **Published results:**

1. Derlytsya M., Pigovsky Y., Pasichnyk R., Kochan V. Improved Control System of Multi-Zone Thermal Object // Scientific Journal of Khmelnytsky Podillya Technical University. – 2004. – No. 2. – Vol. 1. – pp. 30-33.
2. Kochan V., Vasylykiv N., Chyrka M. The Error Evaluation of Temperature Measurement in Diffusion Furnace // Proceedings of the VIII International Conference Temperature. – 2003. – Lviv (Ukraine). – pp. 33.
3. Sachenko A., Kochan V., Pasichnyk R. Development of the Simulation Model of Thermocouples // Proceedings of the IEEE Instrumentation and Measurement Technology Conference IMTC/2003. – 2003. – Vail, CO. – pp. 1673-1677.
4. Derlytsya M. Improvement of the PC Based System of Optimal Control of Multi-Zone Thermal Object // Master Thesis, Ternopil Academy of National Economy. – 2004.
5. Pigovsky Y. Simulation Model for Effectivity Control of the Chip Manufacturing Process // Master Thesis, Ternopil Academy of National Economy. – 2004.

**[Project 30] Using Multisensor Fusion and Neural Networks Techniques for Robot Control****Foreign partner:** Laboratory of Robotics Systems, University of La Coruña, Spain

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Ukraine: Prof. Richard Duro

The project had been performed under the NATO (Cooperative Science & Technology Sub-Program).

**Grant** NATO PST.CLG.978744**Duration:** 2002 – 2004

**Objectives:** development and implementation of main concepts of merging sensor data, using neural networks for controlling mobile robot. It is assumed that robot's movement is performed in unknown (dangerous for human) environment. Main purpose is the endpoint reached through obstructions.

**Main tasks:**

- Development of new methods for merging sensor data, using neural networks.
- Development of algorithms and software for merging sensor data subsystem.
- Hardware implementation of merging methods for sensor data on mobile robot.
- Verification and testing procedures of developed engines for merging sensor data on mobile robot.
- 

**Team:**

- Anatoliy Sachenko
- Volodymyr Turchenko
- Vasyl Koval
- Oleh Adamiv

**Published results:**

2. Koval V. The Fusion of Structured Light and Video Image for Mobile Robot Control // Scientific and Technical Journal Artificial Intelligence. – 2004. – Donetsk (Ukraine). – No1.
3. Koval V. The Method of Obstacle Detection Using Fusion Technique of Heterogeneous Sensors // ASU and Automatic Devices. – 2004. – Kharkiv (Ukraine). – pp. 128-135.
4. Koval V., Turchenko V., Kochan V., Sachenko A., Markowsky G. Smart License Plate Recognition System Based on Image Processing Using Neural Network // Computing. – 2003. – Vol. 2. – Issue 2. – pp. 40-46.
5. Adamiv O., Koval V., Turchenko I. Predetermined Movement of Mobile Robot Using Neural Networks // International Scientific Journal Computing. – 2003. – Ternopil (Ukraine). – Vol. 2. – Issue 2. – pp. 64-68.
6. Koval V., Turchenko V., Sachenko A., Becerra J., Duro R., Golovko V. Infrared Sensor Data Correction for Local Area Map Construction by a Mobile Robot // The Lecture Notes in Artificial Intelligence, LNAI2718. – 2003. – pp. 306-315.
7. Koval V. The Method of Local Area Map Construction for Mobile Robot // Scientific Journal of Ternopil State Technical University I.Pulyuj. – 2002. – Ternopil (Ukraine). – Vol. 8. – No2. – pp. 80-88.
8. V. Koval, "Adversary merging sensor data algorithm on multisensory systems", // Sensors and systems, #7 (38) Sep. 2002. Pp.39-41.
9. Vasyl Koval. Methods and Algorithms of Map Development of Mobile Robot Environment Using Sensor Data Fusion: Ph.D. Theses on speciality 05.13.23 / Ternopil Academy of National Economy; NAS of Ukraine; State Research Institute of Information Infrastructure. – Ternopil, 2004. – 208 p.

## **[Project 31] Development of an Intelligent Sensing Instrumentation Structure**

**Foreign partners:** Electronic Laboratory, Aristotle University, Thessaloniki, Greece, Parallel Computations Laboratory, University of Calabria, Italy, Department of Electronics at Brest Polytechnic Institute, Belarus.

Principal investigator from Ukraine: Prof. Anatoliy Sachenko

Principal investigator from Greece: Prof. Theodore Laopoulos

Principal investigator from Italy: Prof. Lucio Grandinetti

Principal investigator from Belarus: Prof. Volodymyr Golovko

The project had been performed under the “INTAS Open Call” program, grant # INTAS OPEN 97-0606.

**Duration:** 1999 – 2001

**Objective:** development of information measurement system for increase of measurement accuracy using automated correction of instrumental compound measurement error.

### **Research tasks:**

- Target area analysis and requirements definition for intelligent sensor measurement system;
- Development of distributed structure for intelligent sensor measurement system;
- Development of methods for result processing with the target objective to increase the system's operational characteristics;
- Development and testing of the prototype intelligent sensor measurement system.

### **Team:**

- Anatoliy Sachenko
- Volodymyr Kochan
- Volodymyr Turchenko
- Roman Kochan

### **Published results:**

1. Sachenko A., Kochan V., Turchenko V., Tymchyshyn V., Vasylykiv N. Intelligent Nodes for Distributed Sensor Network // Proceedings of the 16<sup>th</sup> IEEE Instrumentation and Measurement Technology Conference IMTC/99. – 1999. – Venice (Italy). – Vol. 3. – pp. 1479-1484.
2. Golovko V., Grandinetti L., Kochan V., Laopoulos T., Sachenko A., Turchenko V., Tymchyshyn V. Approach of an Intelligent sensing Instrumentation Structure Development // Proceedings of the IEEE International Workshop on Intelligent Signal Processing WISP'99? Budapest, Hungary, 4-6 September, 1999. – pp. 336-341.
3. Sachenko A., Kochan V., Turchenko V., Laopoulos T., Golovko V., Grandinetti L. Features of Intelligent Distributed Sensor Network Higher Level Development // Proceedings of the 17<sup>th</sup> IEEE Instrumentation and Measurement Technology Conference IMTC/2000. – 2000. – Baltimore (USA). – pp. 335-340.
4. Sachenko A., Kochan V., Turchenko V., Golovko V., Savitsky Y., Dunets A., Laopoulos T. Sensor Errors Prediction Using Neural Networks // Proceedings of the IEEE-INNS-ENNS International Joint Conference on Neural Networks IJCNN'2000. – 2000. – Como (Italy). – Vol. IV. – pp. 441-446.
5. Sachenko A., Kochan V., Kochan R., Turchenko V., Tsahouridis K., Laopoulos Th. Error Compensation in an Intelligent Sensing Instrumentation System, 18<sup>th</sup> IEEE Instrumentation and Measurement Technology Conference IMTC/2001. – 2001. – Budapest (Hungary). – pp. 869-874.
6. Turchenko V., Kochan V., Sachenko A., Laopoulos Th. The New Method of Historical Data Integration Using Neural Networks // Proceedings of the International Workshop on Intelligent

Data Acquisition and Advanced Computing Systems IDAACS'2001. – 2001. – Foros (Ukraine). – pp. 21-24.

7. Turchenko V., Kochan V., Sachenko A. Estimation of Computational Complexity of Sensor Accuracy Improvement Algorithm Based on Neural Networks // Lecture Notes in Computing Science, No 2130, Ed. By G.Gooss, J.Hartmanis and J. van Leeuwen, Springer-Verlag, Berlin, Heidelberg, New York. – 2001. – pp. 743-748.
8. Volodymyr Turchenko. Neural Network Methods and Means of Efficiency Improvement of Distributive Networks of Sensor Data Acquisition and Processing: Ph.D. Theses on speciality 05.13.13 / Lviv National Polytechnical University. – Lviv, 2001. – 188 p.
9. Volodymyr Tymchychyn. Efficiency Increasing of Specialized Computer System Design on the Base of Typical Microprocessor Platforms: Ph.D. Theses on speciality 05.13.13 / Lviv National Polytechnical University. – Lviv, 1999. – 200 p.
10. Patent of Ukraine 25609A, MKI G06F 15/00. Two-Wired Local Area Network, Signal Repeater and Invertor for Using in it / V. Kochan, V. Tymchyshyn (Ukraine); Applied 30.10.97 # 97105295; Issued 30.10.98.
11. Patent of Ukraine 25498A, MKI G06F 11/00. Method of Communication Channel Bandwidth Increasing on the Base of Serial Interface and Device for it Realisation / V. Kochan, V. Tymchyshyn (Ukraine); Applied 27.01.98 # 98010432; Issued 30.10.98.

## 10. RESEARCH ACTIVITIES

### IDAACS Conferences and Symposia

#### A – IDAACS Conferences

The idea of IDAACS Workshop was proposed by Prof. Lucio Grandinetti (Italy), Prof. Theodore Laopoulos (Greece) and Prof. Anatoliy Sachenko (Ukraine) during the working meeting in Cetraro, Italy, in June, 2000. One of the main strategic goals of IDAACS is a promotion of the close scientific cooperation between the research teams and scientists from the countries of Western and Eastern Europe. Therefore the Workshop's motto is "IDAACS – the crossing point of Intelligent Data Acquisition & Advanced Computing Systems and East & West Scientists". Since 2001 the following IDAACS Workshops, Conferences and Symposia were organized:

- IDAACS'2001. July1-4 2001, Foros, Crimea, Ukraine.
  - Workshop Chairman: Anatoly Sachenko
  - Co-Chairmen of International Program Committee (IPC): Theodore Laopoulos, Greece, Robert E. Hiromoto, USA
  - Statistics: 70 participants, 18 countries, 112 papers, 30 oral and 35 poster presentations, 280 P., 1 Vol.
  - Special Issues: International Journal of Computing
  - Sponsors: INTAS, NEC, HP invent, Science & Technology Center in Ukraine(STCU), Aval bank, Institute of Computer Information Technologies, IEEE Instrumentation & Measurement Society, IEEE Region 8.
- IDAACS'2003. August 8-10 2003, National University "Lviv's Polytechnic ", Lviv, Ukraine.
  - Workshop Co-Chairmen: Anatoly Sachenko, Bohdan Stadnyk, Ukraine
  - IPC Co-Chairmen: Lucio Grandinetti, Italy, Fernando Lopes Pena, Spain
  - Statistics: 85 participants, 21 countries, 112 papers, 60 oral and 52 poster presentations, 529 P., 1 Vol.
  - Special Issues: International Journal of Computer Standards & Interfaces, IEEE Transactions on Instrumentation and Measurement, International Journal of Computing, Sensors & Systems
  - Sponsors: Ternopil Academy of National Economy (TANE) of IEEE Instrumentation & Measurement Society, STCU at MES of Ukraine, Aval bank.
- IDAACS'2005. September 5-7 2005, Technical University of Sophia, Sophia, Bulgaria.
  - Workshop Co-Chairmen: Anatoliy Sachenko, Ukraine, Plamenka Borovska, Bulgaria
  - IPC Co-Chairmen: Domenico Grimaldi, Italy, Peter A. J. Reusch, Germany
  - Statistics: 99 participants, 27 countries, 147 papers, 96 oral and 51 poster presentations, 738 P., 1 Vol.
  - Special Issues: International Journal of Computer Standards & Interfaces, IEEE Transactions on Instrumentation and Measurement, Journal of Computing, Sensors & Systems
  - Sponsors: TANE, Technical University of Sophia, STCU, IEEE Bulgaria Section, IEEE Computer Chapter of Bulgaria Section.
- IDAACS'2007. September 6-8 2007, University of Applied Sciences Fachhochschule Dortmund, Dortmund, Germany.
  - Workshop Co-Chairmen: Anatoliy Sachenko, Ukraine, Peter J. A. Reusch, Germany
  - IPC Co-Chairmen: Richard Duro, Spain, Wieslaw Winiecki, Poland

