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5th International Scientific Conference OTEH 2012

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This paper presents basic information about 5th International Scientific Conference OTEH 2012 held in Belgrade on 18-19 September 2012. The Conference was organized by the Military Technical Institute. Brief summaries of the most interesting papers presented at this Conference are shown as well.

THE International Scientific Conference OTEH intends to provide opportunities for scientists and engineers, researchers, designers and academic community from many countries to share ideas and technical information as well as to build new relationships.

The emblem of the OTEH Conference

The Military Technical Institute, the first and the largest military scientific-research institution in Serbia, has been traditionally organizing the OTEH Scientific Conference devoted to defensive technologies. The Conference was sponsored by the Ministry of Defence.

For the second time, the OTEH Conference had an international character. The call for papers attracted over 170 submissions. The scientific committee selected 143 papers and two plenary lectures.

The accepted papers in the final programme were related to seven topic areas:

1. Aerodynamics and flight dynamics (12 papers);
2. Aircraft (23 papers);
3. Weapon systems, ammunition, energy materials, combat vehicles (29 papers);
4. Integrated sensor systems and robotic systems (16 papers);
5. Telecommunication and information systems (18 papers);
6. Materials and technologies (34 papers);
7. Quality, standardization, metrology, maintenance and exploitation (11 papers).

Among the accepted papers, there were 32 papers from fifteen foreign countries: Turkey, Italy, France, United Kingdom, Egypt, China, Bulgaria, Belarus, Ukraine, Bosnia and Herzegovina, Slovenia, Montenegro, Algeria, Poland and Czech Republic.

The list of all papers and authors, as well as other information concerning the OTEH 2012, can be found on the website: www.vti.mod.gov.rs/oteh

The opening of the Conference

The first plenary lecture was given by Dr. Vincent Chiaruttini, ONERA Institute, Paris, France:

- *An adaptive remeshing technique for 3d crack growth simulations*

The presented study encompasses the work done in Z-Cracks, a crack-propagation tool for the FEM analysis code Z-Set, developed at Onera - the French Aerospace Lab - and at the Centre des Materiaux of the Ecole des Mines de Paris - Paristech. The objective is to provide a tool for industrial use, which has to be robust, accurate, and with low computation time. Two methods are implemented at the present time: one is based on the G-theta method, another uses an adaptive meshing of cohesive zone elements. The presence of cracks is unsafe for many critical industrial parts, such as rotors in aircraft engines. For this

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reason, manufacturers carry out routine inspections, using non-destructive methods of detection. However, the limitations of these methods and the growing need for lean, cost-efficient structures in a wide range of industrial applications (aeronautics, automotive industry, civil engineering, etc.) have led to new approaches of damage tolerance design. Conservative lifetime computations give way to increasingly sophisticated, realistic simulations of crack propagation. The goal of manufacturers is to define the time between inspections correctly, by modeling how small, undetectable cracks would propagate due to fatigue loading.

The first plenary lecture was given by Dr Vincent Chiaruttini, ONERA, Institute, France

The second plenary lecture was given by Dr. Filippo Neri, Vitrualabs, Rome, Italy:

- *New technologies for advanced defence systems*

This lecture highlights how the new Active Electronically Steering Antennas (AESA) and the very fast Digital Signal Processing allow the design and manufacturing of cost-effective advanced Multifunction Radar and advanced Super-Integrated Defence Systems.

The second plenary lecture was given by Dr. Fillippo Neri, President of Virtualabs Company, Italy

By the time of the third conference, the award for the best paper at the Conference has been established. The best paper at the OTEH 2012 is:

- *An example of side force determination in the rocket motor thrust vector control system* (Nikola Gligorijević, Saša Živković, Sredoje Subotić, Stevan Kozimara, Momčilo Nikolić, Slobodan Čitaković, Military Technical Institute)

The side force is one of the main parameters when calculating a procedure for the maneuvering capability of a thrust vector controlled (TVC) rocket. It depends on the rocket motor thrust and the efficiency of the applied type of a TVC system. There are many different difficulties to make the side force measurements fully reliable. In this work, the indirect method was applied to evaluate the TVC side force for the antitank guided missile Malutka. Two types of the thrust and total impulse measurements were made in the rocket motor static tests: with and without turning the TVC system on. The difference between the two is used to calculate the side force applying the approximate classic engineering method supported by a more reliable computational fluid dynamics method (CFD).

Author of the best paper, Nikola Gligorijević, was given the plaque

Some of the most interesting papers are presented below.

- *Training simulator of the manual commanded LOS guided Antitank Missile* (Slobodan Mandić, Miloš Pavić, Bojan Pavković, Srđan Stojković, Military Technical Institute)

A manual LOS (Line of Sight) guidance system of the antitank missiles requires a human operator in the guidance loop. His task is to track both the target and the missile, and to generate commands in order to bring the missile into the LOS. The efficiency of the guidance depends on the skill of the human operator. One type of the training simulator for manual LOS guidance, the realization of which is based on the simulation of the missile silhouette over the prerecorded frames of the background with fixed and moving targets, is given in the paper. Having been read from the recorded film of the background, the coordinates of the target are transformed into the real position of the target in the space. These target positions in a function of time are the input to the mathematical model of the missile movement relative to the target. The calculated coordinates of the missile are transformed into the missile silhouette position on the screen display of the training simulator. The complete mathematical model and description of the hardware realization with the results of the characteristic simulation are given in the paper.

- *Aerodynamic characteristics of the missiles movable wing in the presence of the fixed wing* (Ali Akgül, Emrah Gülay, ROKETSAN Missile Industries Inc., Ankara-

Türkiye, Jovan Isaković, Slobodan Mandić, Military Technical Institute)

In order to investigate the effect of canards on the wing aerodynamic performance, Computational Fluid Dynamics (CFD) simulations and wind tunnel experiments were performed at Mach numbers 0.6 and 1.9. A cylindrical body with an ogival nose, a wing section and canard geometry are used in this study. By changing the span dimensions and the location of the canard on the body, five different body-wing-canard configurations and one body-wing configuration are obtained. The wind tunnel measurements and computations of normal force, hinge and bending moment coefficients are done for these configurations. The CFD calculations are performed by the FLUENT software package. The comparison of the results from the analysis and the experiment shows that predictions are in good agreement.

- *Aerodynamic prediction for HB-1 and HB-2 supersonic and hypersonic test cases and comparison with experiment* (Hasan Erkan Celiker, Oral Akman, Gökhan Akman, Ali Akgül, ROKETSAN Missile Industries Inc., Ankara-Türkiye,)

In this article, aerodynamic prediction tools – engineering-level and Computational Fluid Dynamics (CFD) - are validated for rocket/missile systems at hypersonic and supersonic speeds. There are famous test cases: HB-1 and HB-2 are used for aerodynamic analyses by using FLUENT and CFD++ commercial CFD packages and engineering-level missile aerodynamic codes: Missile DATCOM, MISL3 and Aeroprediction (AP). Computations are carried out at Mach numbers ranging from 1.5 to 10 and at an angle of attack ranging from -4º to 16º. The computational results are compared with the experimental data presented. As a conclusion, the CFD results are in good agreement with the experimental data as expected; engineering-level missile aerodynamic codes can also be still used for the conceptual aerodynamic design phase.

