

6th International Scientific Conference on Defensive Technologies OTEH 2014

Danica Simić¹⁾
Mirjana Nikolić¹⁾

This paper provides the basic information about 6th International Scientific Conference on Defensive Technologies OTEH 2014, organized by the Military Technical Institute in Belgrade, on 9-10 October 2014. It also gives a brief overview of the prominent and interesting papers by thematic areas, presented and discussed at this Conference.

Key words: defensive technologies, military industry, international scientific conference, Serbia.

Introduction

OTEH is an International Scientific Conference on Defensive Technologies, traditionally organized by the Military Technical Institute every two years, as a multidisciplinary review of current development trends in the area of military-technical science. The Military Technical Institute is the biggest research and development institution in this area in the Republic of Serbia, and a part of the University of Defense.

The 6th International Scientific Conference OTEH 2014, held from 9 to 10 October in the Military Technical Institute in Belgrade, provided opportunities for scientists and engineers, researchers, designers and universities from many countries to share ideas and technical information regarding defensive technologies, as well as to build new relationships. The Conference was sponsored by the Ministry of Defense. For the third time, the OTEH Conference had an international character.



The emblem of the OTEH Conference

Realization of the Conference

The activities regarding the Conference began by opening a website with general information in February 2014. The inaugural meeting of the Organizing Committee was held in May, when the Organizing and Scientific Committee was constituted as well as the Secretariat of the Conference. It was taken into account that the members of the Scientific Committee should be from at least five foreign countries for the Conference to have an international character. Out of the total number of 38 members of the Scientific Committee, 17 members are from abroad: from Belarus, Germany, Turkey, Czech Republic, New Zealand, China, Bulgaria, Canada, Bosnia and Herzegovina, Slovenia, Romania and Slovakia. The official language of the Conference is English.

The call for papers for the Conference OTEH 2014 attracted over 190 submissions. The Scientific Committee selected 158 papers and plenary lectures. The papers accepted for the final program were grouped in eight topic areas:

1. Aerodynamics and flight dynamics (10 papers),
2. Aircraft (26 papers),
3. Weapon systems and combat vehicles (21 papers),
4. Ammunition and energetic materials (20 papers),
5. Integrated sensor systems and robotic systems (21 papers),
6. Telecommunication and information systems (12 papers),
7. Materials and technologies (36 papers),
8. Quality, standardization, metrology, maintenance and exploitation (10 papers).

Similarly to OTEH 2012 and OTEH 2011, the 6th Scientific Conference OTEH 2014 had an international character since among the accepted papers, 31 of them were from 13 foreign countries: Sudan, Czech Republic, United Kingdom, Canada, Bulgaria, Belarus, Bosnia and Herzegovina, Slovenia, Montenegro, France, Algeria, Macedonia and Austria (Table 1 shows the number of papers and authors from each country). The total number of authors and co-authors was 417, and 65 of them from abroad.

¹⁾ Military Technical Institute (VTI), Ratka Resanovića 1, 11132 Belgrade, SERBIA

Table 1. Overview of the number of papers from abroad

COUNTRY	Number of papers	Number of authors / co-authors
Serbia	134	352
Montenegro	2	5
Bosnia and Herzegovina	4	8
Slovenia	1	1
Bulgaria	1	2
Czech Republic	1	4
Macedonia	3	7
Sudan	8	15
Belarus	2	4
Canada	1	1
United Kingdom	1	2
Algeria	5	11
Austria	1	1
France	1	4
TOTAL 14	158	417

At the beginning of the opening ceremony, the Director of the Military Technical Institute, Col. Dr. Zoran Rajić, gave the introductory speech.



Introductory speech of the Director of the Military Technical Institute, Col Zoran Rajić, PhD (Eng)

The 6th International Scientific Conference on Defensive Technologies OTEH 2014 was officially opened by the Minister of Defense of the Republic of Serbia, Mr. Bratislav Gašić. On this occasion, he said that OTEH, being a very significant scientific-technical manifestation, represents an opportunity for all those directly and indirectly included in the activities of defensive technologies to meet in one place and exchange their experiences. He also said that the Ministry of Defense will always encourage an international military-technical cooperation.



International Conference OTEH 2014 was officially opened by the Minister of Defense of the Republic of Serbia, Mr. Bratislav Gašić

The opening ceremony was attended by over 500 guests, about 80 of whom were from abroad: 51 authors / co-authors of the papers, 15 students of the Military Academy from Algeria, and military attaches from 13 countries (Bulgaria,

Greece, Indonesia, Hungary, Libya, Polish, USA, Slovakia, Slovenia, Turkey, Ukraine, France and the Czech Republic). It was also attended by numerous accredited representatives from the following media: RTS, Tanjug, Beta, Sky Plus, BG Radio, Army Info Forum, magazine "Odbrana", "Kalibar", and the well-known TV show "Dozvolite".

Since the date of the Conference coincided with the 160th anniversary of the birth of Mihajlo Pupin, on this occasion a lecture was held by a guest from The Institute Mihailo Pupin, prof. dr. Dragoljub Martinović.