- Statistics: 105 participants, 35 countries, 180 papers, 95 oral and 52 poster presentations, 720 P., 1 Vol.
  - Special Issues: IEEE Transactions on Instrumentation and Measurement, Journal of Computing, Sensors & Systems
  - Sponsors: TNEU, University of Applied Sciences Fachhochschule Dortmund, IEEE Instrumentation & Measurement Society, RWE Systems AG, DSW21, Anna and Hermann Reusch Foundation, the Deutsche Forschungsgemeinschaft (German Research Foundation).
- IDAACS'2009. September 21-23 2009, Department of Electronics, Informatics and Systems, University of Calabria, Rende, Italy.
    - Workshop Co-Chairmen: Anatoliy Sachenko, Ukraine, Domenico Grimaldi, Italy
    - IPC Co-Chairmen: Vladimir Oleschuk, Norway, Dominique Dallet, France
    - Statistics: 122 participants, 25 countries, 142 papers, 86 oral and 56 poster presentations, 722 P., 1 Vol.
    - Special Issues: River Publishers, International Journal of Computing
    - Sponsors: Ukraine I&M / CI Joint Societies Chapter, University of the Calabria, Department of Electronics at University of the Calabria, IEEE Ukraine Section, IEEE Instrumentation & Measurement Society, IEEE Italy Section, IEEE Region 8. Workshop participant approved the IPS proposal to change the status from "Workshop" to "Conference"
- IDAACS'2011. September 15-17 2011, Czech Technical University in Prague, Prague, Czech Republic.
    - Conference Co-Chairmen: Anatoliy Sachenko, Ukraine, Domenico Grimaldi, Italy
    - IPC Co-Chairmen: Dana Petcu, Romania, Axel Sikora, Germany
    - Statistics: 197 participants, 32 countries, 197 papers, 96 oral and 51 poster presentations, 738 P., 1 Vol.
    - Special Issues: International Journal of Computing, Sensors & Transducers Journal, Computer Standards & Interfaces.
    - Sponsors: IEEE Ukraine I&M / CI Joint Societies Chapter, TNEU, Czech Technical University in Prague, Faculty of Electrical Engineering at Czech Technical University, Office of Naval Research, Honeywell spol. S r.o., H TEST a.s., authorized distributor of Agilent Technologies Agilent Technologies H TEST a.s., IEEE Ukraine Section, IEEE Czechoslovakia Section, IEEE Instrumentation & Measurement Society, IEEE Region 8, River Publishers.
- IDAACS'2013. September 12-14, Hochschule für Technik und Wirtschaft, University of Applied Sciences Berlin (HTW Berlin), Berlin, Germany.
    - Conference Co-Chairmen: Anatoliy Sachenko, Ukraine, Jürgen Sieck, Germany
    - IPC Co-Chairmen: Vladimir Haasz, Czech Republic, Kurosh Madani, France
    - Statistics: 185 participants, 28 countries, 185 papers, 120 oral and 60 poster presentations, 940 pages, 2 volumes.
    - Special Issues: River Publishers, Journal of Cyber Security and Mobility, International Journal of Computing, Elsevier Engineering Applications of Artificial Intelligence, Sensors & Transducers Journal.
    - Sponsors: IEEE Ukraine I&M / CI Joint Societies Chapter, THEY, University of Applied Sciences in Berlin, IEEE Instrumentation & Measurement Society, Office of Naval Research, The University of Maine, IEEE Region 8, River Publishers, IEEE Ukraine Section.
- IDAACS'2015. September 24-26, Faculty of Electronics and Information Technology and Faculty of Mathematics and Information Science, Warsaw University of Technology, Warsaw, Poland.
    - Conference Co-Chairmen: Anatoliy Sachenko, Ukraine, Wiesław Winiecki, Poland



- IPC Co-Chairmen: Robert Hiromoto, USA, Linas Svilainis, Lithuania
- Statistic: 180 participants, 29 countries, 185 papers, 24 oral and 3 poster sessions, 991 pages, 2 volumes.
- Special Issues: River Publishers, Journal of Cyber Security and Mobility, International Journal of Computing, Elsevier Engineering Applications of Artificial Intelligence.
- Sponsors: IEEE Ukraine I&M / CI Joint Societies Chapter, TNEU, University of Applied Sciences in Berlin, IEEE Instrumentation & Measurement Society, Office of Naval Research, The University of Maine, IEEE Region 8, River Publishers, IEEE Ukraine Section.

## **B – IDAACS Symposia**

The first IEEE International Symposium on Wireless Systems within the Conferences on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS-SWS'2012) was held in 2012.

- IDAACS-SWS'2012. September 20-21'2012, University of Applied Sciences in Offenburg, Offenburg, Germany.
- Workshop Co-Chairmen: Evren Eren, Uwe Grossmann, Juergen Sieck, Axel Sikora, Germany
- Statistics: participants from 12 countries, 39 papers, 27 oral presentations, 127 P., 1 Vol.
- Special Issues: International Journal of Computing, Sensors & Transducers Journal, Computer Standards & Interfaces.
- Sponsors: Faculty of Electrical Engineering and Information Technology at Offenburg University of Applied Sciences, IEEE Ukraine Section IM/CIS Joint Chapter, IEEE Instrumentation & Measurement Society.

The second IEEE International Symposium on Wireless Systems within the Conferences on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS-SWS'2014) was held in 2014.

- IDAACS-SWS'2014. September 11-12'2012, University of Applied Sciences in Offenburg, Offenburg, Germany.
- Workshop Co-Chairmen: Svitlana Antoshchuk, Volodymyr Brovko, Ukraine, Evren Eren, Uwe Grossmann, Juergen Sieck, Axel Sikora, Germany
- Statistics: participants from 7 countries, 15 papers, 15 oral presentations, 127 P., 1 Vol.
- Sponsors: Faculty of Electrical Engineering and Information Technology at Offenburg University of Applied Sciences, IEEE Ukraine Section IM/CIS Joint Chapter, IEEE Instrumentation & Measurement Society.

The third IEEE International Symposium on Wireless Systems within the Conferences on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS-SWS'2016) was held in 2016.

- IDAACS-SWS'2016. September 26-27'2016, University of Applied Sciences in Offenburg, Offenburg, Germany.
- Workshop Honorary Chairman: Anatoliy Sachenko, Ukraine;
- Workshop Co-Chairmen: Volodymyr Brovko, Ukraine, Evren Eren, Uwe Grossmann, Axel Sikora, Germany
- Statistics: participants from 9 countries, 24 papers, 24 oral presentations, 146 pages, 1 Volume
- Sponsors: Faculty of Electrical Engineering and Information Technology at Offenburg University of Applied Sciences, IEEE Ukraine Section IM/CIS Joint Chapter, IEEE Instrumentation & Measurement Society.

## International Journal of Computing

The International journal of Computing was established on the basis of Branch Research Laboratory of Automated Systems and Networks in 2002. Its main goal is to present results in the areas of Computer Science, Computer Engineering and Information Technology. The official language of the Journal is English. Journal is published 4 times per year.

Since November 2016 the IJC Journal is indexed by Scopus Elsevier. Also the Journal is indexed by Finnish publication forum, Norwegian Social Science Data Services, Google Scholar, and Index Copernicus International.

The Journal's Editor-in-Chief is Prof. Anatoliy Sachenko, the Executive Editor is PhD, Associated Professor Volodymyr Turchenko, Associated Editors are Prof. Robert E. Hiromoto, University of Idaho, USA and Prof. Volodymyr Kochan. The Journal staff includes Mr. Taras Lendyuk, the Technical Editor, Inna Shylinska, the Language Editor and Mrs. Halyna Kryva, the Economist.

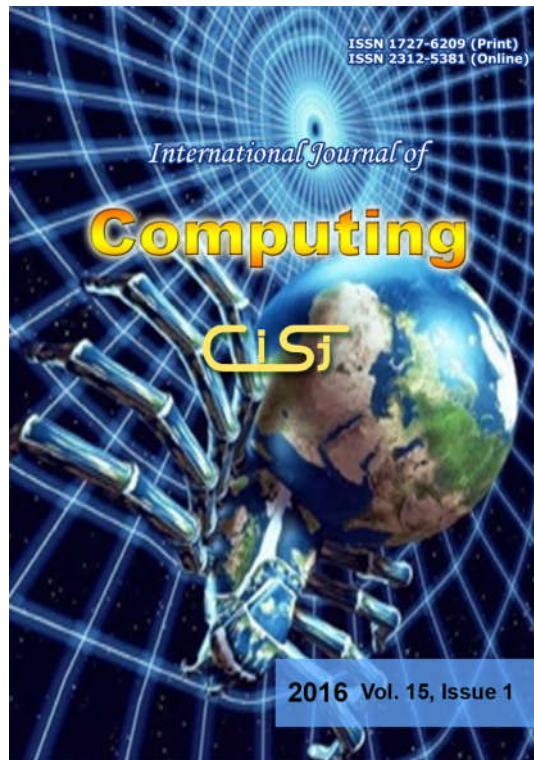
The Editorial Board consists of more than 40 recognised scientists from 17 countries: Australia, Belarus, Bulgaria, Czech Republic, France, Germany, Greece, Italy, Japan, Lithuania, Norway, Poland, Portugal, Romania, Russia, Spain, Ukraine and USA.