- *Overview of uncertainty sources in flow velocity vector measurement by LDA* (Slavica Ristić, Institute Goša Belgrade, Jelena Ilić, Faculty of Mechanical Engineering Belgrade, Ognjen Ristić, Institute Mihajlo Pupin Belgrade, Đorđe Čantrak, Faculty of Mechanical Engineering Belgrade, Slobodan Tašin, Faculty of Technical Science, Novi Sad)

Many sources of uncertainties are inherent in LDA practices and must be recognized to obtain good experimental results. The analysis of uncertainty, for tests that include LDA measurements of velocity vectors in wind tunnels or in cylindrical pipe swirl flows, is a very complex problem. An overview of the most significant uncertainty sources in the LDA measurements is presented. One of the main groups of uncertainty sources is determined by the optical components arrangement. In this paper, special attention is paid to the estimation of laser-Doppler anemometry uncertainty of measurement volume positioning in test devices caused by the wind and water tunnel windows thickness, or by the pipe wall curvature (without using refractive index matching). The required corrections for measurements of velocity components such as shift of the measuring volume and its orientation are analyzed and determined for the VTI wind and water tunnels and for some very often used geometry of cylindrical pipes in industry. Depending on different experimental conditions, some of these sources of uncertainty may be neglected, but generally, it is necessary to take into account all of them in all optical methods such as LDA, PDA, PIV, etc.

- *Preliminary measurements of aerodynamic characteristics of the HB standard model in the trisonic wind tunnel of VTI* (Dijana Damljanović, Đorđe Vuković, Aleksandar Vitić, Jovan Isaković, Dušan Ćurčić, Military Technical Institute)

Tests with standard models serve to confirm the overall wind tunnel data quality and to provide confidence in the obtained results. Because of high supersonic starting loads, the T-38 trisonic blowdown wind tunnel in the VTI has not been verified above Mach 2 by using standard models so far. As a part of a current VTI research programme, two configurations of the HB standard model were designed, produced and tested in the Mach number range from 1.5 to 4 at Reynolds number ranging from 3.2 to 5.4 million. The results are considered preliminary, as an extensive test schedule with the same models is planed after modifications and recalibration of the wind tunnel. The measurements of forces and moments were performed with an internal six-component balance, and flowfield visualization was performed by the schlieren method. The tests results were compared with available references from AEDC, NASA-Ames and ONERA.

- *Computational study of flow around low-Reynolds airfoils* (Dragan Komarov, Jelena Svorcan, Slobodan Stupar, Aleksandar Simonović, Marija Stanojević, Faculty of Mechanical Engineering, Belgrade)

A numerical analysis of the incompressible flow around two low-Reynolds airfoils was conducted. The drag and lift curves of the airfoils have been computed. The results were compared to available experimental results (University of Illinois at Urbana-Champaign Low-Speed Airfoil Tests). Several RANS turbulence models were used for computations in order to investigate their capabilities to predict airfoil aerodynamic characteristics in a wide range of angles of attack, from low to high incidences. Both steady and unsteady computations were done depending on the expected prevailing nature of the investigated flow. The main challenge in the computations was to identify separation regions which greatly influence aerodynamic characteristics of the airfoils. Generally, the used RANS-based computational methods ought to be customized in order to predict a flow around low-Reynolds airfoils for a wider range of angles of attack.

- *Strength analysis of aircraft structures with respect to fatigue* (Stevan Maksimović, Marija Blažić, Military Technical Institute, Ivana Vasović, Institute Goša Belgrade, Mirjana Đurić, Military Technical Institute, Mirko Maksimović, Belgrade Waterworks and Sewerage)

The subject of this investigation is focused on developing a computation procedure for a strength analysis of aircraft structures with respect to fatigue. For that purpose, computation procedures for life estimation of constructions under cyclic loads of constant amplitude and load spectrum will be defined here. A special aspect of this investigation is based on the application of Strain Energy Density (SED) in a residual life estimation of structural elements with initial cracks. A verification of computation procedures for life estimation will be supported with corresponding experimental tests for the determination of the low cyclic fatigue properties of materials and corresponding parameters of fracture mechanics including fatigue tests of representative aircraft structural elements.

- *One approach in organizing technology of deposition of metallic coatings on aircraft engine turbine blades*

(Strain Posavljak, Faculty of Mechanical Engineering, Banja Luka, Slavko Vulić, Zoran Karac, ORAO A.D., Bijeljina)

One approach in organizing the technology of deposition of thin metallic coatings on the turbine blades of two aircraft engine was described in this paper. The technology of deposition of one coating on the base of Ni and two coatings on the base of Al was organized using a specially defined and completed system. The cathodic arc deposition technique was used. The results of a verification with the criteria of acceptability included in this paper confirmed a success of the organisation process. The data about thermal fatigue take an important place in the set of these results. In the turbine blades of one aircraft engine, the cathodic arc deposition technique for one coating on the base of Al, is used now instead of the elder pack-aluminizing technique.

- *Object-based remote sensing (RS) images classification* (Yumin Tan, Jianzhu Huai, Beihang University, Bejing China)

A framework aimed at classifying remote sensing (RS) images based on object attributes is proposed in this paper. The framework consists of two modules, the first module segmenting images into objects, the second classifying those objects considering their geometrical features. Our previous achievement, a two-stage segmentation method composed of initial graph-based partition and subsequent hierarchical clustering is used in the first module to produce image objects. In the second module, these objects are classified by the supervised maximum likelihood classifier giving both geometrical and spectral features of objects. The experimental results were compared with the conventional pixel-based maximum likelihood classifier and those provided with commercial software. It was found that randomly chosen features might not benefit classification and that this framework achieved comparable accuracy to pioneering methods and had a potential to improve speed.

- *Developments in glass cockpit technology for basic and advanced military trainers* (Robert Wilsey Freas, Total Reaction Ltd, Esterline CMC Electronics, Langport, UK)

Over the last 10 years, the introduction of 4th and 5th Generation front-line fighter aircraft has led to a revolution in basic and advanced military flying training.

- *Wireless sensor networks technology in aircraft structural health monitoring* (Dragoljub Vujić, Military Technical Institute, Radoslav Stojić, Faculty of Information Technology, Belgrade, Zoran Filipović, Institute Goša, Belgrade)

Aircraft industry has to meet a challenge of reducing operational and maintenance costs. One of the possible ways for reducing these costs is the introduction of wireless sensor networks (WSNs). WSNs have been already finding a variety of applications for both safety-critical and non-safety critical distributed systems. This paper deals with the application of WSNs for aircraft structural health monitoring. Special attention has been given to the use of Micro-Electro-Mechanical Systems (MEMS) as a promising technology for implementation into WSNs. Some important technological challenges which have to be solved in the near future are presented at the end of the paper.

- *Civil uses UAV system capabilities* (Milica Marjanović, Vanja Stefanović, Milan Bajović, Military Technical Institute)

A conceptual design of civil UAV systems is made to satisfy typical aerial work applications (day and night aerial ground surveillance, pollution and general environmental conditions, aerial photography and fire prevention). Capabilities needed for potential uses, general systems requirements for civil UAV systems, functional and performance requirements of selected missions are presented in this paper.