First plenary lecture "Aerodynamics of separated flow" was held by prof. Dr. Leonid Grechikhin, Republic of Belarus

Two plenary lectures were held. The first plenary lecture "Aerodynamics of separated flow" was held by prof. Dr. Leonid Grechikhin (Minsk State Higher Aviation College, Republic of Belarus), and the second lecture "Modelling of laser attack on airplane during landing maneuver" was held by prof. Dr. Martin Macko (Defense University, Brno, Czech Republic).

The total number of the Conference participants was 417. In two days of work during the Conference, 16 sessions were held in four halls. Finally, the authors presented 133 papers in the context of open discussion. The average number of the participants in the sessions was about 40. Out of the total number of the accepted papers, only 25 papers were not presented due to the absence of the authors.

On the margins of the sessions, on the second day of the Conference, the participants had the opportunity to visit the Laboratory for Rocket Motors and the Laboratory for Experimental Aerodynamics. A cocktail reception for the Conference participants and invited guests was organized in the House of Guards in Topcider. For the guests from abroad, the Military Technical Institute organized sightseeing of Belgrade from an open bus.

At the closing ceremony, the attendees were addressed by the President of the Scientific Committee, Dr Zoran Anastasijević. As a summary of two-day work, he was pleased to conclude that OTEH 2014 fulfilled the expectations of the organizers. He expressed his gratitude to all the authors and participants from abroad as well as from Serbia for their contributions and efforts which made this Conference possible and successful, and invited all the participants to the next OTEH conference that will be organized in 2016.

Overview of the selected papers by topic areas

The list of all the papers and authors as well as other information concerning OTEH 2014 can be found on the website: www.vti.mod.gov.rs/oteh. Some of the most interesting papers are presented below. The papers have been selected considering their overall quality, applicability in practice, support by experimental work, financial support

through the projects of the Ministry of Education, Science and Technological Development, as well as taking into account the discussions they prompted.

Aerodynamics and flight dynamics

One of the two introductory lectures belongs to this thematic area:

- Aerodynamics of separated flow

Leonid Grechikhin (Minsk State Higher Aviation College, Republic of Belarus)

The molecular kinetic theory used for considering the aerodynamics of aircraft flights made it possible to combine d'Alembert Euler's continual theory and Newton's corpuscular theory into a united theory of aerodynamics of aircraft flights in the Earth's atmosphere. The conditions of separated flow formation as a result of filling the vacuum zone with air flows from different directions at the velocity of sound have been considered. It has been found that the types of aerodynamics of small and large aircraft are essentially different.

- A new control system for the flexible nozzle in the T-38 trisonic wind tunnel,

Biljana Ilić, Mirko Milosavljević (Military Technical Institute, Belgrade)

Within an extensive project at the T-38 trisonic 1.5 m × 1.5 m wind tunnel of the Military Technical Institute, Belgrade, a flexible nozzle position control was implemented in a new wind tunnel control system with the view of replacing the existing system dating from the 1980s. It was based on a completely changed hardware and software platform, with a more efficient position control algorithm, but using the same actuators and sensors as in the previous system. The improvement was achieved and confirmed by wind tunnel tests; however, previous problems with unreliable position sensors still remained. After these activities, the flexible nozzle control system was further improved introducing new position sensors, which brought major software changes and an even more efficient position control algorithm. This paper outlines design considerations for achieving the optimum position control and its implementation on a programmable automatic controller. A brief description of the system safety and diagnostic features is given. The flexible nozzle control system robustness was verified for a complete Mach number envelope of the wind tunnel and the results showed significant improvements in speed, accuracy, stability and reliability in comparison to the previous one, thus enhancing the wind tunnel overall performance.



Participants of the plenary session "Aerodynamics and flight dynamics"

- Comparison of numerically obtained 2d flow fields for the bionic high speed train concept designs inspired with aquatic and flying animals,

Suzana Linić (University of Belgrade, Institute Gosa, Belgrade), Boško Rašuo, Vojkan Lučanin (University of

Belgrade, Faculty of Mechanical Engineering, Belgrade), Mirko Kozić (Military Technical Institute, Belgrade), Mirjana Puharić (University of Belgrade, Innovation Centre of Technology and Metallurgy, Belgrade)