Journal Topics are: Algorithms and Data Structure, Software Tools and Environments; Bio-Informatics; Computational Intelligence; Computer Modeling and Simulation; Cyber and Homeland Security; Data Communications and Networking; Data Mining, Knowledge Bases and Ontology; Digital Signal Processing; Distributed Systems and Remote Control; Education in Computing; Embedded Systems; High Performance Computing and GRIDS; Image Processing and Pattern Recognition; Intelligent Robotics Systems; Internet of Things; IT Project Management; Wireless Systems.

| Issues  |   |
|---|---|
| <ul style="list-style-type: none"> <li>• 2016, Vol. 14, Issue 4</li> <li>• 2016, Vol. 14, Issue 3</li> <li>• 2016, Vol. 14, Issue 2</li> <li>• 2016, Vol. 14, Issue 1</li> <li>• 2015, Vol. 14, Issue 4</li> <li>• 2015, Vol. 14, Issue 3</li> <li>• 2015, Vol. 14, Issue 2</li> <li>• 2015, Vol. 14, Issue 1</li> <li>• 2014, Vol. 13, Issue 4 – thematic issue “ICT in Project Management”</li> <li>• 2014, Vol. 13, Issue 3</li> <li>• 2014, Vol. 13, Issue 2</li> <li>• 2014, Vol. 13, Issue 1</li> <li>• 2013, Vol. 12, Issue 4</li> <li>• 2013, Vol. 12, Issue 3</li> <li>• 2013, Vol. 12, Issue 2</li> <li>• 2013, Vol. 12, Issue 1</li> <li>• 2012, Vol. 11, Issue 4 – Special Issue on Advanced Computing Systems</li> <li>• 2012, Vol. 11, Issue 3</li> <li>• 2012, Vol. 11, Issue 2</li> <li>• 2012, Vol. 11, Issue 1 – Special Issue on Pattern Recognition and Intelligent Processing</li> <li>• 2011, Vol. 10, Issue 4 – Special Issue on Wireless Systems</li> <li>• 2011, Vol. 10, Issue 3</li> <li>• 2011, Vol. 10, Issue 2</li> </ul> | <ul style="list-style-type: none"> <li>• 2011, Vol. 10, Issue 1 – Special Issue on Neural Networks and Artificial Intelligence</li> <li>• 2010, Vol. 9, Issue 4</li> <li>• 2010, Vol. 9, Issue 3 – Special Issue on Wireless Systems</li> <li>• 2010, Vol. 9, Issue 2</li> <li>• 2010, Vol. 9, Issue 1 – Special Issue on Interactive Systems in Culture and Creative Industries</li> <li>• 2009, Vol. 8, Issue 3</li> <li>• 2009, Vol. 8, Issue 2</li> <li>• 2009, Vol. 8, Issue 1 – Special Issue on Artificial Neural Networks and Intelligent Information Processing</li> <li>• 2008, Vol. 7, Issue 3</li> <li>• 2008, Vol. 7, Issue 2 – Special Issue on Intelligent Data Acquisition and Advanced Computing Systems</li> <li>• 2008, Vol. 7, Issue 1</li> <li>• 2007, Vol. 6, Issue 3</li> <li>• 2007, Vol. 6, Issue 2 – Special Issue on Virtual Instrumentation and Virtual Laboratories</li> <li>• 2007, Vol. 6, Issue 1</li> <li>• 2006, Vol. 5, Issue 3 – Special Issue on Neural Network and Artificial Intelligence</li> <li>• 2006, Vol. 5, Issue 2</li> <li>• 2006, Vol. 5, Issue 1</li> </ul> |

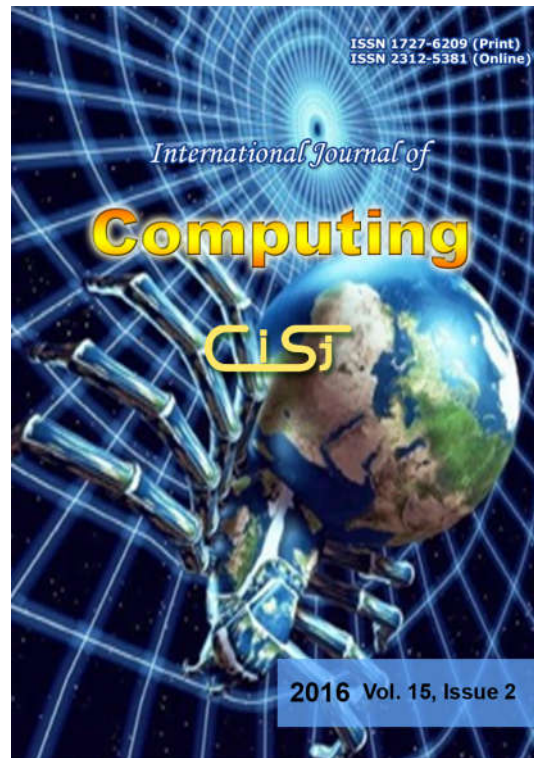
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| <ul style="list-style-type: none"> <li>• 2005, Vol. 4, Issue 3 – Special Issue on Intelligent Data Acquisition and Advanced Computing Systems</li> <li>• 2005, Vol. 4, Issue 2 – Special Issue on Cyberspace Security</li> <li>• 2005, Vol. 4, Issue 1</li> <li>• 2004, Vol. 3, Issue 3</li> <li>• 2004, Vol. 3, Issue 2</li> <li>• 2004, Vol. 3, Issue 1 – special issue ICNNAI'2003, Minsk, Belarus</li> </ul> | <ul style="list-style-type: none"> <li>• 2003, Vol. 2, Issue 3</li> <li>• 2003, Vol. 2, Issue 2 – Special Issue on Intelligent Data Acquisition and Advanced Computing Systems</li> <li>• 2003, Vol. 2, Issue 1</li> <li>• 2002, Vol. 1, Issue 2 – Special Issue on Intelligent Data Acquisition and Advanced Computing Systems</li> <li>• 2002, Vol. 1, Issue 1 – Special Issue on Intelligent Data Acquisition and Advanced Computing Systems</li> </ul> |
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## Contents of Journal of Computing, 2016, Vol. 15, Issue 1



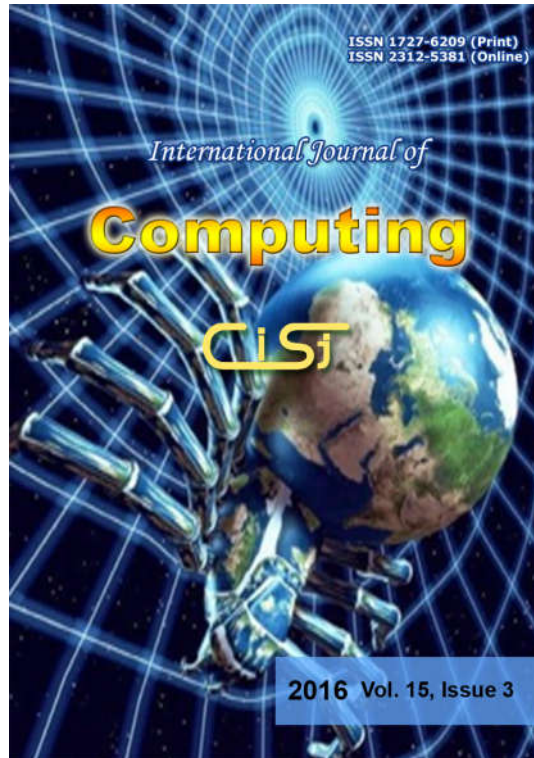
1. D. Reynolds, R. A. Messner. Video Copy Detection Utilizing the Log-Polar Transformation. – pp. 8-13.
2. R. Lahouli, M. Ben-Romdhane, C. Rebai, D. Dallet. Programmable Parallel FBD Sigma Delta ADC Reconstruction Stage Design for Software Defined Radio Receiver. – pp. 14-23.
3. O. Kehret, A. Walz, A. Sikora. Integration of Hardware Security Modules into a Deeply Embedded TLS Stack. – pp. 24-32.
4. O. Ivakhiv. Information State of System Estimation. – pp. 33-41.
5. R. Donida Labati, A. Genovese, E. Muñoz, V. Piuri, F. Scotti, G. Sforza. Computational Intelligence for Biometric Applications: a Survey. – pp. 42-23.

## Contents of Journal of Computing, 2016, Vol. 15, Issue 2



1. R. E. Hiromoto. Parallelism and Complexity of a Small-world Network Model. – pp. 72-83.
2. V. V. Zhikharevich, N. A. Matsiuk, S. E. Ostapov. Solving the Routing Problem by Ant Colony Optimization Algorithms. – pp. 84-91.
3. J. Zalewski. From CAMAC to Wireless Sensor Networks and Time-triggered Systems and Beyond: Evolution of Computer Interfaces for Data Acquisition and Control. Part I. – 92-106.
4. M. Sirola, J. Talonen, M. Sulkava. Improving Support Estimates by Fusion of Pre-election Data. – pp. 107-118.
5. J. Kolakowski, A. Consoli, V. Djaja-Josko, J. Ayadi, L. Morrigia, F. Piazza. Indoor UWB Positioning in Eiger Localization System. – pp. 119-126.
6. M. Dorozhovets, I. Bubela. Computing Uncertainty of the Extreme Values in Random Samples. – pp. 127-135.

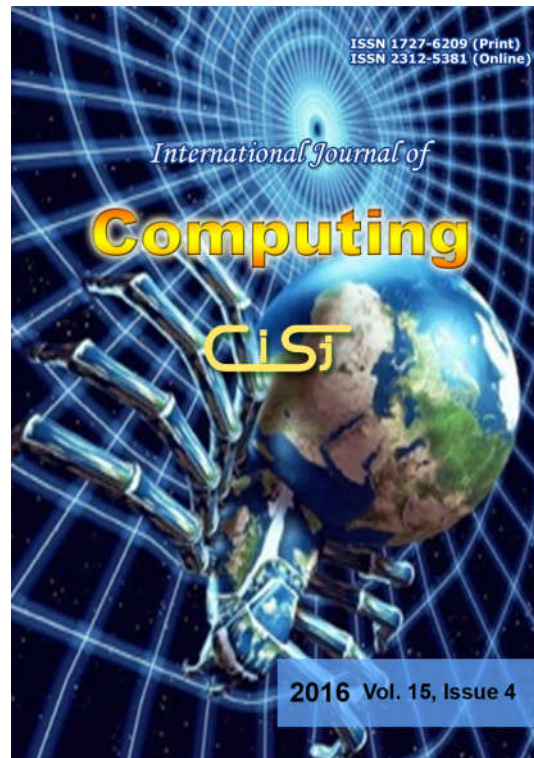
## Contents of Journal of Computing, 2016, Vol. 15, Issue 3



1. J. L. Pach, P. Bilski. A Robust Binarization and Text Line Detection in Historical Handwritten Documents Analysis. – pp. 154-161.
2. M. Patil, T. Abukhalil, S. Patel, T. Sobh. UB Swarm: Hardware Implementation of Heterogeneous Swarm Robot with Fault Detection and Power Management. – pp. 162-176.
3. D. Jonaitis, V. Raudonis, A. Lipnickas. Application of Numerical Intelligence Methods for the Automatic Quality Grading of an Embryo Development. – pp. 177-183.
4. S. Bezobrazov, A. Sachenko, M. Komar, V. Rubanau. The Methods of Artificial Intelligence for Malicious Applications Detection in Android OS. – pp. 184-190.
5. T. Heard, D. Johnson. An Extended Discussion on a High-capacity Covert Channel for the Android Operating System. – 191-199.
6. D. Zahorodnia, Yu. Pigovsky, P. Bykovyy. Canny-based Method of Image Contour Segmentation. – pp. 200-205.