- *Efficiency and reliability of cutting by linear detonation shaped charge (LDSC) with small linear mass of explosive core* (Dušan Vračarić, Slavica Tezić, Dragan Ilić, Military Technical Institute)

This document presents the basic characteristics of the Linear Detonation Shaped Charge (LDSC) and the experimental results of reliability of their initiation and completeness of detonation process of the entire LDSC length. The LDSC has small linear mass of the explosive core. The results of the LDSC cutting efficiency on two types of materials of various thicknesses are shown as well as the LDSC cutting efficiency on the canopy in the light school aircraft LASTA.

- *Reconstruction of aircraft structure with the aim of optimizing and extending aircraft life cycle* (Zoran Vasić, Marija Blažić, Vanja Stefanović, Military Technical Institute)

This paper describes the results of the research based on a process of the reconstruction of the main control surface assembly of a jet training aircraft. The main aim of reconstruction was to extend the life cycle of the whole aircraft through the optimization of the shape and choice of a material for structural parts. The paper presents the cause that initiated the research in this area and a statistic review of the structure behavior in real time during service. The considered variants of the design solution were analysed as well as stress. An efficient numerical method used during the structural analysis of the considered solution is explained. The computation and the design methods were verified on a real example during the manufacture of the control surface assembly and aircraft test flights as well.

- *Strength analysis of main landing gear type layered composite leaf spring for unmanned aerial vehicle* (Ivana Ilić, Srđa Perković, Dragan Ilić, Marko Bojanić, Military Technical Institute)

This paper considers some aspects of the design of a composite leaf spring made of composite materials (combining glass fiber reinforced polymer and CFC layered parts). A special attention in this investigation is focused on the strength and stiffness analysis of the unmanned aerial vehicle (UAV). The Finite Element Analysis (FEA) predictions of the load-deflection curves under static loading are presented together with the test results. The main consideration was given to the optimization of the leaf spring geometry. The objective was to obtain a leaf spring with minimum weight that is capable of carrying given static external forces by constraining limiting stresses and displacements. The finite element results using the MSC/NASTRAN software code showing stresses and displacements were verified with the experimental results. For such purpose, layered shell finite elements are used. A good compatibility of the numerical data to the experimental results is obtained.

- *Redundant stiffness absorbing system for redesigning of recoil forces profiles* (Aleksandra Kari, University of Defense, Military Academy, Belgrade, Momčilo Milinović, Faculty of Mechanical Engineering, Belgrade, Olivera Jeremić, Faculty of Mechanical Engineering, Belgrade Zoran Ristić, University of Defense, Military Academy, Belgrade)

A serial and parallel combination of wire rope absorber junctions provide better absorbing of shock forces and external impulses. This performance is acceptable to be taken for different purposes including recoil force dumping. The paper considers the relations of deviation caused by nonlinearities and hysteretic behavior as a consequence of absorbing energy dissipation. This hysteretic behavior orientated threshold displacements required in the application of this system to be employed in the design of composed hydraulic and wire rope weapon barrel brakes and recuperators. The main experimental parameters represented the differences of the mentioned serial and redundant junctions. The performances are estimated based on the experimental static tests realized in this paper. An attempt of the comparison with an ideal elastic model is also performed.

- *Experimental and model scale tests of RPG propulsion and impact* (Przemysław Kupidura, Zbigniew Leciejewski, Robert Panowicz, Zbigniew Surma, Radosław Trębiński, Military University of Technology, Poland)

The subject of this paper is an analysis of selected problems of passive protection. A mounting mesh or bar structures causing rocket destruction before the fuze action is the simplest method to provide passive protection against RPG rockets. The results of the theoretical and the experimental tests with an RPG rocket of 1:3 scale striking the model of a bar armour are presented in this paper. For this purpose, a special laboratory stand enabling the acceleration of a projectile model to appropriate velocity was developed and the theoretical and practical analyses of the RPG model propulsion were carried out. The projectile model impact tests were conducted for bars of different cross sections fixed into numerous configurations (regarding distance between bars, angles of attack, etc.). The obtained results of the firing tests were compared to the ones acquired with numerical simulations. To perform the analyses, the LS-DYNA software based on the finite element method with the algorithm of explicit integration in time was used. The objective of the presented numerical simulations was to examine consistency with experimental investigations, which was proven to an excellent extent. These results have been finally used during the development of the cage armour for light armoured vehicles.

- *Protection of combat vehicle engine from rotation in opposite direction* (Goran Jerkin, Dragi Lakićević, Drago Petrović, Military Technical Institute)

This paper describes problems, methodology of work, process realization and testing of a suggested solution for protecting the engine system from rotation in the opposite direction in combat vehicles. Different solutions for achieving this function are shown. Existing solutions are described as well as the purpose and demand for automation of this protection. The important parameters needed to define the device performance are presented. The paper contains a practical access to finding a modern solution for build-in tank electrical equipment with a purpose of achieving protection. A modern multifunctional system, with tracking and display parameters, is proposed. The system consists of a transducer, a processor, an actuator, an indicator and a microcontroller. Its main characteristics are programmability, increased energetic efficacy, reliable functioning independent of human factor, and safe work. The system is designed to be used with different transducers and in a temperature range from -30°C to +55°C, which is a requirement for military purposes.

- *Experimental determination of internal losses in the transmission of high speed tracked vehicles in the turning* (Milan Krsmanović, Military Academy, Belgrade, Milić Miodrag, Military Technical Institute, Mladen Pantić, State University, Novi Pazar, Slavko Muždeka, Military Academy, Belgrade)

In addition to considering traction performances of linear motion for tracked vehicles, it is interesting to consider the traction performance of turning, because turning is performed by changing the tracks power balance. The determination of internal losses during turning is done experimentally, as the need arises. This paper describes the configuration of the test stand on which were performed measurements of the power parameters necessary for determining the transmission losses in turning. A theoretical overview of power flows during the turning of the applied test configuration stand is given. The paper also shows the test procedures with the guidance of the parameters during the measurements which were taken as variables. The result of the testing is given depending on the transmission efficiency depending on different power parameters.

- *The influence of the muzzle velocity vector on the evaluation of the gunfire precision* (Slobodan Ilić, Technical Test Center, Belgrade, Damir Jerković, Aleksandar Kari, Military Academy, Belgrade)

The muzzle velocity vector is represented as a characteristic output parameter in the analysis of complex projectile motion through the barrel, regarding the bore wear approach. The evaluation of the gunfire precision is one of the main parameters for determining the criteria of the gun barrel condition estimation. This paper presents the trajectory simulations and the analysis of the pattern, based on several possible variants of the muzzle velocity vector. The limited values of the components of the muzzle velocity vector are defined according to the size of the dispersion pattern as a criterion for the gun barrel condition evaluation, regarding the source of exploitation.

- *Reactive active propulsion* (Dejan Micković, Slobodan Jaramaz, Predrag Elek, Faculty of Mechanical Engineering, Belgrade, Dragana Jaramaz, University UNION-Nikola Tesla, Belgrade, Dušan Micković, Faculty of Mechanical Engineering, Belgrade)

A new interior ballistic concept of reactive active projectile propulsion is analyzed. During acceleration in a rocket launcher, the projectile is separated from the rocket engine chamber by the action of active granular propellant charge located behind the projectile stabilizer. The projectile is then additionally accelerated with corresponding deceleration of the rocket engine chamber. The active propellant charge is initiated by the pyrotechnic delay during the rocket engine function. The interior ballistic cycle terminates near the front of the rocket launcher by the extraction completion of the projectile stabilizer from the launching tube. A theoretical model for reactive active propulsion is presented. The model includes a simultaneous function of the rocket engine and active propellant charge in the launcher. The computer code RAP (Reactive Active Propulsion) for the interior ballistic cycle of reactive active projectiles is developed. The parametric study is carried out based on the RAP code calculations. The moment of active charge initiation by the pyrotechnic train is found to be a very important parameter for the regular functioning of the system. The computational results show the possibilities of the reactive active

propulsion interior ballistic concept to significantly increase projectile performance.