The numerically obtained flow fields, pressure distributions and streamline allocations around five 2D bionic high speed train (BHST) models are compared. The work examined the possibilities whether a bio-inspired design gives a basis for a low-drag, energy efficient and aerodynamically silent BHST concept. Japan's Shinkansen 500 Series was the first brought biomimetic in heavy vehicle applications and approved abilities for environmental protection and drag reduction by design adjustment. A selection of aquatic and flying animals was based on the criteria of their assumed maximum speeds achieved while catching prey and their catching technique in the natural environment, according to available data. The animals in consideration were a kingfisher, a dolphin, a sailfish, a shark and a barracuda. The tested BHST configuration consisted of two idealized driving cars connected smoothly on aft-ends, placed in the open railroad surrounding. The BHST biomimetic nose, smoothly connected with the after-body of the same design, represented the train in a real scale. The equal and aligned cross sections formed a 2D numerical model between the domain's sidewall. The test velocities were 100 km/h, 200 km/h, 300 and 400 km/h. The Computational Fluid Dynamic tool in use was the ANSYS Fluent 12. The tetrahedral mesh, excluding the boundary layer, counted up to 10e+06 elements. The introduced inner adapting surfaces covered the BHST and the ground with the purpose to control the mesh, from the inflation layer to the outer space at a distance of about one third of the BHST length. The boundary condition set for the ground was a moving wall. Assuming compressible flow that might appear under the BHST bottom, the applied turbulent model was a two-transport equation model, Standard k-ε, with non-equilibrium wall treatment. The flow field behavior, as a result, showed good potentials of the explored BHST designs for adoption and further research as a bio-inspired design basis for train speeds over 200 km/h. The emphasized bio-inspired design was kingfisher-like.

Aircraft

- Comparative analysis of the analog and the digital cockpit of Lasta training aircraft,

Slaviša Vlačić, Aleksandar Knežević (Military Academy, Belgrade), Nikola Pekić (Department for Strategic Planning, MoD)

Lasta training aircraft, as a new type in the Serbian Air Force service, brings a lot of technical improvements in comparison to older types of training aircraft. One of the biggest improvements is the implementation of a digital glass cockpit. This paperwork explains the most important advantages of the digital glass cockpit versus the analog cockpit applied on the prototype P1 and the first production lot of the Lasta training aircraft. The emphasis of the paperwork is on the first exploitation experiences and future expectations.

- Computational fluid dynamics of the turbulent air flow through a vaned diffuser turbocharger,

Abdelmadjid Chehhat (Mechanical engineering department, Faculty of technology, Abbes Laghrou University, Khenchela, Algeria), Mohamed Si-Ameur (Laboratory of Energetic and Industrial Systems, University of Batna, Algeria)

This work deals with a numerical study with the moving reference frame (MRF) technique. Many research works on the impeller-diffuser interactive phenomenon, both experimental and numerical ones, have been undertaken so far. However, it is found from the literature that the study on the impeller-diffuser-

volute interaction has not been the focus of attention in these works and neither was the performance of the turbocharger centrifugal compressor by varying the number of diffuser vanes. Hence, a numerical analysis was accomplished in order to extensively explore the impeller-diffuser fluid interaction in a real turbocharger used in military engines applications when the number of diffuser vanes was changed at an unaltered number of impeller blades. It was concluded that the number of diffuser vanes has a considerable effect on the pressure and temperature at the compressor outlet.



Participants of the International Conference OTEH 2014

- *The sources of measurement uncertainty related to aircraft flight testing,*

Zoran Filipović (Institute GOŠA, Belgrade), Sakhr Abu Darag, Donia Mohammed, (Sudan University of Science and Technology, Khartoum), Dragoljub Vujic (Military Technical Institute)

This paper describes the sources of measurement uncertainty related to flight testing, as well as the analysis of some methods of eliminating or minimizing measurement uncertainty in collected flight data. Measurement uncertainty is an estimation of a potential error in a measurement result caused by variability in the equipment, the processes, the environment, and other sources. Flight testing is a very complex experimental procedure. In fact, many of these error sources require special attention. As a result, it combines most of the types of errors found in experimental methods. For instance, systematic and random errors are found in data acquisition systems from which data are collected. Random errors come from the atmosphere, electromagnetic interference and from a pilot's technique. Bearing in mind that aircraft testing is the last stage of creating an aircraft, it is necessary to understand where the sources of the flight testing uncertainty lie, to take steps to avoid or minimize that uncertainty, and then to present the data in a manner that recognizes the remaining uncertainty. Evaluating the measurement uncertainty in any particular situation thus comprises the identification, quantification and combination of these components. Therefore, the Air Force Flight Test Centers are continually seeking ways to improve the planning, execution, analysis, and reporting of developmental test and evaluation programs. The statistical methods are used to calculate confidence intervals or uncertainty for final results.

Weapon systems and combat vehicles

The second introductory lecture, held by prof. Macko, belongs to this topic area:

- *Modelling of laser attack on airplane during landing manoeuvre,*

Teodor Balaz, Frantisek Racek, Pavel Melsa, Martin Macko (University of Defence, Brno)

Laser attacks against airplanes seem to be a significant threat for air traffic today. Irradiation of the windshield of the airplane cockpit can cause serious effects that can decrease pilot's ability to control the airplane. Therefore, the paper deals with the necessary steps for threat classification, namely the evaluation of the superposition of a laser beam spot and the airplane windshield during the laser attack and eye reaction.