## Contents of Journal of Computing, 2016, Vol. 15, Issue 4



1. Yu. Kondratenko, O. Gerasin, A. Topalov. A Simulation Model for Robot's Slip Displacement Sensors. – pp. 224-236.
2. H. D. Tsague, B. Twala. Investigation of Carrier Mobility Degradation Effects on MOSFET Leakage Simulations. – pp. 237-247.
3. M. Schölzel, E. Eren, K.-O. Detken, L. Schwenke. Monitoring Android Devices by Using Events and Metadata. – pp. 248-258.
4. N. I. Korsunov, D. A. Toropchin. The Method of Finding the Spam Images Based on the Hash of the Key Points of the Image. – pp. 259-264.

## Specialized Scientific Council K58.082.02

Specialized scientific council in specialties:

- 05.13.05 – Computer Systems and Components;
- 05.13.06 – Information Technologies;

In 2016 such theses were defended:

- **V. Ya. Pikh**, PhD thesis “Processors of the Fourier Spectral Cosine Transform on the Basis of Various Correlation Functions and the Number-Theoretic Bases”, speciality 05.13.05 – Computer Systems and Components.
- **O. R. Osolinskiy**, PhD thesis “Information-measuring System of Energy Consumption of Microcontrollers”, speciality 05.13.05 – Computer Systems and Components.
- **S. V. Ivasiev**, PhD thesis “Methods and Computational Tools for Solving the Problems of Number Theory in Rademacher-Krestenson Bases”, speciality 05.13.05 – Computer Systems and Components.

## IEEE Instrumentation & Measurement/Computational Intelligence Joint Societies Chapter

The Instrumentation & Measurement / Computational Intelligence Joint Societies Chapter of IEEE Ukraine Section were established on June 7, 2005. The Chairman of the Chapter is Prof. Anatoliy Sachenko. The Chapter consists of 38 members from Lviv, Ternopil, Khmelnytsky, Kyiv, Kharkiv, Ivano-Frankivsk, Zaporizhzhya, Chernivtsi and Odessa, in particular:

Prof. S. Antoshchuk, Odessa National Polytechnic University  
 Dr P. Bykovyy, Ternopil National Economic University  
 Dr O. Blazhko, Odessa National Polytechnic University  
 Prof. E. Volodarsky, National Technical University of Ukraine “Kyiv Polytechnic Institute”  
 Prof. M. Dorozhovets, Lviv National Technical University  
 Prof. A. Drozd, Odessa National Polytechnic University  
 Prof. O. Ivakhiv, Lviv National Technical University  
 Prof. R. Kochan, Lviv National Technical University  
 Dr O. Kochan, Ternopil National Economic University  
 Dr V. Kochan, Ternopil National Economic University  
 Prof. V. Krylov, Odessa National Polytechnic University  
 Dr S. Lysenko, Khmelnytsky National University  
 Dr V. Lyashkevych, Yury Fedkovych Chernivtsi State University  
 Dr I. Maykiv, Ternopil National Economic University  
 Dr V. Mukhin, National Technical University of Ukraine “Kyiv Polytechnic Institute”  
 Dr A. Piskozub, Lviv National Technical University  
 Prof. O. Pomorova, Khmelnytsky National University  
 Prof. M. Pryymak, Ternopil Ivan Pul’uj State Technical University  
 Prof. S. Rippa, National University of the State Taxation Department of Ukraine  
 Prof. A. Sachenko, Ternopil National Economic University  
 Dr V. Turchenko, Ternopil National Economic University  
 Prof. M. Cherkassky, Lviv National Technical University  
 Dr G. Shilo, Zaporizhzhya National Technical University  
 Dr V. Yatskiv, Ternopil National Economic University

List of technical meetings, which have been run by the I&M/CI Chapter:

- I. On January 18, 2016 a joint research seminar of the IEEE I & M / CI Chapter, the Information Computer Systems and Control Department, and the Research Institute for Intelligent Computer Systems was held at Ternopil National Economic University. There

were two presenters: Alex Nykorak presented a talk entitled “Characteristic Requirements for Data Bandwidth between Cooperating Robots” and Vasyl Yatskiv presented a talk entitled “Methods and special processors for encoding data in wireless sensor networks based on medullary arithmetic”. There were the 36 people took a part in the the seminar including the 14 IEEE members.



- II. On January 28, 2016 a joint research seminar of the IEEE I & M / CI Chapter, the Information Computer Systems and Control Department, and the Research Institute for Intelligent Computer Systems was held at Ternopil National Economic University. There were two presenters: Diana Zahorodnia presented a talk entitled “Structural-statistical Identification of Hierarchical Objects by the Characteristic Points of Their Contours ” and Olexander Drozd presented a topic entitled “Resource Approach to the Analysis of Computer Systems”. In total, 36 people took a part in the seminar including the 10 IEEE members.



- III. On February 16, 2016 a joint research seminar of the IEEE I & M / CI Chapter, the Information Computer Systems and Control Department, and the Research Institute for Intelligent Computer Systems was held at Ternopil National Economic University. There were two presenters: Serhiy Maslovsky presented a talk entitled “Information Technology of Individualized Learning and Knowledge Control for the Computerization System of Education” and Oleksandr Osolinskiy presented a talk entitled “Information-measuring System of Energy Consumption of Microcontrollers”. In total, 36 people took a part in the work of the seminar including the 11 IEEE members.





- IV. On April 26, 2016 a joint research seminar of the IEEE I & M / CI Chapter, the Information Computer Systems and Control Department, and the Research Institute for Intelligent Computer Systems was held at Ternopil National Economic University. There were two presenters: Volodymyr Shaporin presented a talk entitled “Models and Methods of Analysis of Security Risks of Information Systems” and Myroslav Komar presented a talk entitled “Methods of Protection Against Computer Attacks based on Neural Networks and Artificial Immune Systems”. In total, 36 people took a part in the work of the seminar including the 10 IEEE members.
- V. On July 1, 2016, in the Framework of the International Scientific Conference and the Summer School at the University of Applied Sciences and Arts, Dortmund (Germany), a joint scientific seminar was held with involment of the IEEE I & M / CI Chapter. There were two presenters: Yuriy Ivanyshak presented a talk entitled “Architectural Regularities of the Viable Project Management System” and Serhiy Hutsal presented a talk entitled “Improved Model of a Financial Sustainability in Organization”. There were 36 people attended the seminar including the 19 IEEE members.



- VI. On September 8, 2016 a joint research seminar of the IEEE I & M / CI Chapter, the Information Computer Systems and Control Department, and the Research Institute for

Intelligent Computer Systems was held at Ternopil National Economic University. There were two presenters: Mykhailo Dombrovsky presented a topic entitled “Proactive Management of Transformation Projects of a Corporation "Ternopiloblenergo" to Transmission and Supply Companies” and Oleg Sachenko presented a topic entitled “Formation of a Strategically Oriented Portfolio of Innovation Projects for the Modernizing the Electric Power Equipment”. There were 17 people attended the seminar including the 10 IEEE members.

- VII. On October 17, 2016 a joint research seminar of the IEEE I & M / CI Chapter, the Information Computer Systems and Control Department, and the Research Institute for Intelligent Computer Systems was held at Ternopil National Economic University. There were two presenters: Carsten Wolff presented a topic entitled “Exchange Experience in Project Implementation within the Framework of European Educational and Research Programs in the areas of Project Management and Computer Science” and Oksana Dunets a topic entitled “Multi-Agent Management of IT Project”. There were 36 people attended the seminar including the 11 IEEE members.



- VIII. On November 9, 2016, in the Framework of the II International Conference "Information Technologies and Interactions (IT & I-2016)" at the Kyiv National Taras Shevchenko University, a joint scientific seminar was held with involvement of the IEEE I & M / CI Chapter. There were two presenters: Oksana Dunets presented a talk entitled “Multi-Agent Management of IT Project” and Sergey Bushuyev presented a talk entitled “Global Trends in Project Management Development”. There were 37 people took a part in the seminar including the 12 IEEE members.
- IX. On December 14, 2016 a joint research seminar of the IEEE I & M / CI Chapter, the Information Computer Systems and Control Department, and the Research Institute for Intelligent Computer Systems was held at Ternopil National Economic University. There were two presenters: Yuriy Ivanyshak presented a talk entitled “Project Management for Improving the University's Information Infrastructure” and Taras Lendyuk presented a talk entitled “Knowledge-oriented Methods and Information Technology for Creating the Computerization System of Education”. In total, 36 people took a part in the seminar including the 9 IEEE members.

## **IEEE Student Branch**

The Institute of Electrotechnical and Electronics Engineers (IEEE) Student Branch at Ternopil National Economic University (TNEU) was founded in 1998.

Student Branch consists of students of the Faculty of Computer Information Technologies, PhD students and junior researchers of TNEU. In 2016 there were 3 active members in the Branch. The Branch Committee consists of the Chair – Yuriy Ivanyshak, a Counselor – Prof. Anatoliy Sachenko.

Members of the IEEE Student Branch at TNEU take part in international conferences and projects. Also they assist in organization and preparation of the series of Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS) IEEE Workshops: 2001, 2003 – Ukraine, 2005 – Bulgaria, 2007 – Germany, 2009 – Italy, and the IEEE IDAACS Conference in 2011 – Czech Republic, 2013 – Germany, 2015 – Poland.

The main advantages of IEEE membership include: access to IEEE electronic resources, IEEE subscription in the scientific magazines and popular scientific literature “Spectrum”, “Computer”, “IEEE Transaction on Instrumentation and Measurement”; assistance and discounts for participation at international conferences, for example, as IEEE member scientist could win a travel grant to the conference in the country region (Ukraine, along with Europe, Middle East and Africa, belongs to region 8). Almost all conferences sponsored by IEEE give discount to students for registration fee, participation in competitions organized by IEEE in the region.

Overall, IEEE supports scientific activities of students and young scientists, supporting them in the development of their scientific career, increases collaboration between scientists from different universities and international scientific – educational organizations. For example, IEEE members have access to a digital library of articles Hplere IEEE conferences, are printed journals IEEE, have the opportunity to join the scientific communities in different scientific fields can win grants to visit academic conferences and receive a discount when registering them. Also between branches and regions there is a contest for the best scientific article or website and mobile robots. Each of these competitions is accompanied by cash prizes.

## Other Research Activities

### [Org 1] **Sergey Bushuyev**

- Reviewing the 8 papers for international and national conferences.
- Reviewing the 14 articles in international and national scientific journals.
- Member of the organizing / program committee:
  - Bukovel, February 2016, Strategic Project Management;
  - Kyiv, May 2016, Project Management in the Development of Society;
  - Mykolaiv, September 2016, Practical Aspects of Project Management;
  - Odessa, December 2016, Project management: Innovations, Nonlinearity, Synergetics.