- *A new approach in the design of weapons and military Equipment* (Jasmina Babić, Military Technical Institute, Bojan Babić, Faculty of Mechanical Engineering, Belgrade, Dragan Borovčanin, Military Technical Institute)

With increasing competition in the military market, expediting the problem solving process has become crucial in the military industry. Today, there are numerous tools and techniques to support efficient solving of various problems. All the tools have distinct advantages and drawbacks. This paper shows a synergetic use of two techniques: Theory of Inventive Problem Solving (TRIZ) and Axiomatic Design (AD). The approach has been demonstrated through a real life military engineering example.

- *Ballistic resistance of nanomodified hybrid thermoplastic composites* (Vera Obradović, Dušica Stojanović, Irena Živković, Radmila Jančić Hajneman, Vesna Radojević, Petar Uskoković, Radoslav Aleksić, Faculty of Technology and Metallurgy, Belgrade)

The resistance to penetration of a shot bullet was tested for four samples of composite fabric forms. Each sample consisted of 16-17 pieces of fabrics containing four layers of polyurethane placed between aramid fibers. All the fabrics were coated with a γ-aminopropyl triethoxysilane (AMEO silane)/ethanol solution. There were two samples coated with a poly (vinyl butyral) (PVB)/ethanol solution and the other two were coated with the same solution but with the addition of 30 wt.% AMEO silane modified silica nanoparticles which were reinforcements. The samples were both a hard and a flexible option. The bullet-shooting test was applied to all the composites by two different bullets. The structural design of the samples improved the ballistic resistance after the bullets had been shot. Some ballistic image analyses for print and indentation depth of the samples were performed in the Image Pro-Plus software.

- *Using active damping as a precision enhancing technology for 128 mm artillery rockets with increased range* (Bojan Pavković, Miloš Pavić, Military Technical Institute, Danilo Ćuk, Faculty of Mechanical Engineering, Belgrade)

Artillery rockets are used on the battlefield for indirect fire on distant targets. As they have large impact point dispersion, they are considered to be area weapons and are fired from multi tube launchers. Achieving a high hit probability requires spending a vast number of rockets. The application of a control system enables the reduction of their impact point dispersion and increase the hit probability. An active damping control system with pulsejets as a control mechanism is simple, inexpensive and efficient enough to achieve the dispersion reduction which justifies their application. This paper presents the performances of such a system applied on a hypothetic 128 mm artillery rocket with a range of 32 km. As the active damping control system cannot compensate the most influential disturbance for artillery rockets precision – deviation of the rocket motor total impulse, the reduction of the hit point dispersion achieved using this system is presented for various deviations of that parameter as a function of the range. The simulation of a 6-degrees-of-freedom mathematical model is performed with the Monte Carlo technique as a tool for analysis.

- *Shock to detonation transition of high explosives Investigation* (Vesna Džingalašević, Gordana Antić, Danica Simić, Zoran Borković, Military Technical Institute)

This paper includes the results of the examination of the explosive detonation process development by shock wave initiation obtained in the past three years. A new method has been defined first, the modified GAP test which examines the explosive sensitivity to shock waves. The GAP system consists of a flat shock wave generator and an attenuator of polyethylene, whose shock adiabate is already determined. Shock sensitivity is examined for explosive charges FH-5 and FP-5 and for cast composite explosives LKE-11 and LKE-15 by a modified GAP test. The shock to detonation transition, an SDT process, was tested on cast composites (LKE-70/10, LKE-11 and LKE-15) and pressed explosives (FH-5 and FP-5), for different values of the shock wave pressure. The distance to detonation and the "Pop-plot" diagram were determined based on the analyses of the obtained results, for each explosive composition and intensity of the shock pressure.

- *Titanium (IV) oxide as ballistic modifier in composite solid propellants* (Vesna Rodić, Military Technical Institute)

The paper presents the research into the development of composite solid propellants based on hydroxyterminated polybutadiene including titanium (IV) oxide as not only a ballistic stabilizer but also a ballistic modifier of these propellant types. A number of different compositions regarding their solid content, coarse/fine ratio of ammonium-perchlorate powder sizes and titanium (IV) oxide content have been made for the research. The effects of titanium (IV) oxide, along with other ingredients of the propellant, on the burning rate law parameters have been examined.

- *Solid propellant rocket motor nozzle heat transfer model verification* (Saša Živković, Radoslav Sirovatka, Nikola Gligorijević, Sredoje Subotić, Stevan Kozomora, Momčilo Nikolić, Military Technical Institute)

Heat transfer is one of the most important and complex rocket motor design tasks. A physical process of heat transfer is unsteady and complex in itself and solid propellant rocket motor constructive and technological particularities additionally complicate design. Active thermal protective materials with an ablative reaction mechanism are frequently in use, and the motor parts are geometrically complex and made from diverse materials. All these factors lead to the calculation with numerical methods, and one of them is described in this paper. A simple measurement is conducted to improve calculation reliability and for results verification.

- *Program "SVOD" for solid propellant grain design* (Goran Marjanović, Saša Živković, Nikola Gligorijević, Military Technical Institute)

Rocket motor solid propellant grain design is a complex task. The design must integrate the results from geometry shaping and inner ballistics calculations. The grain geometry optimization can be achieved by iterative shaping and calculations, using a computational technique. This paper describes and demonstrates a program SVOD intended for this task.

- *Sonars for detecting small submerged objects and defining their shapes* (Miodrag Vračar, Military Technical Institute)

Sonars for detecting small-submerged objects and defining their shapes operate at relatively high frequencies, higher than a few hundred kilohertz, in order to obtain

narrow beams and short pulse lengths required to reduce the reverberation accompanying echoes. The main principles of such types of sonars are discussed. In addition, the principles for obtaining narrow beams are discussed and a particular attention is directed to the parametric acoustic radiator.

- *Prospects of development of active aerial platform detection radars* (Sergei Kostromitski, Peter Shumski, Igor Sadovski, JSC KB Radar, Minsk)

The report treats the main directions of the development of a new generation of aerial platform detection radars featuring digital signal shaping and processing, digital pattern-forming, automatic detection, tracking and classification of targets, protection against jamming and antiradiation missiles, detection of low-flying low-velocity and stealthy targets of enhanced mobility.

- *CFAR detector models in receiver of the software defined radar* (Dejan Ivković, Military Technical Institute, Bojan Zrnić, Defense Technology Department, Belgrda, Milenko Andrić, Military Academy, Belgrade, Dragan Nikolić, Military Technical Institute)

This paper describes the software models of CA-CFAR, OS-CFAR and the TM-CFAR detectors in the receiver of the software defined radar. A comparative analysis of these CFAR detector models in terms of detection of radar targets in conditions of real clutter is performed. The software models of the CFAR detector are implemented in MATLAB.