- *Numerical simulation of fragmentation warhead mechanisms,*

Predrag Elek, Slobodan Jaramaz, Dejan Micković (University of Belgrade – Faculty of Mechanical Engineering, Weapon Systems Department, Belgrade), Nenad Miloradović (Yugoimport FDSP, Belgrade)

This paper is about the determination of the velocity of fragments and their rejection angles, as well as their importance in the warhead fragmentation design and the evaluation of warhead efficiency. It is well known that simplified analytical approaches such as Gurney equations and Taylor formula provide only a rough estimate of a velocity vector of fragments. Therefore, the numerical approach is a logical and inevitable choice when more accurate calculations are needed. In this paper, the commercial multi-purpose program Abaqus, based on the finite element method, is used for the simulation of the mechanism of explosive propulsion. The applied modeling techniques as well as the procedure of the model creation through the modules of Abaqus have been presented. The experimental results of a well-documented test of the fragmentation warhead with premade fragments are compared with the simulation results of the corresponding numerical model. Very good agreement between the experimental data and the numerical results suggests that Abaqus can be successfully used for the simulation of warhead mechanisms.

- *Longitudinal dynamic stability investigation for a subsonic cruise missile using a 3 dof flight dynamics model,*

Ahmed Osama Mahgoub, Khalid Ibrahim Bashir (Sudan University of Science and Technology, Khartoum), Eimad Eldin El Hadi Musa (Karary University, Khartoum)

This paper studies the dynamic stability characteristics of a subsonic cruise missile configuration using a 3 Degrees-of-Freedom (3DOF) nonlinear flight dynamics model. The aerodynamic data for the configuration and control surface effectiveness have been obtained using USAF digital DATCOM, and the missile static stability was checked using the data from DATCOM. The aerodynamic data and the stability derivatives obtained were used in constructing a nonlinear 3 DOF longitudinal flight dynamics model to check the dynamic stability of the missile. The model was constructed using Simulink® and the Aerospace Blockset included with the package. Two simulations with different inputs were analyzed. The initial conditions for the first simulation were non-equilibrium initial conditions without a control input; the other simulation was with a double step elevator input with different initial conditions. The run time for each simulation was 500 seconds and 60 seconds, respectively. Both of the longitudinal dynamic modes (Phugoid and short period) were present in the response obtained from the simulation. From the simulation results and DATCOM output, it was found that the missile is both longitudinally statically and dynamically stable and that the missile response to the elevator input was proper.

- *Smart targets system for fire shooting,*

Jane Stoimanov, Nenad Jordanovski, Jugoslav Achkoski (Military Academy "General Mihailo Apostolski", Skopje)

The training plans at all military forces include fire shooting training. A traditional way of checking results is a process that takes a lot of time, especially during long range fire shooting. The time which soldiers spend on walking to the targets and counting the hits with different instruments can be significantly reduced with the smart targets system for fire shooting (STSFS) and it can be less than one second. The STSFS is based on sound detection with sound sensors integrated in a steel plate used as a target. This paper presents the models of the STSFS and the simulations of the systems in a MATLAB software package. Mathematical models for a precise detection of target bullet positions are also shown. It calculates the hit coordinates on the steel plate and, with particular software (information system), the results are displayed on the monitor in less than one second. The STSFS may have implementation in the military environment especially in the process of fire shooting training because it saves time, allows better and faster fire shooting corrections and, with particular software, it allows live streaming of results inside and outside a training filed.

Ammunition and energetic materials

- *Impact of a blast wave from a mixture of AN and urotropine on critical elements of reinforced concrete structures*, Iliyan Hutov (National Military University "Vasil Levski", Veliko Tarnovo), Radi Ganev (University of structural engineering and architecture "Lyuben Karavelov", Sofia)

This paper presents the findings from the research which explores the blast characteristics of a mixture of AN and urotropine. A group of simulated and examined scenarios was used for assessing a new concept of protection techniques, using the LS-DYNA software. The main contribution achieved in this paper is in the results of the simulations. The analysis of the simulation output reveals that the way of reinforcing columns increases their resistance to a blast wave. The proposed techniques are applicable for the protection of critical infrastructure sites.

- *Experimental determination of rocket motor internal ballistic coefficients and performance parameters*, Saša Živković, Nikola Gligorijević (Military Technical Institute, Belgrade), Miloš Filipović (Faculty, University of Novi Pazar, Novi Pazar), Predrag Elek, Momčilo Milinović (Faculty of Mechanical Engineering, University of Belgrade, Belgrade), Mohammed Amine Boulahlib (Military Academy, University of Defense, Belgrade)

In solid propellant rocket motor internal ballistic calculations, the following coefficients, performance parameters and characteristics are required: specific impulse, discharge coefficient, thrust coefficient and propellant burning rate law. All those RM working parameters can be theoretically or semi-empirically predicted, but depends on rocket motor design and on flow losses of combustion products; theoretical values can be very unreliable. The correction of theoretical working parameters can be provided using experimental data, although this approach is expensive and requires necessary experimental equipment. The use of corrected working parameters in internal ballistic calculations leads to highly precise results, and the accuracy of this approach is demonstrated in two different examples.