### [Org 2] **Volodymyr Kochan**

- Member of the Editorial Board at International Journal of Computing.
- Reviewing the papers for international and national conferences.
- Member of the Specialized Scientific Council K58.082.02 at TNEU.

### [Org 3] **Vasyl Koval**

- Reviewing the one paper in international journal.
- Member of the Specialized Scientific Council K58.082.02 at TNEU.
- Member of Organization Committee of Workshop of Young Scientists and Students “Advanced Computer Information Technologies”.

### [Org 4] **Yaroslav Nykolaychuk**

- Reviewing papers for international and national conferences.
- Member of the Program Committee of V Workshop of Young Scientists and Students “Advanced Computer Information Technologies”, May 2016, Ternopil.
- Member and a Vice-Chairman of the Specialized Scientific Council K.58.082.02 at TNEU.

### [Org 5] **Roman Pasichnyk**

- Reviewing the 3 papers in international and national journals.
- Member of the Program Committee of V Workshop of Young Scientists and Students “Advanced Computer Information Technologies”, May 2016, Ternopil.
- Member of the Specialized Scientific Council K58.082.02 at TNEU.

### [Org 6] **Sergey Rippa**

- Reviewing the 11 papers for international and national conferences.
- Reviewing the 6 articles in international and national scientific journals.
- Reviewing the 2 PhD Thesis’.
- Preparation of 5 reviews for PhD Thesis autoreferats.
- A member of specialized academic council K 27.855.01 at NUSTA.

### [Org 7] **Anatoliy Sachenko**

- Chairman of the Specialized Scientific Council K58.082.02 at TNEU.
- Member of Specialized Scientific Council D35.052.08 at National University “Lviv Polytechnics”
- Editor-in-Chief, International Journal of Computing.
- Official opponent of Volodymyr Shaporin’s PhD thesis entitled “Models and Methods of analysis of Information System Safety Risks”, speciality 05.13.06 – Information Technologies, Odessa National Polytechnics University, 4 July 2016.
- Reviewing the 19 papers for national and international conferences.

- Reviewing the two Doctor of Science Theses
- Reviewing the seven PhD Theses
- Honorary chair: The 3rd IEEE International Symposium on Wireless Systems within the Conferences on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS-SWS'2016), 26-27 September 2016, University of Applied Sciences, Offenburg, Germany.
- Member of the Program Committee of International Conferences:
  1. International Research Conference -2016), Dortmund University of Applied Sciences and Arts, Dortmund, Germany.
  2. ICCCS 2016 Windhoek Namibia
  3. PRIP'16 14<sup>th</sup> International Conference on Pattern Recognition and Information Processing, October 3-5, 2016, Minsk, Belarus
  4. SETIT 2016 Tunisia

**[Org 8] Volodymyr Turchenko**

- Deputy Editor at International Journal of Computing, participated in preparing the four issues of the Journal, reviewed the one article
- Reviewer of abstracts for international conferences DCAI'2016, FUZZIEEE'2016, IJCNN'2016
- Reviewer of papers for journals Advances in Cyber-Physical Systems, Neurocomputing;
- A reviewer of the Fulbright Academic Exchange Program Applications in Ukraine.

**[Org 9] Vasyl Yatskiv**

- Reviewing the 2 PhD Theses;
- Member of the Organizing Committee: V All-Ukrainian Seminar of Young Scientists and Students "Advanced Computer Information Technologies", Ternopil, May 2016.
- Member of the Organizing Committee of Conference on "Applied Scientific and Technical Researches".
- Scientific Secretary of the Specialized Scientific Council K58.082.02 at TNEU.

## 11. ACADEMIC ACTIVITIES

### Cooperation Agreements with Universities and Companies

- [Agreement 1] Belarus State University of Informatics and Radioelectronics, Minsk, Belarus.
- [Agreement 2] Brest State Technical University, Belarus.
- [Agreement 3] Donetsk National Technical University, Ukraine.
- [Agreement 4] Zaporizhya National Technical University, Ukraine.
- [Agreement 5] Institute for Cybernetics, National Academy of Sciences of Ukraine, Kyiv, Ukraine.
- [Agreement 6] Institute of Space Research, National Academy of Sciences of Ukraine and NCAO, Kyiv, Ukraine.
- [Agreement 7] Institute of Control, Russian Academy of Sciences, Moscow, Russia.
- [Agreement 8] Institute of Artificial Intelligence, Donetsk.
- [Agreement 9] Odessa National Polytechnic University, Ukraine.
- [Agreement 10] Technical University of Sofia, Bulgaria.
- [Agreement 11] University of Calabria, Italy.
- [Agreement 12] Tsinghua University, China.
- [Agreement 13] University of Maine, USA.
- [Agreement 14] University of New Hampshire, USA
- [Agreement 15] University of South Carolina, USA.
- [Agreement 16] Physics-Mechanics Institute of G. Karpenko, National Academy of Sciences of Ukraine, Lviv, Ukraine.
- [Agreement 17] University of Siegen, Germany
- [Agreement 18] Chernivtsi National University by Yu.Fedkovich, Chernivtsi, Ukraine
- [Agreement 19] Wuhan University of Technologies, Wuhan, Hubei, China
- [Agreement 20] Kaunas University of Technology, Lithuania
- [Agreement 21] Hochschule für Technik und Wirtschaft Berlin, University of Applied Sciences, Germany
- [Agreement 22] Fachhochschule Dortmund, University of Applied Sciences, Germany
- [Agreement 23] Pre-Carpathian National University by Vasyl Stefanyk, Ivano-Frankivsk, Ukraine
- [Agreement 24] Silesian Technical University, Poland.
- [Agreement 25] Warsaw University of Technology, Poland
- [Agreement 26] National University of State Tax Service of Ukraine, Irpin, Kiev region.
- [Agreement 27] National University of Water and Environmental Engineering, Rivne, Ukraine.
- [Agreement 28] Kiev National University of Construction and Architecture, Ukraine.
- [Agreement 29] Lviv State University of Life Safety, Lviv, Ukraine
- [Agreement 30] Ivan Franko National University of Lviv, Lviv, Ukraine

### Defended Theses and Awarded Degrees

- [Def 1] Stepan Ivasiev defended PhD thesis titled “Methods and Computational Tools for Solving the Problems of Number Theory in Rademacher-Krestenson Bases”, 05.13.05 – Computer Systems and Components, supervisor Prof. Yaroslav Nykolaychuk.
- [Def 2] Stepan Melnychuk defended DsC thesis titled “Methods and Hardware and Software for Processing Signals with Poliparametrical Information Entropy”, 05.13.05 – Computer Systems and Components, scientific consultant Prof. Yaroslav Nykolaychuk.
- [Def 3] Oleksandr Osolinskiy defended PhD thesis titled “Information-measuring System of Energy Consumption of Microcontrollers”, 05.13.05 – Computer Systems and Components, supervisor Prof. Volodymyr Kochan.
- [Def 4] Roman Pasichnyk defended DsC thesis titled “Mathematical Models of Systems with Limiting Factors and Methods of their Identification”, 01.05.02 – Mathematical Modeling and Computing Tools, scientific consultant Prof. Mykola Dyvak.
- [Def 5] Volodymyr Pikh defended PhD thesis titled “Processors of the Fourier Spectral Cosine Transform on the Basis of Various Correlation Functions and the Number-Theoretic

Bases”, 05.13.05 – Computer Systems and Components, supervisor Prof. Yaroslav Nykolaychuk.

[Def 6] Oleg Sachenko defended PhD thesis titled “Formation of a Strategically Oriented Portfolio of Innovation Projects for the Modernization of Electric Power Equipment”, 05.13.22 – Projects and Programs Management, supervisor Prof. Sergey Byshyev.

[Def 7] Vasyl Yatskiv defended DsC thesis titled “Theoretical Foundations of the Creation and Structural Organization of Components of Wireless High-performance Sensor Networks”, 05.13.05 – Computer Systems and Components, scientific consultants Prof. Anatoliy Sachenko and Prof. Juergen Sieck.

### **Defended Master Theses**

[DefMas 1] Roman Virastiuk, Information Measurement System for Average Energy Consumption of Microprocessor Systems, PhD Associated Professor Volodymyr Kochan.

[DefMas 2] Vitaliy Bets, Microprocessor System for Low Temperature Regulation, PhD Associated Professor Volodymyr Kochan.

[DefMas 3] Nazariy Kikalo, The Coding Method for Video Data in Distributed Computer Systems, PhD, Associated Professor Nataliya Yatskiv.

[DefMas 4] Vladyslav Lysak, Multiagent System of Optimal Searching the Hotel Reservation, DsC, Professor Anatoliy Sachenko.

[DefMas 5] Ruslan Stasyshyn, Models and Methods of Software Protection Against Unauthorized Access into Computer Systems, PhD, Myroslav Komar.

[DefMas 6] Volodymyr Turash, Mathematical Tools and Software for the Inventory Management System, PhD, Associated Professor Yuriy Pigovsky.

[DefMas 7] Ivan Micnkevych, Method and Software for Statistical Estimation the Application Usage in Desktop Operating Systems, PhD Associated Professor Yuriy Pigovsky.

[DefMas 8] Ihor Pyk, Models of Risks Estimation in Software Project using Genetic Algorithm, PhD Associated Professor Andriy Melnyk.

[DefMas 9] Stepan Prots, Software for Research the Reliability of Complex Technical Systems, PhD Associated Professor Andriy Melnyk.

[DefMas 10] Petro Pushak, Software Module for Sales Prediction, PhD Associated Professor Roman Pasichnyk.

[DefMas 11] Alina Dubovska, Software Module of Production Provision Estimation, PhD Associated Professor Roman Pasichnyk.

[DefMas 12] Roman Mudrak, Math Software for Information Support using the Cluster System, PhD Associated Professor Roman Pasichnyk.

### **Internship of Staff, PhD Students and Students**

#### ***Staff Internship***

[Internship 1] Nadiia Vasylykiv, Assistant Professor, Department for Information Computer Systems and Control, LtD “Eleks”, 18.04 – 18.05.2016.

[Internship 2] Taras Lendyuk, lecturer, Department for Information Computer Systems and Control, private enterprise “MagneticOne”, 25.04 – 25.05.2016.

[Internship 3] Oleg Sachenko, lecturer, Department for Information Computer Systems and Control, LtD “Eleks”, 17.10 – 17.11.2016.

#### ***Student Internship***

[Internship 4] Oluvasina Adedeji Adabayo, Department for Information Computer Systems and Control TNEU, Ternopil, Oleg Sachenko.