- *The analogue platform of digital defined radar* (Slobodan Simić, Military Academy, Belgrade, Zoran Golupčić, Peripolis- elektronika, Belgrade, Aleksa Zejak, RT-RK Computer based systems, Novi Sad)

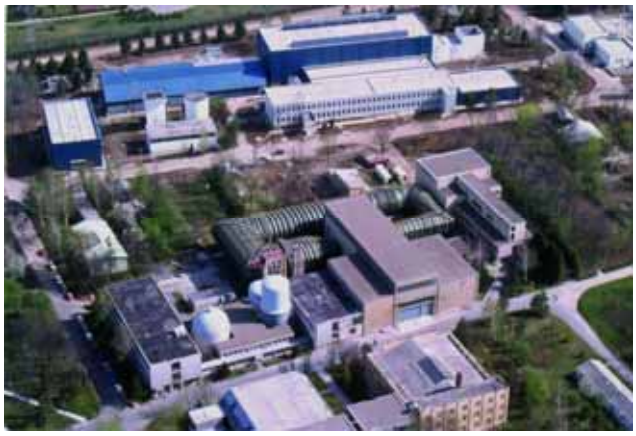
The main component in a software defined radar, responsible for radar signal processing and signal generation, is FPGA circuits. Internal clocks generators inside the FPGAs are capable of operating at the speeds of a few tens of gigahertz. Unfortunately, these signals are not available at the FPGA pins. High speed data streams available at the I/O pins are automatically coded by FPGA transceivers and transceiver bit streams are not suitable for the application in a form of radar signals. An additional problem could be the price and availability of FPGA components with a gigabit transceiver. Digitally generated analog signals are limited in the spectrum and could be directly applied in VHF and UHF radars. In order to apply digitally generated analog signals in X, Ku or Ka radars, analogue platforms fully transparent to low frequency radar signal (generated digitally by FPGA) are described. The proposed architecture performs the required functionality by minimizing the number of analogue components. There are no requirements for analog hardware programming i.e. all flexibility is achieved by digital components. The proposed analogue platform enables independent development, testing and production of analogue hardware and digital hardware and software components.

- *Direction finder with switched antenna elements in combination with root-music algorithm for DOA estimation* (Ivan Pokrajac, Predrag Okiljević, Military Technical Institute, Desimir Vučić, UNION University, Belgrade)

In modern direction finder radio-frequency (RF) signal acquisition can be performed by a parallel or a sequential method. In this paper, we consider the development of a direction finder in the case of sequential signal acquisition. The parallel signal acquisition is performed simultaneously from all L antenna elements. Sequential signal acquisition means that the number of RF channels M is lower than the number of antenna elements L in the antenna array. The total acquisition interval is divided into subintervals, and at each subinterval a multiplexer selects a different subset of M elements to connect to the RF signal acquisition channels. Since the direction finder based on sequential signal acquisition only collects data on M channels simultaneously, hardware costs can be reduced at the expense of a time-accuracy trade-off compared to a system based on parallel signal acquisition. In this paper, we use a well-known high resolution algorithm for the direction of arrival estimation Root-MUSIC. Some simulation results are presented in this work.

- *Equipment for calibration and reparation analog cards in Teledyne data acquisition system for measuring in wind tunnel* (Vladimir Lapčević, Goran Ocokoljić, Zoran Rajić, Dušan Ćurčić, Military Technical Institute)

In this paper, the equipment for calibration and reparation of analog cards in the Teledyne data acquisition system is presented. The Teledyne data acquisition system is used for data acquisition of sensor signals in the wind tunnel. It consists of several different card types: a digital data processor card, a setup card, an analog multiplexer card, a card with analog digital converter, two digital input cards and 32 analog cards. Analog cards measure analog sensor voltages. They are the main part of the Teledyne data acquisition system. The analog cards calibration software is developed and used in a combination with a high precision calibrator. The testing equipment is developed for the reparation of analog cards. It enables reparation of analog cards without the Teledyne data acquisition system, and also enables an approach to analog cards with the scope.



Experimental Aerodynamic Laboratory in the Military Technical Institute

- *SOI piezoresistive low pressure sensor for high temperature environments* (Milče Smiljanić, Katarina Radulović, Žarko Lazić, Vesna Jović, Bogdan Popović, IHTM-CMTM Belgrade)

A prototype of piezoresistive low pressure sensors for high temperature environments has been fabricated on the Silicon-On-Insulator (SOI) wafers utilizing a novel maskless wet etching technique. The prototype has a structured square diaphragm with a concentric boss. The SOI pressure sensors have piezoresistors dielectrically isolated from each other and from the substrate by silicon dioxide. A high temperature transducer prototype has been made utilizing the fabricated sensor. A high temperature method for pressure measurements has been formed. The transducer prototype performance was measured at temperatures up to 300°C. These SOI pressure sensors are

intended for extreme environmental conditions and high operating temperatures often needed in military-grade applications and when it is necessary to perform sensitive low pressure measurements. Some examples include aerospace applications like aircraft engines, wind tunnels, various missiles, etc.

- *Passive ranging based on using commercial cameras* (Goran Dikić, Boban Bondžulić, Milenko Andrić, Military Academy, Belgrade)

This paper presents the results of the experiment made with two commercial cameras trying to determine the target range. In the light of limited cameras features, only laboratory experiments are considered. The target distance is estimated using the nonparallel imaging axis and triangle similarity.

- *Computer simulation of swarming tactics for UGV combat platforms (*Mirko Jezdimirović, Military Technical Institute, Momčilo Milinović, Faculty of Mechanical Engineering, Belgrade, Radomir Janković, UNION University, Belgrade, Olivera Jeremić, Faculty of Mechanical Engineering, Belgrade)

This paper presents a methodological attempt to simulate a tactics of a simultaneous attack using robotized (UGV-Unmanned Ground Vehicle) platforms. Numerical methods are used to determine the time of departure and the location of platforms in order to achieve a simultaneous arrival in the zone of effective fire on the moving armored targets. The method of proportional navigation, with given initial conditions of velocity and iteratively changing conditions of the initial position is used. Time delay departure of robotized platforms has been established and calculated in relation to the furthest platform, with respect to the target. The results of simulation are presented for the two hypotheses of target motion (rectilinear and curvilinear), in the lateral oblique attack.

- *Cross-layer protocols applications in the multimedia Mobile networks* (Milijko Jevtović, Engineering Academy of Serbia, Belgrade, Boban Pavlović, Military Academy, Belgrade)

Layered architecture based on the ISO/OSI reference model has a fundamental importance for an easy design in the case of traditional wired networks. On the other hand, this structure has significant limitations for multimedia applications. The main reasons refer to varied demands for QoS (Quality of Service), which cannot be satisfied relying on the traditional architecture of standardized network protocols. Designing Cross-layer protocols can be defined as a process which has been done by rejecting the layered OSI communication protocol architecture – open systems connectivity, and which includes the creation of new interfaces between the layers. In this way, the new boundaries between the layers of the OSI architecture and communication protocol are redefined. The design of the new protocol is such that it depends on the protocols of other layers, i.e. the parameters associated with other layers or protocols in their environment are to be adjusted. This paper indicates the main possibilities and effects of using cross-layer protocols in the next generation of mobile networks: mobile ad hoc wireless multimedia networks, 3G/4G Universal Mobile Telecommunication Systems (UMTS), wireless access networks, wireless sensor networks, planetary satellite multimedia networks and mobile multi-hop multimedia network.