- *Prediction of energetic performances of double base propellants*, Miloš Filipović (State University of Novi Pazar), Aleksandar Milojković (Military Technical Institute, Belgrade)

A suitable method for calculating energetic performances of a double base propellant was developed and successfully

verified. This method is based on generally accepted hypotheses, a consistent and simple calculation of the chemical equilibrium in a predominantly gaseous, multi-component reactive mixture, and on an appropriate numerical scheme involving the propellant formula and the assigned rocket motor operating conditions. A computer program, which permits the calculation of the equilibrium composition of the combustion products and the theoretical energetic performances of double base propellants, has been developed. The results of the calculations have been compared with the experimental data obtained by static tests of several rocket motors. All comparisons gave satisfactory agreement.



Participants of the International Conference OTEH 2014

- *Optimization of chromatographic conditions for separation of diphenylamine and its nitro and nitroso derivatives by liquid chromatograph*,

Vesna Petrović, Slaviša Stojiljković, Jelena Šultans (Technical Overhaul Works Kragujevac)

The optimization of the conditions for the baseline separation of diphenylamine (DPA) and its nitro and nitroso derivatives by reversed phase high performance liquid chromatography is performed. The chromatographic resolving of N-nitroso DPA, mononitro DPA, N-nitroso-mononitro DPA, dinitro derivatives and some N-nitroso-dinitro derivatives of DPA but also some other components of gunpowder and rocket propellants (dinitrotoluene, nitroglycerine and phthalates) is achieved with no influence on the quantitative determination of effective stabilizers, DPA and N-nitroso-DPA. The method is optimized for the estimation of the chemical stability of nitrocellulose-based powders and rocket propellants and the selected parameters are in accordance with AOP48 Ed.2 method regarding the resolution and maximum column temperature.

Integrated sensor systems and robotic systems

- *Light concentration in semiconductor infrared detectors for night vision by graded antireflection layer incorporating plasmonic particles*,

Marko Obradov, Zoran Jakšić, Dana Vasiljević Radović (IHTM – Center of Microelectronic Technologies, University of Belgrade, Republic of Serbia)

Enhancement of responsivity and specific detectivity is one of the strategic goals of the technology of infrared detectors for night vision. One of the recently proposed approaches to this purpose is the use of localized surface plasmons polaritons which cause strong localizations of electromagnetic fields, ensuring extreme shortening of the necessary propagation paths of incident radiation. This approach has been obtained as an extension of a similar strategy used for solar cells, through a modification by various redshifting approaches. Another method to increase incident optical flux in detectors is the use of antireflective (AR) coatings, among

the most efficient ones being those with the refractive index gradient. The design of monolithically integrated systems for detector enhancement incorporates gradient index of AR coatings, with embedded plasmonic particles at their high-index surface. Such structures ensure maximum transmission in infrared with simultaneous redshifting of plasmonic resonance, resulting in large localizations of infrared radiation in the near field part overlapping with the active region of the photodetector. The paper shows the designed and optimized structures utilizing finite elements modeling, starting from the Helmholtz equation. The available materials and technological approaches are considered. An enhancement of figures of merit of about 30 times compared to the conventional detectors without plasmonic/AR structures is obtained.

- *A technical solution of the optoelectronic multisensor system,*

Nebojša Šapić, Nikola Jovanović, Katarina Savić (Military Technical Institute, Belgrade)

The paper presents an ISTAR-based model of an optoelectronic multisensor system designed for passive observing, surveying and acquisition of targets. The model is mounted on a vehicle and consists of multiple optoelectronic sensors which generate images in multiple spectral bands whose purpose is better detection, recognition and identification of targets. Apart from optoelectronic sensors, namely a video imager, a thermal imager, and a laser range finder, the model also integrates a GPS receiver, a digital compass, a pan-tilt mechanism, a computer network, control units, and appropriate software for command and control. The system promotes modular architecture and uses a standard network and computer hardware, and open network protocols. The custom software application provides overall system functionality.

- *An FPGA implementation of the beamforming algorithm with digital MEMS microphones,*

Iva Salom, Vladimir Čelebić, Milan Milanović (Institute Mihailo Pupin, University of Belgrade), Dejan Todorović, Mirjana Radosavljević (Dirigent Acoustics, Belgrade), Juriž Prezelj (Faculty of Mechanical Engineering, University of Ljubljana, Slovenia)

The goal of the project described in this paper was to design an acoustic system for the localization of the dominant noise source by implementing the conventional delay-and-sum beamforming algorithm on the FPGA platform with a sound receiver system based on digital MEMS microphones. Such configuration enables the execution of the beamforming algorithm in real time. Additionally, FPGAs bring many benefits in terms of safety, reliability, rapidity, and power consumption. The system was designed and verified using the rapid prototyping methodology with Matlab Simulink tools. A performance evaluation of the FPGA design is presented in terms of hardware resources for the chosen Xilinx Spartan-6 family.

