



Recently in 2009 we have celebrated 75th anniversary of our predecessor National Institute of Telecommunication (PIT) created in 1934 in Warsaw. Sixty years before, in 1951, this Institute was divided into two separate entities: Industrial Institute of Telecommunication (PIT) and our Institute of Telecommunications (IŁ). In 2005 Institute of Telecommunication has get formal status of national research centre (IŁ PIB), we use English abbreviation of NIT (National Institute of Telecommunications). Sixty years of our separate activities and development was presented in details in No. 3–4/2009 of special edition of our Polish periodic journal “Telekomunikacja i Techniki Informacyjne” (TITI).

Regarding this 60th anniversary of our Institute of Telecommunications in 2011, let me underline some important facts having place in the last two years from previous celebrate anniversary. In October 2010 our Institute has reached high category A for the research institution, certified by the Ministry of Science and High Education. I am really satisfied that this score we have got in 6th place in the group of 47 research institutions evaluated for the period of previous 5 years. As our new achievements we can also count gold medals and honorable mentions for our equipment awarded in international innovation fairs in Warsaw, Bruxelles, Seoul and Singapour.

In recent two years we significantly have developed our co-operation with outstanding research centres in Poland and abroad. We have sign up agreements with Faculty of Electronics and Information Technology (WEiTI) of Warsaw University of Technology and with Electronics Faculty of Military University of Technology (WAT) in Warsaw. Co-operation with WEiTI is finalized with common application for 7th FP project, and in the framework of the agreement with WAT we have admitted for training the group of 26 students and graduates. In 2011 we have also sign up the agreement with Korean Institute of Information Technology KETI. In 2010 we have send to the ITU in Geneva two reports from our research works conducted in NIT (pilot tests of DAB+ system and ground conductivity map of Poland). By the occasion of Plenipotentiary Conference of ITU in Guadalajara in Mexico we have issued special edition of our “Journal of Telecommunications and Information Technology” (JTIT), you can find there detail information on our co-operation with ITU and other organizations. In collaboration with partners we have organized important international conferences ICTON in Munich (2010) and Stockholm (2011), and also DSTIS conference in our headquarter in Warsaw (2011). In connection with our 60th anniversary we are going to organize important national 22nd Symposium on Telecommunication and Information Technology KSTiT’2012, which will take place in NIT in Warsaw (12–14 of September, 2012), and from many years is important conference and place of meeting of Polish researchers.

Our important activities in the last two years were devoted to the new research projects. From 2008 till 2011 we have almost duplicated the number of realized projects (from 11 to 20). In this period we have finalized an important project Polish National Project PBZ devoted to the new generation services and networks, conducted together with almost all main technical universities in Poland, and we have started new projects on Internet of the Future IIP, Information System on BroadBand Infrastructure and BB Poland Portal SIPS, Information System on the Protection Against the Threats ISOK, Mobile Testing Laboratory MLB, Information System for Radio Networks Planning PIAST and others.

We have significantly increased the value of realized research projects, however still our finance results are not satisfying us. This was the main reason of our restructuring activities started in order of better use of our human and material resources: we have created a new Department of Internet Architecture and Applications, we have canceled and re-organized some of supporting divisions, we have negotiated with our social partners and implemented new Collective Work Agreement and new work regulations. We also implement new legal framework for science sector in Poland: we have modified our Statute, in June 2011 we have elected our new Scientific Council and first time in our history important personalities from telecommunication companies in Poland have been included in this Council, we have also elected a disciplinary spokesman and Disciplinary Commission.

On the beginning of 2012 and the next years we are before next challenges of further restructuring, taking up new projects and creation of new research teams. Let me congratulate all our workers, partners, Authors and Readers of JTIT, on previous successful years of common work and achieved results. I wish you, in next decades of scientific and research operations in our National Institute of Telecommunications, a great personal and outstanding professional satisfaction from your work.

Wojciech Hałka  
Director of NIT

# JOURNAL OF TELECOMMUNICATIONS AND INFORMATION TECHNOLOGY

## *Preface*

This issue of the *Journal of Telecommunications and Information Technology* contains two groups of articles. The first ten papers, **edited by Jarosław Arabas as Guest Editor**, are devoted to various aspects of applying Evolutionary Computation (EC) to global optimization, while the next seven cover various issues related to communication networks and their security, plus somewhat more remote subjects of intelligent agents and semiconductor memory devices.