- *Monopulse tracking of azimuth and elevation changes of the projectile by using radar with small printed antennas* (Predrag Manojlović, Nenad Popović, Siniša Jovanović, Aleksandar Kopta, IMTEL Komunikacije, Belgrade)

The radar application for projectile or rocket velocity measuring invokes needs for obtaining a larger number of flight parameters in addition to the start and end velocity. Modern radar projectile trajectory tracking systems can provide such data; however, they are very expensive and bulky equipment. This paper presents a design principle for projectile tracking radars with four printed microstrip antennas over the spatial angle. The presented radar has small dimensions and belongs to the low cost category suitable for various types of field testing. The described solution of monopulse radar operates in a frequency range from 10.3 to 10.7 GHz; however, the same concept could be applied to other frequency bands.

- *Microwave microstrip wide band-stop filter on high-resistivity silicon (HRS) substrate* (Dušan Nešić, Ivana Jokić, Miloš Frantilović, IHTM-CMTM, Belgrade)

Low-resistivity silicon (standard CMOS-grade silicon, resistivity 1 - 30 Ω-cm) is a troublesome issue for microwave passive components. One solution is using high-resistivity silicon (HRS) with a resistivity of 2 kΩ-cm or higher. The idea of this paper is to simulate a circuit with ideal waveguides and to apply it to the microstrip structure on HRS substrate. A wide band-stop filter on high-resistivity silicon (HRS), of 5 kΩ-cm resistivity, is introduced. The starting point is an ideal circuit model with ideal waveguides. The filter is simulated and fabricated in microstrip technology and compared with the ideal model. The structure is adjusted to the conditions of silicon and technological boundaries.

- *The importance of codification and implementation of technologies of automatic identification in the system of defense of the republic of Serbia* (Danko Jovanović, Logistic Department GS SAF, Belgrade, Velibor Jovanović, Central Logistic Base GS SAF, Belgrade, Veljko Petrović, Department of defense technologies, Belgrade)

Codification represents the process of determining a codification code for material assets with the aim of their unambiguous recognition. Bearing in mind that the current nomenclature does not allow the products and services, which go through the process of codification, to enter on the market of the NATO codification system users, and that it does not allow SAF interoperability with the armies participating in the UN missions, there was a need to sign the Contract of adopting the NATO codification system between the Ministry of Defense of the Republic of Serbia and the Group of national NATO codification directors (AC-135), which gave Serbia a membership as a sponsored non-NATO country. The application of technologies of automatic identification in the system of defense means tracking the state of codified things to the extent desired by subordinates in charge. The media of technologies of automatic identification (BARCODE and RFID) are used as code exponents with a high quality of data and adequate description of material assets in order to provide the key level of supplies transparency in a supply chain. By using them and applying an adequate information system, the Ministry of Defense of the Republic of Serbia would be able to establish its own codification system and harmonize it with the NATO codification system in order to successfully realize a unique codification and classification of assets with the aim of their unambiguous recognition.

- *Increasing availability in optical communication networks by proactive recovery* (Jelena Pešić, Telecom Bretange, Brest, France, Slavko Pokorni, Information

Technology School, Belgrade)

Communication networks are an essential part of current information and communication technology in civil and military applications. In most of these applications, it is of great importance that connections between the communicating users remain without a failure. Therefore, the reliability and availability of these networks are of great importance. In war environment, the most frequent reasons for the connections failures are links damage or cuts caused by air raids, artillery raids, etc. Resent research results show that damage or cuts of optical cables can be predicted using the method of machine learning, in order to act before, and not after cable damage. In this paper, we describe a method of proactive protection/restoration where the recovery is triggered before the optical fiber is cut. The advantage of the method is discussed with respect to its ability to improve network availability.

- *Evaluation of low spinnability of AlMg5 alloy during flow forming* (Radović Ljubica, Milutin Nikačević, Military Technial Institute, Belgrade)

A preform, a hot forged cup, was subjected to flow forming in the industrial scale in order to form thin-walled tubes (90mm warhead shells). The deformation behavior and the microstructure of AlMg5 alloy from two metallurgical heats, as well as in various process stages has been studied by means of mechanical characterization, optical and SEM/EDS microscopy. The influence of the chemical composition and applied reduction on the surface features was also studied. The spinnability was estimated on the basis of contraction during tensile testing of AlMg5 alloy and compared to the achieved one in flow forming. The heat with higher content of alloying elements (Mg, Mn, Fe, Si) had higher mechanical properties of the perform as well as flow formed tubes. It has lower spinnability and a large amount of surface defects (microcracks) on the flow formed shells, which is attributed to the inhomogeneous material flow during deformation.

- *Ballistic investigation by w - carbide ammo on the ARMOUR PROTECTION STEEL - PROTAC 500* (Jure Bernetič, Matjaž Marčetič, Gorazd Kosec, Slavko Ažman, Acroni d.o.o. Jesenice, Tomaž Vuherer, Faculty of Mechanical Engineering, Maribor, Zijah Burzić, Ilić Nada, Military Technicl Institute, Belgrade, Borut Kosec, Faculty of Natural Sciences and Engineering, Ljubljana, Milenko Rimac, University of Zenica, MI Kemal Kapetanović)

The ballistics testing results according to VPAM APR 2007 are represented in this work. The ballistic testing was done using 308 Win 7.62 × 51 FMJ/FB/WC ammunition. Two different cartridges from the producer Nammo AP 8 and Ruag SWISS P AP were used. Both types of ammunition have the tungsten carbide core. Damage – craters caused by the projectiles, were cut and analyzed over the transverse section by optical and scanning electron microscopy. The EDS analyses of the characteristic areas were also carried out.

- *Influence of process parameters on tunnel type defect appearance and weld quality in FSW welded Al 2024 plates* (Igor Radisavljević, Military Technical Institute, Nenad Radović, Faculty of Technology and Metalurgy, Belgrade, Vencislav Grabulov, IMS, Belgrade, Milutin Nikačević, Military Technical Institute)

Some experiences in the elimination of the tunnel type defect Friction Stir Welded Al alloy 2024-T351 are presented in this paper. In order to evaluate the influence of the processing parameters (ratio between rotation and welding speed) on the occurrence of tunnel type defects and the quality of welded joint, different welding parameters were varied. Welded joints were tested by means of both non-destructive (visual, penetrant, X-ray and ultrasonic inspection) and destructive (metallographic, tension and hardness) testing. A sound joint was obtained in a wider R/V ratio between 5.00 and 25.65. The results suggest that with this ratio, material flows around the pin with optimal speed, i.e. a sufficient amount of material is available to fulfill the gap and prevent tunnel formation, which leads to quality joint production.

- *Decomposition of organic dyes and CWA simulants by nano TiO_2-treated standard military textiles* (Sonja Bauk, Maja Vitorović – Todorović, Military Taechnical Institute, Karel Mazanec, VOP-026, Šterbek, VTUo unit Brno, Czech, Željko Senić, Nataša Pajić, Military Technical Institute, Dušan Rajić, Faculty of Technology, Belgrade)

The world-wide use of pesticides together with the possibility of chemical warfare agents usage in military actions, terrorist attacks or in accidents, increased the risks of chemical contamination occurrence and consequently stipulated the need for the development of new protective materials and equipment with improved properties. Nowadays, therefore, research is directed towards the design of so-called “smart textiles”, capable of “self-decontamination”, i.e. decomposition of toxic chemicals. We investigated different methods for the synthesis of TiO_2 nanoparticles and their deposition on standard military textiles (cotton/polyester 50%). The photocatalytic activity of such obtained textiles was tested by the degradation of organic dyes and chemical warfare agent simulants.