- [Internship 5] Emmanuel Mayton Adjose, Ltd “Charmante Ukraine”, Ternopil, Oleg Sachenko.
- [Internship 6] Endurance Osamudiamhen, Department for Information Computer Systems and Control TNEU, Ternopil, Oleg Sachenko.
- [Internship 7] Abdulrahman Olavale Bakare, Research Institute for Intelligent Computer Systems TNEU, Ternopil, Oleg Sachenko.
- [Internship 8] Saifullah Sadallah Basma, Research Institute for Intelligent Computer Systems TNEU, Ternopil, Oleg Sachenko.
- [Internship 9] Serhii Hutsal, Research Institute for Intelligent Computer Systems TNEU, Ternopil, Oleg Sachenko.
- [Internship 10] Andronicus Bukata Mumbi, Ltd “Eleks” (Ternopil branch), Ternopil, Oleg Sachenko.
- [Internship 11] Jean-Julles Nsangou Ianini, Department for Information Computer Systems and Control TNEU, Ternopil, Oleg Sachenko.
- [Internship 12] Roman Babiak, Ltd “Eleks” (Ternopil branch), Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 13] Yevhen Bodnar, Ltd “Eleks” (Ternopil branch), Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 14] Volodymyr Voytovych, Ltd “Eleks” (Ternopil branch), Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 15] Vitaliy Havrylyuk, Ltd “Maks-Yavir”, Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 16] Oksana Dunets, Research Institute for Intelligent Computer Systems TNEU, Ternopil, DsC, Prof. Anatoliy Sachenko.
- [Internship 17] Roman Zozulia, Ltd “Maks-Yavir”, Ternopil, DsC, Prof. Anatoliy Sachenko.
- [Internship 18] Valentyn Kalashniuk, Ltd “Eleks” (Ternopil branch), Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 19] Nikita Liubutsin, Research Institute for Intelligent Computer Systems TNEU, Ternopil, DsC, Prof. Anatoliy Sachenko.
- [Internship 20] Andriana Lakhno, Ltd “Technologies of taste”, Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 21] Volodymyr Neizhlyy, Digital Marketing Studio “Golden Web”, Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 22] Oleg Parkhomchuk, Ltd “Technologies of taste”, Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 23] Iryna Rozdobudko, Ltd “Charmante Ukraine”, Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 24] Alina Sachenko, Ltd “Charmante Ukraine”, Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 25] Andriy Khalimon, Research Institute for Intelligent Computer Systems TNEU, Ternopil, DsC, Prof. Anatoliy Sachenko.
- [Internship 26] Zoriana Chak, Ltd “Maks-Yavir”, Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 27] Ivan Shkorupa, Ltd “Technologies of taste”, Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 28] Oleg Turchyn, Ltd “Eleks” (Ternopil branch), Ternopil, PhD, Associated Professor, Grygoriy Gladiy.
- [Internship 29] Nazar Veretyk, Ltd “Sayuz”, Ternopil, PhD, Associated Professor, Vasyl Yatskiv.
- [Internship 30] Roman Derkach, Ltd “Sayuz”, Ternopil, PhD, Associated Professor, Vasyl Yatskiv.
- [Internship 31] Victor Kysil, Ltd “Totus”, Ternopil, PhD, Associated Professor, Vasyl Yatskiv.
- [Internship 32] Taras Polishchuk, State Higher Educational Enterprise “Drohobych Mechanics and Technology College”, Drohobych, PhD, Associated Professor, Vasyl Yatskiv.



## 12. PUBLICATIONS

### Monographs (Parts of Monographs), Books (Parts of Books)

- [Publ 1]. M. B. Alexander, S. M. Balaban, M. P. Karpinski, S. A. Rajba, V. M. Chyzh. Information Security in the Wireless Sensor Network Environment, Ternopil: Ivan Pulyui TNTU, 2016, 224 p.
- [Publ 2]. O. Petrov, B. Borowik, M. Karpinsky, O. Korchenko, V. Lakhno. Immune and Defensive Corporate Systems with Intellectual Identification of Threats, Pszczyna: Śląska Oficyna Drukarska, 2016, 222 p.
- [Publ 3]. I. Z. Yakymenko, M. M. Kasyanchuk, L. O. Dubchak, S. V. Ivasiev. Tutorial of discipline “Discrete Mathematics”, Ternopil, TNEU, 2016, 165 p.
- [Publ 4]. Ya. M. Nykolaychuk, B. B. Krulikovskiy, S. V. Shatny. Microprocessor systems. Tutorial, Rivne: NUVGP, 2016, 191 p.
- [Publ 5]. V. V. Yatskiv. Theoretical Foundations of the Creation and Structural Organization of Components of Wireless High-performance Sensor Networks. Abstract of Doctoral Thesis, speciality 05.13.05 – Computer Systems and Components, Lviv, 2016, 40 p.
- [Publ 6]. R. M. Pasichnyk. Mathematical Models of Systems with Limiting Factors and Methods of their Identification. Abstract of Doctoral Thesis, speciality 01.05.02 – Mathematical Modeling and Computing Tools, Lviv, 2016, 43 p.
- [Publ 7]. O. R. Osolinskiy. Information-measuring System of Energy Consumption of Microcontrollers. Abstract of PhD Thesis, speciality 05.13.05 – Computer Systems and Components, Ternopil, 2016, 20 p.
- [Publ 8]. S. V. Ivasiev. Methods and Computational Tools for Solving the Problems of Number Theory in Rademacher-Krestenson Bases. Abstract of PhD Thesis, speciality 05.13.05 – Computer Systems and Components, Ternopil, 2016, 20 p.
- [Publ 9]. V. Ya. Pikh. Processors of the Fourier Spectral Cosine Transform on the Basis of Various Correlation Functions and the Number-Theoretic Bases. Abstract of PhD Thesis, speciality 05.13.05 – Computer Systems and Components. Ternopil, 2016, 20 p.
- [Publ 10]. O. A. Sachenko. Formation of a Strategically Oriented Portfolio of Innovation Projects for the Modernization of Electric Power Equipment. Abstract of PhD Thesis, speciality 05.13.22 – Projects and Programs Management, Lviv, 2016, 21 p.

### Journal Papers

- [Publ 11]. A. O. Sachenko, V. V. Kochan, V. S. Kharchenko, V. V. Yatskiv, M. A. Chernyshov, P. Ye. Bykovyy, O. Yu. Roshcupkin, V. S. Koval. Concept of Building of Mobile Systems of Post-emergency Monitoring of Nuclear Power Plants using Quadrocopter Fleet, Radioelectronic and Computer Systems. Kharkiv «KHAI», 2016, no. 5 (79), pp. 207-214.
- [Publ 12]. D. I. Zahorodnia. Comparison of Methods for the Allocation of Characteristic Points of the Contour, Radioelectronic and Computer Systems. Kharkiv «KHAI», 2016, no. 3 (77), pp. 56-61.
- [Publ 13]. G. Yu. Shcherbakova, V. N. Krylov, R. A. Pisarenko, O. V. Logvinov. The study of Automated Clustering using the Wavelet Transform, Systems of Information Processing. Ivan Kozhedub Kharkiv University of Air Forces, 2016, issue 2, pp. 73-75.
- [Publ 14]. S. D. Bushuyev, D. A. Bushuyev, R. F. Yaroshenko. The Analyses of Project Management Methodologies based on Genome Models, Technology Audit and Production Reserves, 2016, vol. 4, issue 2 (30), pp. 4-12.
- [Publ 15]. D. A. Bushuyev, S. D. Bushuyev. Nonlinear Dynamics of Organizations Development, Strategic Management, Management of Portfolio, Programs and Projects. Transaction of National Technical University “KhPI”, 2016, no. 1 (1173), pp. 3-8.

- [Publ 16]. S. D. Bushuyev, M. S. Dorodh, N. V. Shakun. Innovative Thinking in the Formation of New Project Management Methodologies, Management of Complex Systems Development, 2016, no. 26, pp. 49–57.
- [Publ 17]. S. D. Bushuyev, D. A. Bushuyev, R. F. Yaroshenko. The Analyses of Project Management Methodologies based on Genome Models, Technology Audit and Production Reserves, 2016, vol. 4, issue 2 (30), pp. 4-12.
- [Publ 18]. S. D. Bushuyev, O. O. Boyko. System Integration of Approaches in the Management of Construction Projects, Management of the Development of Complex Systems, 2016, issue 26, pp. 43-48.
- [Publ 19]. T. V. Lendyuk. Information Technology for the Formation of an individual learning path, taking into Account the Complexity of The Educational Material and the Level of Students Knowledge, Measuring and Computing Engineering in Technological Processes, 2016, no. № 3 (56), pp. 213-221.
- [Publ 20]. T. V. Lendyuk. Knowledge-oriented Information Technology for Constructing of Adapted Learning System, Bulletin of the Brest State Technical University, 2016, no. 5, pp. 16-21.
- [Publ 21]. N. M. Vasylykiv, L. O. Dubchak, T. V. Lendyuk, I. V. Turchenko Fuzzy system of the task distribution for testing students, Scientific Transactions of Yuriy Fedkovych Chernivtsi National University. Series: Computer Systems and Components, vol. 7, issue 2. – Chernivtsi: ChNU, 2016, pp. 20-24.
- [Publ 22]. O. Berezhsky, L. Dubchak, N. Vasylykiv. Competentive Approach to Preparation of Bachelors on the Specialty “Computer Engineering”, Scientific Journal of the V. O. Sukhomlynsky Mykolaiv National University. Geometric Modeling and Information Technology, 2016, no. 2, pp. 11-16.
- [Publ 23]. Sergei Bezobrazov, Anatoliy Sachenko, Myroslav Komar, Vladimir Rubanau. The Methods of Artificial Intelligence for Malicious Applications Detection in Android OS // International Journal of Computing, 2016, Vol. 15, Issue 3, 184-190.
- [Publ 24]. V. N. Krylov, R. A. Pisarenko, G. Yu. Shcherbakova. Information Technology of Quality Assessment of Assembly Units in Radio Equipment Manufacturing, Scientific and Technical Journal Electrotechnic and Computer Systems, 2016, no. 23(99), pp. 127-131.
- [Publ 25]. M. P. Komar. Increasing the Stability of Computer Systems to Cyberattacks, Transactions of Chernivtsi National University: Computer Systems and Components. – Chernivtsi, 2016, vol. 7, issue 1, pp. 6-12.
- [Publ 26]. T. G. Tsavolyk. Corrective Codes in the System of Residual Classes with Special Modules, Measuring and Computing Engineering in Technological Processes, 2016, no. 3, pp. 100-104.
- [Publ 27]. N. G. Yatskiv, S. V. Yatskiv. Prospects of the Use of Blockchain Technology in the Internet of Things, National Forestry University of Ukraine. Scientific herald of NLTU of Ukraine, 2016, issue 26.8, pp. 381-387.
- [Publ 28]. O. R. Osolinsky. Investigation of Methodical Error in Measurement of Average Energy Consumption of Microcontrollers // Bulletin of the Ivan Puluх Ternopil National Technical University, 2016, no. 1(81), pp. 118-124.
- [Publ 29]. O. I. Volynsky, P. V. Gumenny. Theoretical Bases of Determination of Remnants on the Basis of Counters in Various Theoretic-numerical Bases, Bulletin of Khmelnytsky National University. Khmelnytskyi, 2016, no. 4(239), pp. 164-173.
- [Publ 30]. J. Su, O. Kochan, V. Kochan, C. Wang. Development and Investigation of the Method for Compensating Thermoelectric Inhomogeneity Error // International Journal of Thermophysics, Vol. 37, Issue 1, 2016, Article 10. <http://dx.doi.org/10.1007/s10765-015-2025-x>.
- [Publ 31]. Ya. M. Nykolaychuk, B. B. Krulikovskiy, N. Ya. Vozna, G. Ya. Protsiuk. Problems of Structuring of Informatics for Monitoring of Oil Fields and Protection of Water Resources, Bulletin of the National University of Water Management and Nature Management, Rivne, 2015, issue 3(71), part 2, pp. 258-264.