- *An efficient solid state VHF band radar transmitter,*
Zvonko Radosavljević, Dejan Ivković, Dragan Nikolić (Military Technical Institute, Belgrade), Dragan Paunović (MITEC d.o.o Belgrade)

One of the most important parts of radar modernization is a radar transmitter high power amplifier (HPA). A modernized radar provides significant performance improvement: range, resistance to the electronic warfare (ECCM), moving target indication (MTI factor). In this paper, the VHF-band high speed pulsed high power amplifier using four modules with MRF6V121KHR6 MOSFET is designed and proposed. The construction and the proposed technical solution of 2000 W radar amplifiers is tested and the experimental evaluation showed the feasibility of radar transmitter modernization.

Telecommunication and information systems

- *Multibeam receiving antenna at the missile lateral structure,*

Zoran Golubičić (Peripolis – elektronika, Belgrade), Slobodan Simić (Military Academy, Belgrade), Aleksa Zejak (RT-RK Computer based systems, Novi Sad, Serbia)

In this paper, a linear array antenna mounted along the missile body is presented. The linear array consists of patch type radiating elements. The antenna is able to operate at lower frequency (L or S band) and could be compatible with long range acquisition radars. The dimensions of the linear antenna array are not related with the missile diameter and the linear array could be positioned at a missile with a small diameter. The linear array, collinear with the antenna body, forms many simultaneous beams, narrow in the planes collinear to the missile and wide in the plane orthogonal to the missile. Depending on the element phasing, the radiation pattern could be formed in the form of different conical shapes with the apex at the missile longitudinal axes. It means that the array simultaneously receives signals from the almost full sphere. The array has the maximum gain at the plane orthogonal to the missile and it can be decreased for four dB at the cone angle of 70 degrees. This work was partly supported by the Ministry of Education and Science of the Republic of Serbia under Project TR-32041, year 2014.

- *Different types of WFQ mechanisms in a VOIP traffic analysis,*

Vladimir Suša, Boban Pavlović, Radovan Dragović (Military Academy, University of Defence, Belgrade)

In order to provide a desirable end-to-end QoS in IP telecommunication networks, it is necessary to manage an appropriate QoS mechanism for achieving the optimal values of QoS parameters. This primarily refers to QoS parameters which are monitored in real-time applications, such as packet delay, packet delay variation (jitter) and packet loss. In this approach, the Weighted Fair Queuing (WFQ) mechanism was analyzed. The simulation scenario based on a given telecommunication network through the OPNET Network Simulator is applied. The simulation model contains a network node with defined applications (Background and VOiP applications) and profiles (Background and VOiP profiles) which are implemented to end users and appropriate network elements (routers). The five simulation scenarios in total, with four different solutions for the Quality of Service configuration, are presented. The initial scenario comprises a model without a QoS mechanism. The other four scenarios have different WFQ implementations according to ToS (Type of Service), transport protocol (TCP or UDP), port value (for different applications) and finally according to the values of the DSCP field in the IP header. By comparing the obtained QoS parameter values for all simulation scenarios, the optimal solution for choosing an appropriate WFQ implementation is given.

- *Adsorption-desorption based random number generator,*
Olga Jakšić, Dragan Tanasković, Danijela Randjelović, Filip Radovanović (IHTM – Centre of Microelectronic Technologies, University of Belgrade, Serbia)

Data tracking and hacking is especially dangerous in modern defence forces where classified data transmission must involve cryptographic methods for secure and reliable data coding. The more unpredictable the cipher is, the more reliable the message is. A hardware random number generator or a true random number generator (TRNG) is a crucial part for every telecommunication system that involves secure and confidential electronic data transfer (official state agencies, e-banking, military data networks, etc.) because it generates

random numbers from a physical process which provides statistically random noise signals, which are truly unpredictable contrary to pseudo-random number generators generated by various software algorithms. A typical hardware random noise generator uses a transducer to convert the random physical process (thermal noise, photoelectric effect or other quantum phenomena) to an electrical signal, amplifiers and AD converters. On the other hand, the pseudo-random number generation based on methods and algorithms may be examined by statistical tests for randomness and check whether it is cryptographically secure. There is a possibility to implement the noise generated by adsorption-based sensors as a creation in an algorithm for pseudo-random number generation and also the possibility of adsorption-based random hardware generation. This work has been funded by the Serbian Ministry of Education, Science and Technological Development within the framework of project TR 32008.

Materials and technologies

- *The possibility of decontamination of highly toxic chemicals thickened formulations*, Radovan Karkalić (Military Academy, Belgrade), Željko Senić (Military Technical Institute, Belgrade), Branko Kovačević (CBRN Training Center, Krusevac), Dalibor Jovanović (Technical Test Center, Belgrade)

The highly toxic thickened chemicals are specific formulations of highly toxic chemicals mixed with the substances (usually acrylic resins) in order to increase their durability on contaminated surfaces. The role of thickener is to reduce the volatility of the highly toxic chemicals. Although there are many formulations of thickened highly toxic chemicals, the most common form of administration is to add an organic polymer, for example, copolymers of methyl-, ethyl-, butyl methacrylate to highly toxic chemicals (S-mustard, soman, VX etc.). This type of high-molecular weight polymer is used as a thickener composition with the highly toxic chemicals. Some of the thickened formulations of highly toxic chemicals are: thickened lewisite thickened soman and thickened VX. This paper presents the results of decontamination of thickened highly toxic chemicals by adsorption materials, alkaline solutions, chlorine-activated materials and micro-emulsions.