- *Microindentation hardness testing of different composite systems with thin electrodeposited nickel and copper films* (Jelena Lamovec, Vesna Jović, Ivana Mladenović, Milija Sarajlić, IHTM, Belgrade, Vesna Radojevič, Faculty of Technology and Metallurgy, Belgrade)

Thin Ni and Cu films with fine-grained structures have been electrodeposited from self-made sulphamate-based and sulphate-based electrolytes, respectively. DC electrodeposition of Ni films was performed on single crystal Si wafers with different orientations named (100) and (111), and electrodeposition of Cu films was performed on massive electrodeposited Ni films as the substrates. In order to investigate the influence of the microstructure of the substrates and Ni and Cu thin films on the mechanical properties of these composite structures, Vickers microhardness testing for different loads was done. For any composite system of thin film on a substrate, there is a critical indentation depth when a measured hardness value is not the hardness of the electrodeposited film, but the so-called "composite hardness", because the substrate also participates in the plastic deformations during the indentation process. A composite hardness model of Chicot-Lesage was chosen and applied to the experimental data in order to analyse and determine the absolute film hardness. A further analysis of the work hardening parameter $(t/d)^m$, that can express the difference in tendency of the composite hardness with the indentation load, was performed for the above-mentioned composite systems.

- *Interesting surface morphology of Zn-Mn alloy coatings rich in manganese* (Mihael Bučko, Military Academy, Belgrade, Jelena Bajat, Bojan Jokić, Faculty of Technology and Metallurgy, Belgrade, Siniša Gačić, Technical Testing Center, Belgrade)

The manganese addition can significantly improve the

corrosion resistance of sacrificial Zn coatings on steel. The best properties are obtained in the Zn-Mn alloys where Mn content is in the range of 30 – 40 atomic percent. The scope of this work was to use, for the first time according to our knowledge, the electrolyte containing Zn and Mn chlorides, in electrodeposition of Zn-Mn alloys which would have high Mn content on the one hand, and satisfactory surface appearance and morphology, on the other hand. The alternation of two deposition parameters, i.e. deposition current density and manganese ion concentration in the electrolyte, was investigated. The electrochemical reactions of interest were studied by cyclic voltammetry and chronoamperometry. The samples obtained were characterized by scanning electron microscopy and energy dispersive X-ray spectrometry. The coatings deposited at current densities higher than 200 mA cm-2 have shown to be with a smooth, homogeneous and bright surface.

- *The possibility of increasing the inhibitor/propellant bond strength using different primers* (Mirko Gojić, Vesna Rodić, Danilo Serdarević, Military Technical Institute)

After the plan conducted experiment of firing cannon projectiles performed at different temperatures: -30°C, 25°C and 50°C, deviations from the target were found only at a temperature of 50°C. After a detailed analysis of potential causes that have led to increased scattering from the target hits at 50°C, decrease in the bond strength (adhesion) inhibitor/solid propellant appeared to be the most likely cause, since the bond strength decreases with increasing temperature. In order to achieve higher bond strength values, numerous experiments were performed in order to increase the surface energy of inhibitors using different methods of preparation of its surface and the choice of primers of different chemical structures.

- *Using aluminum foam with convex elevation technique for blast alleviation* (Mohamed Barakat, Ehab Mahmud, Military Technical college, Egypt)

This paper presents the findings from the programme of research exploring the effects of aluminum foam panels as a sacrificial cladding design for the curved elevation technique of the strategic installations to alleviate the blast waves. Infinite element simulations have been carried out in order to investigate the behaviour of aluminum foam panels subjected to blast loading. Each simulation was used to calculate the pressure and impulse transfer from the blast loading, as assessed using the AUTODYN software in 2D & 3D V3.1.17. The main contribution achieved in this paper is presented in the results of the simulations. The analysis of the simulation output reveals that the aluminum foam panels technique offers a significant reduction in impulse and pressure values in the effects of the blast waves on the structure. This technique can be used without affecting the functionality of the structure or the street. It also offers benefits of shielding and robustness whilst having good aesthetic appeal and other architectural advantages.

- *Influence of additional force impulse at the monotonic load on the deformation of 2024-T3 aluminum alloy* (Volodymyr Hutsaylyuk, Lucjan Śnieżek, Janusz Torzewski, Military University of Technology, Warsaw, Mykola Chausov, Valentin Berezin, National University of Life and Environmental Sciences of Ukraine, Kyiv)

The paper presents the results of the experimental studies on the impact of the additional force impulse at the monotonic tension on the tensile strain of 2024-T3 aluminium alloy. The loading was carried out in the inelastic range. Microfracture analyses of surfaces and fractures were used for establishing the nature and mechanisms of destruction of the examined elements.

- *Application of 3d-random fiber composites for damaged honeycomb* panels *repair* (Mirko Dinulovoć, Faculty of Mechanical Engineering, Belgrade, Branimir Krstić, Military Academy, Belgrade, Predrag Andrić, 204th Air Brigade, 24th Air Technical Battalion, Belgrade)

Honeycomb composite panels are used extensively in aircraft structures. One of the problems with the use of these materials is that of structural repair. Composite structures require different repair techniques than their metal counterparts do. It is crucial to develop repair methods that restore the original strength of the part without compromising its structural integrity. A new repair methodology, applicable to field repair of damaged composite panels with the honeycomb core is presented. To restore load bearing capacity of a damaged panel, a specially designed core plug composed of 3D random fiber composite material is used. A numerical simulation of the stress-strain field of the repaired structure, the material constitutive equations and a complete repair procedure is presented in this paper. The analysis has shown that 3D random fiber composites can be successfully applied for the repair of damaged honeycomb cores at relatively small repair cost and in an efficient way, especially in cases where the aircraft downtime costs are of critical importance.

- *Photon management in semiconductor infrared photodetectors: diffractive and plasmonic antireflective structures* (Zoran Jakšić, Milija Sarajlić, Katarina Radulović, Marko Obradov, Dragan Tanasković, Slobodan Vuković, IHTM, Belgrade)

Due to their high specific detectivities and high response speeds, photodetectors based on narrow-bandgap semiconductors like indium antimonide and mercury cadmium telluride are indispensable for mid- and far-infrared wavelength ranges. Their response is directly proportional to the infrared radiation flux introduced to the detector active area. Thus, various photon management techniques are of crucial importance for enhancing their performance. This work analyzes the use of subwavelength nanophotonic structures with antireflective properties. It considers a surface-based diffractive optical structure that can be produced by micromachining and nanofabrication. The first part of the consideration is dedicated to all-dielectric subwavelength arrays with 1D and 2D periodicity, which effectively behave as impedance-matching structures with graded effective refractive index. The consideration is then expanded to metal-dielectric structures, especially to these belonging to the class of the so-called plasmonic ultra-absorbers. Technologies available in Serbia are then investigated for the fabrication of the dielectric and metal-dielectric subwavelength antireflective structures for the infrared, including isotropic and anisotropic etching of surface reliefs and ultrathin-film deposition techniques. It is concluded that diffractive dielectric and plasmonic structures offer a novel degree of freedom in the optimization of infrared semiconductor photodetectors.