Evolutionary Computation is a family of methods which are inspired by findings in fields of genetics and evolution. EC methods are quite popular in solving optimal design tasks of various kind, they can be also met in business intelligence applications, in the decision support systems and in many other fields where the task is to find an approximation to the optimal solution. A natural field of EC applications are optimization tasks where the solution cannot be represented in a standard way, e.g., as a vector of real or integer parameters, but a nonstandard or structured representation is needed, e.g., a tree of a variable size.

The first paper *Evolutionary Computation for Global Optimization – Current Trends* by Jarosław Arabas briefly introduces the idea of the EC. The paper also overviews development lines that can be observed in the literature on the EC, with a particular stress on their applications in global optimization. Then, three articles follow which report on progress on development of various EC methods.

Andrzej Obuchowicz and Przemysław Prętki in the paper *Self-Adaptive Stable Mutation Based on Discrete Spectral Measure for Evolutionary Algorithms* consider the mutation operator that uses  $\alpha$ -stable mutations. They introduce an approach which allows to adaptively tune the mutation parameters to improve the efficiency of the resulting global optimization method based on an algorithm from the EC family.

Krzysztof Trojanowski, Mikołaj Raciborski and Piotr Kaczyński present a *Self-Adaptive Differential Evolution with Hybrid Rules of Perturbation for Dynamic Optimization*. They consider optimization tasks when the objective function undergoes changes and focus on the ability of the differential evolution algorithm to follow the changing location of the optimum. They mix the mutation mechanism specific for the differential evolution, which is based on using a difference between two points from the current population, with the “traditional” mutation that uses a normal variate. They also consider using an  $\alpha$ -stable distribution instead of the normal, and they report on the efficiency increase thanks to the introduced mechanisms.

The article *Improving Population-Based Algorithms with Fitness Deterioration* by Adrian Wolny and Robert Schaefer is devoted to the issue of the multimodal optimization when the task is to locate as many local optima as possible. To obtain this goal they apply a technique that gradually discourages an EC based optimization method from revisiting local optima that have been discovered already. They perform deformations of the original objective function by adding penalty terms which are defined in a way to approximate shapes of attraction basins of local optima.

Next articles present applications of EC methods. Przemysław Miazga considers *Topological Synthesis of Tree Shaped Structures Based on a Building Blocks Hypothesis*. He summarizes result of applying an EC method to the design of microwave circuits fabricated as a certain shape of metallization on a laminate plate. The design consists in planning the metallization pattern which can be a quite complicated tree-form shape. Thus it is advisable to perform the optimization process directly on the tree representation of the metallization pattern. Przemysław Miazga presents results of experiments that verify effectiveness of the presented approach.

Maciej Michalak and Robert Nowak report on an *Evolutionary Algorithm that Designs the DNA Synthesis Procedure*. Synthesis of long DNA strands uses a natural tendency of DNA to form particles made of two strands which are kept together by the complementarity bonds. To facilitate the synthesis one has to split the desired long DNA strand and its complementary strand into pieces such that pieces of the desired and complementary strand mutually overlap. Then a stepwise procedure to mix these strands in one solution is applied. Maciej Michalak and Robert Nowak use an EC method to suggest a proper division of a desired long DNA strand and to plan the procedure of mixing the resulting fragments.

Ewa Niewiadomska-Szynkiewicz, Michał Marks and Mariusz Kamola discuss the results of the *Localization in Wireless Sensor Networks Using Heuristic Optimization Techniques*. They experimentally compare the results obtained by two different EC methods, by the simulated annealing and by a problem-specific heuristic method.

Paweł Zawistowski and Jarosław Arabas consider the black-box approximation problem where the goal is to create a regression model using only empirical data without incorporating knowledge about the character of nonlinearity of the approximated function. Their paper *Incrementally Solving Nonlinear Regression Tasks Using IBHM Algorithm* presents a method which is used to build a model being a weighted sum of components being monotonic and bounded functions, each characterized by a set of parameters. They use an EC method to tune the parameters of each component function to maximize correlation between them and the approximation error function.