- *Research and testing of novel Solid-liquid phase change compounds for the military microclimate cooling systems*, Dalibor Jovanović, Predrag Stojisavljević, Ljubiša Tomić (Technical Test Center, Belgrade, Serbia), Radovan Karkalić (Military Academy, Belgrade), Aleksandar Nikolić, Veselin Maslak (Faculty of Chemistry, Belgrade)

Phase Change Materials (PCM) absorb energy during the heating process and release energy to the environment in the phase change range during a reverse cooling process. Personal body cooling is one of the several potential areas in which the phase change method of heat storage can be applied. This paper presents the results from the joint research activities conducted in the Technical Testing Centre and Faculty of Chemistry in Belgrade related to the chemical analysis of two commercially available PCMs: n-hexadecane and an inorganic salts mixture. The functionality of the chemicals was tested in the Military Medical Academy where both PCM compounds were integrated in different types of cooling garments (InORG, OrgT and OrgO). The experiments comprised the testing of the cooling garment efficiency on soldier's physiological performance during exceptional heat stress in hot environment. Physiological strain was determined by body core temperature (T_{ty}) and mean skin

temperature (T_{sk}). The study results indicate a direct influence of the used PCM type physical and thermodynamic properties (melting temperature and latent heat of fusion) on the personal cooling system functionality and cooling intensity.

- *Independent power and energy sources for military applications*,

Gvozden S. Tasić, Petar Z. Laušević, Ivana M. Perović, Snežana M. Miulović, Vladimir M. Nikolić, Milica P. Marčeta Kaninski (University of Belgrade, Vinča Institute of Nuclear Sciences, Belgrade)

This paper presents an overview of different military applications of fuel cells. Fuel cells offer significant reduction in weight, volume and cost compared to conventional power sources. Fuel cells are suited for silent operations because of their low heat and noise signatures. Recently, fuel cells have found use in a variety of critical military applications such as: unmanned aerial and ground vehicles, soldier portable power, in silent camp, silent watch applications, in submarines, warships, trucks, cars, forklifts for defense depots and for portable and stationary power generation.

Providing electrical power to meet the tactical requirements of the future battlefield will become a critical enabling technology. By installing fuel cell distributed generation systems, electrical sources can be placed right at the location, eliminating power lines that are vulnerable to accident or attack. Generating power on site at stateside and forward operating locations also dispenses with the need to deliver fuel. This paper also presents the results in the development of a 5 kW μ -CHP (combined heat and power) system for the supply of electrical and thermal energy, as well as other fuel cell systems being developed at the Hydrogen Energy Division of the Vinca Institute of Nuclear Sciences.

- *Investigation of possible superstructures for nanoaperture array-based plasmonic sensors for a simultaneous detection of multiple dangerous substances*, Dragan Tanasković, Olga Jakšić, Marko Obradov, Zoran Jakšić (IHTM – Centre of Microelectronic Technologies, University of Belgrade)

Monitoring dangerous substances, including toxic and explosive materials in trace amounts is one of the primary targets of the CBRNe (chemical, biological, radiological, nuclear and explosive) protection. The goal is to detect and recognize warfare agents and to obtain approximate information about their concentration. Hazard identification is critical in field work for the implementation of appropriate protective measures, but currently this process requires sophisticated equipment and complex lab analyses. Since it cannot be known in advance which warfare agent will be used, one has to simultaneously check for different possible substances. The usual approach is to utilize an array of different sensors, each dedicated to a single agent. The aim of this paper is to analyze a possible nanoplasmonic sensor with high sensitivity and custom-designed spectral selectivity convenient for a simultaneous detection of multiple warfare agents. A new simple geometry of a nanoplasmonic metamaterial sensor is proposed where the basic metamaterial fishnet structure (a metal-dielectric-metal sandwich with rectangular openings) is modified by superposing additional subwavelength patterns. Thus a unit cell superstructure is obtained with multiple tailorable spectral peaks that increase the selectivity at different wavelengths. The finite element method was used for the simulations of the proposed sensor. Our results show that selectivity can be tuned by modifying geometry at a deep subwavelength scale.

Quality, standardization, metrology, maintenance and exploitation

- *Problems of reliability prediction of electronic equipment*, Slavko Pokorni (Information Technology School, Belgrade),

The military handbook for the reliability prediction of electronic equipment MIL-HDBK-217 is still used by more than 80% of engineers. However, in spite of the fact that the MIL-HDBK-217 was updated several times to keep pace with technology advancement as well as with the changes in the prediction procedure, it has its limitations. Besides that, problems in setting requirements for reliability were encountered in practice, leading to differences between the calculated reliability and actual reliability in use. The limitations of the MIL-HDBK-217 and the efforts to revise it are presented in this paper as well as the problems to establish good reliability requirements in connection with the statistics of causes of failures, which shows that big percentage of failures accounts for non-hardware failures. A way how to establish good contractual reliability requirements is also discussed.