- [Publ 32]. Ya. M. Nykolaichyuk, M. M. Kasyanchuk, I. Z. Yakymenko. Theory and Methods for Constructing a System of Modules for a Modified Perfect Form of a Residual Class System, International Scientific and Technical Journal “Problems of Control and Informatics”, 2016, no. 4, pp. 109-115.
- [Publ 33]. M. Karpinsky, L. Korkishko. DPA Simulation of First-order Attacks, Information Security, 2016, vol. 22, no. 2, pp. 184-195.
- [Publ 34]. Diana Zahorodnia, Yuriy Pigovsky, Pavlo Bykovyy. Canny-based Method of Image Contour Segmentation // International Journal of Computing, 2016. Vol. 15, Issue 3, pp. 200-205.
- [Publ 35]. Ya. Nikolaychuk, I. Yakymenko, M. Kasianchuk. Theoretical Foundations of the Modified Perfect form of Residue Number System // Cybernetics and Systems Analysis. – March, 2016. – Volume 52, Issue 2. – pp. 219-223.
- [Publ 36]. Ya. Nikolaychuk, M.N Kasianchuk, I.Z. Yakymenko. Theory and Methods of Constructing of Modules System of the Perfect Modified Form of the System of Residual Classes // Journal of Automation and Information Sciences. – 2016. – Vol. 48, №8. – pp. 56-63
- [Publ 37]. V. Golovko, A. Kroschanka. The Nature of Unsupervised Learning in Deep Neural Networks: A New Understanding and Novel Approach // Optical memory and neural networks. – pp. 127-141.
- [Publ 38]. A. Shaikhanova, A. Zolotov, L. Dubchak, M. Karpinski, V. Karpinskyi. Access Distribution Scheme to the Computer System Based on Fuzzy Logic // Graph-Based Modelling in Engineering / Eds. S. Zawiślak, J. Rysiński. – Springer, 2017. – pp. 39-50. Chapter in monograph.
- [Publ 39]. E. N. Apanel, B. V. Drivitinov, V. A. Golovko, G. Yu. Voicehovich, A. S. Mastykin. Principle of protection of brain blood supply, Izvestiya of the National Academy of Sciences of Belarus. Series of Medical Sciences, 2016, no. 2, pp. 118-126.
- [Publ 40]. Al-Zayadi Haider, Al-Sharify Mushtag Talib, Al-Sharify Talib, Yuriy Khlaponin, Mikolaj Karpinski. Proportional Allocation Method of the Required Bandwidth Capacity for the User Station using the LTE Technology // Technical Transactions: Automatic Control, Czasopismo Techniczne. Elektrotechnika. Wydawnictwo Politechniki Krakowskiej, 2016, pp. 199-208.
- [Publ 41]. Marek Boguslav Aleksander, Karina Janisz, Mikolaj Karpinski, Anton Yavorskyi, Nataliia Yavorska. Prediction of the Crash Vehicle using Machine Learning Methods // Autobusy. – 2016. – Nr. 6. – pp. 734-739.
- [Publ 42]. I. Dobrotvor, I. Stadnyk, K. Szwedziak. Determination of Power Output and Impact on the Rheological Parameters of Raw Materials During Rolling // Agricultural Engineering, 2016, Vol. 20, No.2, pp. 195-203.

### Conference Proceedings

- [Publ 43]. T. V. Lendyuk, S. P. Rippa, S. I. Sachenko. Formation of an Individual Learning Path using Knowledge-oriented and Fuzzy Approaches. Modern Problems of Informatics in Management, Economy, Education and Coping with the Consequences of the Chernobyl Catastrophe [Proceedings of the XV International Scientific Workshop, Kyiv – Svityaz, July 4-8, 2016], pp. 279-283.
- [Publ 44]. V. M. Panasiuk, O. M. Cheresnuk, T. V. Lendyuk. Analysis of the Efficiency of Innovative Activity of Industrial Enterprises using Economic-Mathematical Modeling. Modern Problems of Informatics in Management, Economy, Education and Coping with the Consequences of the Chernobyl Catastrophe [Proceedings of the XV International Scientific Workshop, Kyiv – Svityaz, July 4-8, 2016], pp. 288-292.
- [Publ 45]. D. I. Zahorodnia, O. I. Hubchakevych, V. V. Kysil. Control Access to the Computer based on the Recognition of the User Face. Proceedings of the V International.

- Conference of Young Scientists and Students “Current Problems of Modern Technologies”, November 17-18, 2016, Ternopil: TNTU, pp. 42-43.
- [Publ 46]. N. M. Vasylykiv, I. V. Turchenko, N. J. Veretyk. Factors Affecting the Reliability of the Operation of Information Management Systems. Advanced Computer Information Technologies: Proceedings of the VI National Seminar for Young Scientists and Students ACIT'2016, Ternopil: TNEU, pp. 99-100.
- [Publ 47]. N. M. Vasylykiv, R. V. Zozuliy, A. Yu. Makhno, T. O. Polishchuk. Internet Technologies in Advertising Projects of the Enterprise. Advanced Computer Information Technologies: Proceedings of the VI National Seminar for Young Scientists and Students ACIT'2016, Ternopil: TNEU, pp. 184-185.
- [Publ 48]. G. M. Gladiy. Method of System Dynamics in Simulation of Network Marketing Processes. Proceedings of the XII International Conference “Intellectual Systems of Decision Making and Problems of Computational Intelligence” (ISDMCI'2016), Zalizny Port, 24–28 May 2016, pp. 47-48.
- [Publ 49]. G. M. Gladiy. Method of System Dynamics in the Management of Project Risks. XIII International Conference “Project Management in the Development of Society”, Kyiv, May 13-14, 2016, pp. 78-79.
- [Publ 50]. G. M. Gladiy, V. V. Neizzhalyy. Project Management for a Dealer Car Center. Proceedings of the 3<sup>rd</sup> International Conference on Information Technologies and Interaction, Kyiv, November 8-10, 2016, pp. 86-87.
- [Publ 51]. G. M. Gladiy, Z. I. Chak. Information Technology in the Management of Corporate Projects. Proceedings of the 3<sup>rd</sup> International Conference on Information Technologies and Interaction, Kyiv, November 8-10, 2016, pp. 94-95.
- [Publ 52]. V. B. Voytovych, G. M. Gladiy. Algorithm for Selecting Innovative IT Projects. Proceedings of the 3<sup>rd</sup> International Conference on Information Technologies and Interaction, Kyiv, November 8-10, 2016, pp. 98-99.
- [Publ 53]. Z. I. Dambrovsky, I. Ye. Rozdobudko. Information Requirements for Project Management of the Creation of the Exhibition Center of Mobile Configuration. Proceedings of the 3<sup>rd</sup> International Conference on Information Technologies and Interaction, Kyiv, November 8-10, 2016, pp. 104-105.
- [Publ 54]. M. Z. Dombrovsky, A. O. Sachenko. An Approach to Building an Integrated Project management. Proceedings of the XIII International Conference “Project Management in the Development of Society”, May 13-14, 2016, Kiev.
- [Publ 55]. Yu. M. Ivanyshak, A. O. Sachenko. Some Aspects of Building a Management System for Interaction in Project Teams and Organizations. Proceedings of the XIII International Scientific and Practical Conference “Project Management in the Development of Society” 13-14, 2016, Kiev.
- [Publ 56]. M. Z. Dombrovsky, A. O. Sachenko. Increase the Effectiveness of Achieving Project Results on the Basis of Proactive Management. Project Management: Status and Prospects: Proceedings of the XII International Scientific and Practical Conference September 13-16, Mykolaiv: NUS, 2016, pp. 52-53.
- [Publ 57]. O. V. Dunets, A. O. Sachenko. Application of Multi-agent Modeling for IT Project Planning. Project Management: Status and Prospects: Proceedings of the XII International Scientific and Practical Conference September 13-16, Mykolaiv: NUS, 2016, pp. 55-56.
- [Publ 58]. Yu. M. Ivanyshak, A. O. Sachenko. Incompatibility of the Philosophy or Culture of Organizations with the Key Values of Flexible Project Management Methodologies. Project Management: Status and Prospects: Proceedings of the XII International Scientific and Practical Conference September 13-16, Mykolaiv: NUS, 2016, pp. 59-61.
- [Publ 59]. O. V. Dunets, O. A. Sachenko. Multi-Agent IT Planning Management Project. Proceedings of the 3<sup>rd</sup> International Conference on Information Technologies and Interaction, Kyiv, November 8-10, 2016, pp. 245-246.
- [Publ 60]. Taras Skumin, Vladimir Golovko, Anatoliy Sachenko, Myroslav Komar. Application of Neural Networks of Deep Trust for Detecting Computer Attacks. Proceedings of the V

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### 13. PARTICIPATION IN CONFERENCES, SYMPOSIUMS AND WORKSHOPS, AND RESEARCH VISITS

#### Conferences

- [Visit 1] **International Conference «Integrated Strategic management, management of portfolio, programs and projects», 16-18 February 2016, Slavske, Lviv region, Ukraine**
- Anatoliy Sachenko
  - Yuriy Ivanyshak
  - Oksana Dunets
  - Sergiy Bushuyv
- [Visit 2] **13-th International Conference “Modern Problems of Radio Engineering, Telecommunications and Computer Science” (TCSET’2016), 23-26 February 2016, Lviv-Slavsko, Ukraine**
- Oleksandr Osolinskiy
- [Visit 3] **36-th International Conference “Electronics and Nanotechnologies (ELNANO-2016)”, 18-21 April 2016, Kyiv, Ukraine**
- Taras Skumin
  - Taras Tsavolyk
  - Myroslav Komar
  - Volodymyr Kochan
  - Anatoliy Sachenko
  - Vasyl Yatskiv
- [Visit 4] **IEEE Symposium Sensors Applications Symposium (SAS’2016), 19-23 April 2016 p., Catania, Italy**
- Anatoliy Sachenko
- [Visit 5] **VI National school for young scientists and students “Advanced Computer Information Technologies” ACIT’16, 20-21 May 2016, Ternopil, Ukraine**
- Nadiia Vasylyk
  - Vasyl Koval
  - Iryna Turchenko
  - Nataliya Yatskiv
  - Taras Tsavolyk
  - Yaroslav Nykolaychuk
- [Visit 6] **XIII International Conference “Project Management in Development of Society”, 13-14 May 2016, Kyiv, Ukraine**
- Sergiy Bushuyev
  - Anatoliy Sachenko
  - Grygoriy Gladiy
  - Mykhailo Dombrovsky
  - Zbyzhek Dombrovsky
  - Yuriy Ivanyshak
  - Oleg Sachenko
- [Visit 7] **13-th International Conference “Development and use of Applied Systems”, May 19-21, 2016, Suceava, Romania**
- Oleksiy Roshnupkin
  - Anatoliy Sachenko
  - Myroslav Komar
  - Volodymyr Kochan
- [Visit 8] **International Conference “Cyber Forum 2016 Dessert B2S-S2B”, 21-23 May 2016, Chernivtsi, Ukraine**
- Volodymyr Kochan
  - Anatoliy Sachenko