The paper *Benchmarking Procedures for Continuous Optimization Algorithms* by Karol Opara and Jarosław Arabas is devoted to experimental procedures that accompany the development of global optimization methods, and the EC in particular. It has become a common practice to use a set of widely recognized test functions to demonstrate the quality of optimization methods. The paper overviews two popular benchmark sets and the standardized test methodology that accompanies them. The authors comment on problems with aggregating the results obtained for test functions contained in the benchmark set to judge on the relative quality of optimization methods.

The first part of this volume is concluded with the paper *The "Second Derivative" of a Non-Differentiable Function and its Use in Interval Optimization Methods* by Bartłomiej J. Kubica who contributes to optimization methods which use interval calculus. The approach has no direct relation with the EC so far but it seems to be a promising optimization tool. The author introduces a concept of a second derivative definition in the interval calculus and provides examples showing that this significantly fastens the optimization process.

Then follows the network-and technologies-related part. Pankaj Kumar Sharma, R. K. Nagaria, and T. N. Sharma in the paper *Enhancement of Power Efficiency in OFDM System by SLM with Predistortion Technique* report how a selected mapping (SLM) and proper predistortion can mitigate the problem of high peak to average power ratio characteristic of OFDM radio networks, resulting in more efficient utilization of power amplifier, lower error ratio and reduced amplifier cost.

The next article, *Providing QoS Guarantees in Broadband Ad Hoc Networks* by Marek Natkaniec *et al.* is also about radio networks, presenting a novel QoS architecture for IEEE 802.11 multihop broadband ad hoc networks integrated with infrastructure. The authors are convinced that the proposed solution will provide QoS support for a variety of services in

future mobile ad hoc networks, providing scalability and traffic differentiation absent in other solutions previously reported in literature.

The last work related to radio networks include here is *SVD Audio Watermarking: A Tool to Enhance the Security of Image Transmission over ZigBee Networks* by Mohsen A. M. El-Bendary *et al.* This paper discusses audio watermarking as a tool to improve the security of image communication over the IEEE 802.15.4 ZigBee network, with the aim being improved resistance of encrypted watermark to attacks and degradation (fading, noise etc.) experienced in the ZigBee networks.

Baibaswata Mohapatra, Rajendra K. Nagaria and Sudarshan Tiwari in their paper *Guaranteed Protection in Survivable WDM Mesh Networks – New ILP Formulations for Link Protection and Path Protection* deal with optimization of survivable optical fiber WDM networks, presenting new, single integer linear programs (ILPs) for finding routing and wavelength assignment with best utilization of network resources (wavelength channels). The solution proposed is superior to previously reported schemes in both network wavelength utilization and computation time required.

Among several biometric access control techniques, iris recognition is highly rated. However, once the reference data are stolen, the user cannot change his biometric features in contrast to a compromised password. Therefore, properly designed security system must perform iris features matching without revealing these features and the reference template. A suitable authentication protocol is described by Przemysław Strzelczyk in his paper *Privacy Preserving and Secure Iris-Based Biometric Authentication for Computer Networks*.

Ahmed M. Elmahalawy, Moukhtar A. Ali and Hany M. Harb in their contribution *Trends and Differences of Applying Intelligence to an Agent* analyze development trends of intelligent agent solutions, with the goal of mimicking human intelligence, and the differences between two main types of intelligence that can be applied to agent: accumulative (the agent accumulates information about environment before decision is made) and dynamic. In addition, detailed terminology of accumulative intelligence is introduced.

The last paper *A Comparative Study of Single- and Dual-Threshold Voltage SRAM Cells* is very different, being devoted to hardware design of semiconductor memory devices. Pragya Kushwaha and Amit Chaudhry analyze performance trade-offs of 5-, 6- and 7-transistor SRAM cells made in 65 nm and 180 nm CMOS technologies, taking into account write time, read time and device power consumption. While the shift to 65 nm technology cuts power consumption by 80–90%, device speed is reduced to variable extent.

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