- *The development of an appropriate framework of ip management*,

Milana Vitas, Dragan Kukolj, Miroslava Dražić, Sandra Kukolj (RT-RK Institute for Computer Based Systems, Novi Sad, Serbia), Željko Tekić (University of Novi Sad/Faculty of Technical Science, Novi Sad, Serbia)

This paper illustrates an appropriate framework for the development and management of intellectual property (IP) assets in enterprises. The focus of this work was on the development of a unique IP management framework consisting of IP strategies with the aim to develop, manage and finally commercialize a patent portfolio. We considered an approach where patent strategies are defined as internal and external. In this paper, it is shown that the IP Audit gives the complete overview of the IP resources of one company. The IP strategies always need to include patent filling strategies and they might be offensive, such as: obtaining a competitive advantage, generating income from transfer of intellectual rights and using as bargaining chips; or strategies could be defensive: fencing technology in, blocking competitors and confusing or intimidating competitors. As the final stage of an appropriate IP framework - the commercialization is developed through its main directions: product enhancement, licensing the patent rights, joint ventures and/or creating strategic alliances. As a contribution to the support of creating the described IP management framework, a recently developed software tool for competitive intelligence based on patent data is used. The Patent Search and Analysis for Landscaping and Management (PSALM) tool analyzes, compares and evaluates strengths and weaknesses of different patent portfolios. A single real-world case study as an illustration of the PSALM tool usage capabilities is presented.

- *Spatial data quality principles and evaluation procedures based on ISO 19113 and 19114 standards*, Stevan Radojčić, Saša Bakrač, Slaviša Tatomirović (Military Geographical Institute, Belgrade)

This paper gives a review of spatial data quality principles and evaluation procedures based on relevant ISO standards,

ISO 19113 and ISO 10114. It also gives an overview of their implementation in Serbia and the Military Geographical Institute of Serbian Armed Forces (MGI), as well as some considerations and suggestions about further efforts in the development of the spatial data quality system in the MGI.

Conclusion

The 6th International Conference on Defensive Technologies (OTEH 2014) was successfully held from 9 to 10 October in the Military Technical Institute in Belgrade. A large number of scientists and researchers gathered on this occasion in the Military Technical Institute to exchange their experiences and ideas in the field of defensive technologies. More than 500 guests attended the Conference, including the authors and coauthors of the papers coming from abroad and from our country, representatives from the Ministry of Defense of the Republic of Serbia, accredited military attaches from 13 countries, students of master's and doctoral academic studies from Algeria, and journalists from many media.



VTI Headquarters

Including two plenary lectures, the total number of accepted papers was 158, out of which 31 were from abroad. Among 417 participants, 65 authors and co-authors were from abroad.

At 16 sessions held in 4 halls, 133 papers were presented and discussed, divided in 8 topics. Besides the working part, the participants had an opportunity to enjoy sightseeing Belgrade, to hear an interesting lecture marking 160 years of the birth of Mihajlo Pupin, and also to visit facilities of the Military Technical Institute.

The aim of the Conference was to promote a cooperation and establish new contacts that might provide even greater participation of authors and researchers from abroad in the next, 7th scientific conference OTEH 2016. OTEH 2014 has fulfilled the assigned aims. During the two-day Conference, many high-quality and original papers from current research projects were presented, as well as the papers on the research already applied in practice in particular military technology areas.

6. Međunarodni naučno-stručni skup iz oblasti odbrambenih tehnologija OTEH 2014

Ovaj rad nudi opšte informacije o 6. Naučno-stručnom skupu OTEH 2014 organizovanom od 09-10 oktobra 2014. godine u Vojnotehničkom institutu u Beogradu. Takođe je dat sažet pregled istaknutih i interesantnih radova po tematskim oblastima, prezentovanim i prodiskutovanim na konferenciji.

Ključne reči: odbrambena tehnologija, vojna industrija, međunarodni naučni skup, Srbija.

6-ая международная научно-специалистическая конференция в области оборонных технологий – OTEX 2014

Эта статья предоставляет общую информацию о 6-ой научно-специалистической конференции OTEX 2014, организованной с 09-10 октября 2014 года в Военно-техническом институте в Белграде. Она тоже даёт краткий обзор передовых, известных и интересных работ по тематическим областям, представленным и обсужденным на Конференции.

Ключевые слова: оборонные технологии, военная промышленность, международная научная конференция, Сербия.

6^{ième} Conférence scientifique internationale sur les technologies défensives OTEH 2014

Cet article fournit des informations générales sur la 6^{ième} Conférence scientifique internationale sur les technologies défensives OTEH 2014 organisée par l'Institut militaire technique à Belgrade du 9 au 10 octobre 2014. Un aperçu concis est donné des travaux importants et intéressants des domaines thématiques, présentés et discutés lors de la conférence.

Mots clés: technologie de défense, industrie militaire, conférence scientifique internationale, Serbie.