- [Visit 9] **XII International Conference “Intelligent Decision-making Systems and Problems of Computing Intelligence” (ISDMCI’2016), 24–28 May 2016, Zalizny Port, Ukraine**
- Grygoriy Gladiy
  - Vitaliy Dorosh
- [Visit 10] **V International Conference “Information Protection and Security of Information Systems”, 2-3 June 2016, Lviv, Ukraine**
- Taras Skumin
  - Myroslav Komar
- [Visit 11] **International Conference of Silesian University and Wroclaw Polytechnics, 20-21 June 2016, Ustron, Poland**
- Anatoliy Sachenko
  - Serhiy Hutsal
- [Visit 12] **12<sup>th</sup> International Conference on the use of ICT in Education, Research and Industry (ICTERI-2016), 21-24 June 2016, Institute of Postgraduate Education of T. Shevchenko Kyiv National University, Kyiv, Ukraine**
- Pavlo Bykovyy
  - Anatoliy Sachenko
  - Volodymyr Kochan
  - Vasyl Koval
- [Visit 13] **International Conference “International Research Conference at the University of Applied Sciences and Arts”, University of Applied Sciences and Arts (Fachhochschule Dortmund), 24-25 June 2016, Dortmund, Germany**
- Anatoliy Sachenko
  - Serhiy Hutsal
  - Oksana Dunets
  - Yuriy Ivanyshak
- [Visit 14] **XIII International Symposium on Temperature and Thermal Measurements. In Industry and Science (TEMPMEKO 2016), 26 June – 1 July 2016, Zakopane, Poland**
- Orest Kochan
  - Diana Zahorodnia
- [Visit 15] **XV International International Scientific Seminar “Modern Problems of Informatics in Economics, Management, Education and Coping with the Consequences of the Chernobyl Disaster”, July 4-8, 2016, Svityaz, Shatsky District, Volyn oblast, Ukraine**
- Myroslav Komar
  - Volodymyr Kochan
  - Taras Lendyuk
  - Anatoliy Sachenko
  - Serhiy Rippa
- [Visit 16] **The IEEE International Conference on Information and Digital Technologies (IDT’2016), 5-7 July 2016, Rzeszow, Poland**
- Anatoliy Sachenko
  - Volodymyr Kochan
- [Visit 17] **I International Conference “Data Stream Mining and Processing” (DSMP’2016), 23-27 August 2016, Lviv, Ukraine.**
- Anatoliy Sachenko
  - Victor Krylov
  - Roman Pasichnyk

- [Visit 18] **XXI International Conference of the Admiral Makarov National University of Shipbuilding “Project Management: State and Prospects”, September 13-16, 2016, Mykolaiv, Ukraine**
- Oksana Dunets
  - Anatoliy Sachenko
  - Mykhailo Dombrovsky
  - Yuriy Ivanyshak
- [Visit 19] **3<sup>rd</sup> IEEE International Symposium on Wireless Systems within the Conferences on Intelligent Data Acquisition and Advanced Computing Systems, 26-27 September 2016, Offenburg, Germany**
- Anatoliy Sachenko
  - Vasyl Yatskiv
  - Taras Tsavolyk
- [Visit 20] **VIII International School Seminar “Theory of Decision Making”, September 26 – October 1, 2016, Uzhhorod National University, Uzhhorod, Ukraine**
- Orest Volynsky
  - Yaroslav Nykolaychuk
  - Nataliya Vozna
- [Visit 21] **III International Conference “Information Technologies and Interactions (IT & I-2016)”, November 8-10, 2016, T. Shevchenko Kyiv National University, Kyiv, Ukraine**
- Oksana Dunets
- [Visit 22] **V International Conference of Young Scientists and Students “Actual Problems of Modern Technologies””, November 17-18, 2016, I. Puluy Ternopil National Technical University, Ternopil, Ukraine**
- Diana Zahorodnia
- [Visit 23] **III International Scientific and Practical Conference “Information Technologies and Interactions (IT & I-2016)”, November 8-10, 2016, T. Shevchenko Kyiv National University, Kyiv, Ukraine**
- Oksana Dunets
  - Grygoriy Gladiy
  - Volodymyr Neizzhalyy
  - Zbyshek Dombrovsky
- [Visit 24] **International Conference of Young Scientists, Postgraduates and Students “Informational-Computing Technologies, Automation and Electrical Engineering (ITEA-2016)”, November 10-11, 2016, National University of Water Management and Environmental Management, Rivne, Ukraine**
- Yaroslav Nykolaychuk

## Research Visits

### *ICS' staff visits*

- [Visit 25] Anatoliy Sachenko, Volodymyr Kochan participated in the joint winter school WINT 2016, which was organized by representatives of the consortium TEMPUS CABRIOLET and TEMPUS Serein on February 6-12, 2016.
- [Visit 26] Anatoliy Sachenko, Oksana Dunets, Yuriy Ivanyshak, Sergiy Gutsal from June 27 to July 1, 2016, participated in the Summer School, organized annually by the Dortmund University of Applied Sciences, Dortmund, Germany.
- [Visit 27] Anatoliy Sachenko on August 27, took part in the meeting of the Executive Committee of IEEE Section Ukraine, where all IEEE centers and student departments in Ukraine were represented. From the side of the united section of the IEEE IEEE I & M / CIS Chapter section, Prof. Anatoliy Sachenko participated in the work of the executive committee.
- [Visit 28] Anatoliy Sachenko, Iryna Strubytska, Yuriy Ivanyshak in October 18, 2016 at the Lviv Polytechnic National University took part in the meeting of partner universities of the joint multi-project on the Erasmus + program. Representatives of the partner universities discussed the peculiarities of the training of project management specialists, proposed a list of modules and prepared a joint master's program in the field of "Project Management" under the Erasmus +
- [Visit 29] Anatoliy Sachenko visited the Dortmund University of Applied Sciences and Arts (Federal Republic of Germany) from October 24-28, 2016, where he attended the 8<sup>th</sup> International Week. In addition, a meeting on the Erasmus + project was held with prof. Peter Aras (Prof. Dr. Peter Arras, Belgium), Prof. Galina Tabunsky (Ukraine), prof. Cristian Mayer (Prof. Dr. Christian Meyer, Germany), Olga Mikheeva (Germany), Prof. Martin Kuhn (Dortmund, Germany), Prof. Martin Eckert, Dortmund, Germany, where they discussed the preparation of the Erasmus + project.
- [Visit 30] Iryna Strubytska paid a visit to the National University of Kyiv-Mohyla Academy on November 16 within the framework of the CBHE – Capacity Building in Higher Education Competition. The organizers of the seminar were the National Erasmus + Office in Ukraine and the Executive Agency for Education, Audiovisual and Culture (EACEA).

### *International and National Collaborators Visits*

- [Visit 31] Alexander Drozd, on February 5, 2016, visited Ternopil National Economic University. During the visit, prof. O. Drozd presented a scientific report: "Resource approach to the analysis of computer systems". He addressed a number of issues related to the development of methodological foundations for the analysis of computer systems, the principles of operation and authenticity of detecting deviations in modern diagnostic systems, and also highlighted the peculiarities of such systems' operation on strategic Ukrainian enterprises.
- [Visit 32] Carsten Wolff, on October 16-18, 2016 During the visit, Carsten Wolf on October 17, 2016, presented an open lecture on "Exchange of experience in project implementation within the framework of European educational and research programs in the fields of project management and computer science".

## 14. AWARDS

- [Award 1]. **Anatoliy Sachenko** won the grant for visiting of International Research Conference-2016, Dortmund University of Applied Sciences and Arts, June 2016, Dortmund, Germany.
- [Award 2]. **Three students: Yuriy Ivanyshak, Oksana Dunets and Serhiy Hutsal** won the grant for visiting International Research Conference-2016 at Dortmund University of Applied Sciences and Arts with a followed Summer School, June-July 2016, Dortmund, Germany.
- [Award 3]. **Anatoliy Sachenko** won the grant for visiting of International Week at Dortmund University of Applied Sciences and Arts, October; 2016, Dortmund, Germany.
- [Award 4]. **Volodymyr Kochan** was awarded by the honorary title “Honored inventor of Ukraine”.
- [Award 5]. **Anatoliy Sachenko** was awarded by honorary title “Honorable Professor of TNEU”.
- [Award 6]. **Oksana Dunets** was awarded by Diploma of I-st degree for the first place in the All-Ukrainian competition of student research papers on Information Technologies.

**15. STATISTICAL DATA**

| Data   | 2006   | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016       |
|--|--|------|------|------|------|------|------|------|------|------|------------|
| Number of Senior Researches                          | 9  | 15   | 18   | 19   | 20   | 22   | 27   | 30   | 34   | 39   | <b>40</b>  |
| Number of Junior Researches                          | 14   | 17   | 15   | 18   | 18   | 15   | 13   | 11   | 14   | 16   | <b>12</b>  |
| Number of Active Research Projects                   | 9  | 7    | 7    | 8    | 4    | 2    | 2    | 3    | 2    | 3    | <b>3</b>   |
| Publications   | 26   | 58   | 57   | 72   | 77   | 104  | 109  | 126  | 127  | 113  | <b>131</b> |
| Patents and applications for the invention           | more than 150 invention certificates of the former USSR and 39 Ukrainian patents |      |      |      |      |      |      |      |      |      | <b>9</b>   |
| Participation in Conferences, Symposia and Workshops | 13   | 18   | 19   | 21   | 36   | 29   | 33   | 28   | 29   | 33   | <b>24</b>  |
| Number of Defended PhD and DrSc Theses               | –  | 3    | 3    | 2    | 0    | 3    | 3    | 3    | 1    | 7    | <b>7</b>   |
| Number of Defended Master Theses                     | 1  | 10   | 7    | 20   | 23   | 22   | 39   | 22   | 48   | 60   | <b>12</b>  |
| Number of Received Awards                            | 1  | 2    | 5    | 7    | 5    | 3    | 2    | 3    | 2    | 5    | <b>6</b>   |

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