- *Adsorption-desorption processes in defense against chemical, biological, radiological, nuclear and explosive threats* (Olga Jakšić, Zoran Jakšić, Danijela Randjelović, Ivana Jokić, Miloš Frantilović, IHTM, Belgrade)

Chemical, biological, radiological, nuclear and explosive (CBRNe) agents may be encountered by military personnel on a variety of occasions, during intentional attacks or

accidental exposure. Thus personal protection kits should include devices that recognize or rule out the presence of dangerous gases, vapors, airborne droplets or solid particles. Alerting, protection, avoidance and mitigation of CBRNe contamination are of prime interest in anti-terrorist measures. Another situation of interest is the detection of trace amounts of general hazardous materials. The interaction of CBRNe with materials mostly proceeds via adsorption-desorption (AD) that is omnipresent, taking place wherever an agent encounters a surface, where it can stay adsorbed for some time and desorb afterwards. AD processes are thus often the fundamental principle of operation of various components (multi/mono analyte sensors, indicators, filters, etc.) designed for a variety of purposes (preventive, protective, and decontamination). The structures are the same but with appropriate modifications. This paper presents our analysis of adsorption-desorption from the design and optimization point of view (the influence of effective surface area, surface material, functionalization, self-cleaning, and reusability). A comparative analysis is given from the applicative point of view for different structures. The case of chemical, biochemical and biological sensors based on surface plasmon resonance is investigated.

- *Nanoaperture array-based plasmonic sensors of dangerous substances using transparent conductive oxides* (Dragan Tanasković, Zoran Jakšić, Katarina Radulović, Olga Jakšić, Milija Sarajlić, Žarko Lazić, IHTM, Belgrade)

Detection of dangerous substances like explosives, pathogenic microorganisms and toxic chemical is of utmost interest for homeland defense and anti-terrorist actions. Among the devices of choice for that purpose are surface plasmon resonance (SPR) chemical-biological sensors since they are ultra-fast, highly sensitive and label-free. We consider one of the advanced types of SPR sensors, those with ordered arrays of subwavelength apertures in plasmonic material. Such sensors show high sensitivity in a transmission readout mode, they are useful for both liquid and gaseous analytes and can be used as a building block for complex microfluidic systems for multianalyte detection. Simultaneously, high electromagnetic field concentrations in nanoapertures enhance nonlinear effects, thus further facilitating detection of complex molecules of dangerous substances. We performed a finite element simulation of the performance of such devices for various materials and nanoaperture sizes and shapes. We dedicated special attention to the case when the subwavelength array is formed in a transparent conductive oxide (TCO) host. An example of a TCO is tin oxide, routinely used in thin layers for window defrosting and defogging elements in armored vehicles. We show that compared to conventional nanoaperture array sensors based on metal hosts, the TCO-based devices simultaneously offer enhanced selectivity and retain high sensitivity.

- *Maintenance cost budgeting optimization* (Momčilo Đorđević, Saša Petrović, Serbian Armed Forces, Belgrade, Sreten Perić, Military Academy, Belgrade, Dragoljub Spasić, Serbian Armed Forces, Belgrade,)

In this paper we define an optimization model that exercises the choice of a maintenance budgeting. The set of maintenance actions provided by the solution of the optimization model guarantees the required level of reliability for the whole system and minimizes the maintenance cost. In this paper we address the problem of system quality from a different point of view: starting from the description of the system and from a set of new requirements, we devise the set of actions to be accomplished to obtain a new architecture able to fulfill the new requirements with the minimum cost and guarantee a given level of reliability.

- *NATO STANAG 2211 and its implementation in Serbian Armed Forces* (Stevan Radojčić, Military Geographical Institute, Belgrade)

This paper shows the main contents of the NATO standard STANAG 2211, discusses the necessity of its adoption by the Serbian Armed Forces and considers some important consequences of its implementation.

- *The new method for testing speed-measuring devices in road traffic* (Goran Janković, Zlatan Topić, Military Technical Institute, Jovica Cvetković, J. Marendić-Miljković, Directorate of Measurements and Precious Metals, Belgrade)

In the area of measuring the speed of vehicles in traffic due to the occurrence of different types of speedometers with respect to the structure, methods of measurement and place of use, there is a need to create a unique method the aim (purpose) of which is to check all the metrological characteristics of measurement in terms of speed compared to the manufacturer's technical specification and metrology requirements of the by-laws for this type of measurement. This method allows easily performed testing to measure the speed of any kind of speedometer (system) on the ground in real terms, regardless of road conditions and weather conditions. As a fully automated method, it is suitable for monitoring because it defines the parameters required for assessing the safety standards of speed and their proper use.

Military Technical Institute

- *Introduction of controlling in the enterprises of Serbian defense industry* (Aleksandar Stojanović, Military Academy, Belgrade, Jovan Davidović, Holding Company "Krušik", Valjevo)

Since 2008, the financial and economic crisis has brought instability to business transactions on the global level, significant decrease in investments and further growth of the unemployment rate. However, it does not influence significantly the downfall of the economic activities in the military industry, as demonstrated by the research of the international institute SIPRI. Dynamic economic changes on the global level are reflected on the military industry where the concept of change management is applied more and more in the enterprises where controlling has a very noticeable role. Controlling presents today one of the most significant managerial functions for the solution of concrete problems during adapting of enterprises to economic changes. The aim of this

elaboration is the presentation of the essence and importance of controlling, history of its development, application in the world and possibilities of implementation in our conditions and, above all, in the enterprises of the defense industry in Serbia (in the further text DIS-Defense Industry of Serbia). The object of exploration is an analysis of the elementary settings of the controlling concept through its essential elements and their application in the DIS enterprises, with a retrospective on the management experiences of the Holding Company 'Krušik', Valjevo. The methodology of exploration encompassed the analysis and synthesis of indicative conclusions. The application of the rigid legal regulations in the area of foreign trade with products and services of both national and foreign military industry presents a factor of limitation that must be taken into consideration when defining strategic and operative plans of enterprises because such business belongs to the primary tasks of controlling. In addition, it demands an ordered estimate of risk.

After two working days, the 5th International Scientific Conference OTEH 2012 was closed, having fulfilled the assigned aims. The next OTEH Conference will be held in Belgrade in 2014.

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5. međunarodni naučno-stručni skup 2012 - OTEH 2012 -

Prikazane su osnovne informacije o 5. međunarodnom naučno-stručnom skupu OTEH 2012 koji je održan u Beogradu od 18-19 septembra 2012. Skup je organizovao Vojnotehnički institut. Takođe, prikazan je i kratak sadržaj najinteresantnijih radova prezentovanih na ovom skupu.

V международный научный симпозиум 2012 - OTEX 2012 -

В этой работе приведены некоторые ключевые факты о V международном симпозиуме из области оборонных технологий OTEX 2012, который состоялся в Белграде в периоде 18-19 сентября 2012 года. Мероприятие было организовано со стороны сербского Военно-технического института. Здесь также показана и краткая информация о наиболее интересных работах, представленных на этом заседании.

Cinquième réunion scientifique internationale - OTEH 2012 -

On a présenté les informations principales sur la cinquième réunion scientifique internationale d'experts du domaine des technologies de défense OTEH 2012 qui a eu lieu à Belgrade du 18 au 19 septembre 2012. La réunion a été organisée par l'Institut militaire technique. On a donné aussi le sommaire des travaux les plus intéressants exposés à la réunion.