

Second Scientific & Expert Conference OTEH-2007

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After the introductory part on the Second Scientific Conference of defense technology researchers, organized by the Military Technical Institute in Belgrade from 3 to 5 October, 2007, the review concentrates on some of 179 accepted papers that, according to overall opinion, aroused the highest interest.

THE second scientific meeting OTEH-2007 was held from 3 to 5 October 2007, in Belgrade. OTEH represents an acronym (in Serbian) for Defense Technologies. This conference of the defense technology researchers held every two years, with the aim of overall and multidisciplinary review of current conditions and further development trends in the area of military-technical science.



The Ministry of Defense entrusted the organization of this year's meeting to the Military Technical Institute. The organization was given to the scientific-research institution with a 60-year long tradition in the development of weaponry and military equipment, the institution which developed around 1300 combat and non-combat products with which, apart from the national army, many foreign armies are equipped as well.

During three days many high-quality and original papers, originating from current research projects, were presented

as well as papers on research already applied in practice or those that refer to forecasting and further developments in particular military technology areas. At the OTEH-2007 179 papers were presented with 287 authors and co-authors. All papers were reviewed and presented in the following 10 thematic sections:

- Armament and ballistics,
- Combat platforms (aircrafts, vehicles, ships),
- Ammunition and ordnance,
- Systems for electronic warfare, guidance and sensors,
- Telecommunication and command-information systems,
- Geo-topography technologies,
- System of quality, standardization, codification and metrology,
- Innovation, new materials, technologies and protection,
- Management in the system of defense and logistics and
- Defense-related medicine.

Some of the most interesting papers from every Section are presented further on. The list of all papers and authors, as well as other information concerning the OTEH-2007, can be found on the website: www.vti.mod.gov.yu/oteh.

– *Analytical model of metallic cylinder motion under the impact of detonation products* (P.Elek, S.Jaramaz, Faculty of Mechanical, Belgrade)

The motion of metallic cylinders under the load of detonation products is discussed. An one-dimensional analytical model of the cylinder motion is formed by using assumptions of viscoplastic behavior of the casing material and polytropic expansion of detonation products. The model results have been verified by comparison to experimental data. The developed model can be used for design and performance analysis of HE warheads, as well as for structural integrity and safety considerations.

– *Loading simulation of the MLRS bearing platform*, (A.Kari, Military Academy, Belgrade, M.Milinović, O.Jeremic, Faculty of Mechanical, Belgrade)

The paper considers the bearing platform of an MLRS under shock impulse load initiated by the plume of launched rocket. The simulation was realized by the ProEngineer Wildfire software package with simplified initial conditions. The mechanical model was realized for an elastic platform attacked by rigid bodies. The stresses around circular the bearing ring fixed on the rigid self-propelled vehicle undercarriage are considered. The results were treated according to the threshold of military standards.

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- *Wear computation of the projectile rotating band using the parameters of the internal ballistic process*, (M.Lisov, Military Technical Institute, Belgrade)

This study presents the research of wear patterns on artillery projectile rotating bands using variable parameters of the internal ballistic process. The results of this research have been used for better visualization of the complex process of rotating band wear in passing of a projectile through an artillery weapon rifled barrel, i.e. for defining the material key characteristics that primarily influence the degree of the rotating band wearing. Apart from this, the study presents the results of the comparative theoretical and experimental research applied to 155 mm artillery systems. The presented experimental results are obtained verifying the function by firing.



Military Technical Institute – Belgrade, SERBIA

- *Characteristics and requirements of new designs of lightweight artillery weapons*, (Z.Ristić, S.Ilić, D.Jerković, Military Academy, Belgrade)

The review of specific requirements and characteristics during research and development of lightweight towed artillery systems in the world is given. The possibility of better absorption of recoil energy and the recoil „management“ during the firing sequence supported by soft-recoil are emphasized as well as possible related technical risks. Application of light materials and the role of other alternative materials in construction of weapon main parts and components are also emphasized, considering a large reduction in total mass of modern towed artillery weapons.

- *Bullet stopping power as a caliber selection optimization element in small arms and ammunition in development*, (P.Cerović, Z.Subotić, Military Technical Institute, Belgrade)

This paper provides the comparative review of methods for the calculation of bullet stopping power. The application of the calculation results is given as a category for analyzing performances of developing missiles, existing missiles or their comparison in order to optimize the caliber selection of the product, i.e. bullet. The incorporation of this method into a software for target destruction probability calculation in real battlefield conditions is implied.

- *Thermal load of multiple friction clutches in braking process*, (M.Milić, M.Pantić, Military Technical Institute, Belgrade; Z.Živanović, Institute “VINCA”, Belgrade)

The results of the thermal load testing of planetary gearbox multiple friction clutches used as main brakes in

combat tracked vehicles, are presented in the paper. The tests were carried out on the inertial test stand by simulating adequate real working conditions. Temperature was measured on the friction surfaces of clutches. Some characteristic results obtained by the simulation of the vehicle braking process were presented.

- *Research of the impact of some tank modernization aspects to armoured battalion swarming effectiveness*, (R.Janković, Faculty of Computer Science, Belgrade)

Swarming is a tactical approach, suitable for both attack and defense, which is more and more being taken into account in conceptualizing combat activities of modern armies. Adaptation for swarming could be the best investment in modernization of technically inferior armies. The influence of some aspects of battle-tank modernization (mobility, dimensions, weaponry and command-information system, its wireless computer network in particular) on the possibility of swarming tactics in combat activities of an armored battalion has been considered in the paper.

- *Strength analysis of aircraft structures with respect to fatigue and fracture mechanics*, (S.Maksimović, Military Technical Institute, Belgrade)

Attention in this work is focused on developing computation methods for strength analysis with respect to fatigue and fracture mechanics. The object of the research is the strength analysis of aircraft structural components with crack type initial damages. Presented computation method is based on combining singular finite elements to determine stress intensity factors for cracked structural components with corresponding crack growth laws that include effect of load spectra on number of cycles or blocks up to failure. To demonstrate efficiency of the presented computation procedure, numerical examples are included. The pins for the wing-fuselage joint are chosen as an illustrative example. Good agreement between the computation and the experimental results is obtained.

- *Strength analysis of mechanically fastened joints at the composite structures*, (I.Ilić, Military Technical Institute, Belgrade)

In this paper the strength of mechanically fastened joints at composites is considered. Primary attention is paid on developing a suitable computation procedure for the initial failure analysis of joints at layered composite structures. To determine stress distributions around holes, the finite element method (FEM) is used. Initial failure of mechanically fastened joints is determined using the Chang-Scott-Springer model of the characteristic curve and the Tsai-Wu initial failure criterion. A finite element model that simulates contact at the pin-hole interface is used for the analysis. The numerical result is compared to the available experimental results and good agreement is observed.

- *Optimal design of aircraft structural components with respects to the minimum mass*, (D.Malobabić, Military Technical Institute, Belgrade)

In this paper the optimal design procedure of the engine mount structure for light training aircraft is presented. The optimal design procedure of the engine mounting is achieved with respect to the minimum mass of structure and to satisfying strength constraints. The engine mounting is modeled by line finite elements. The optimal design of the engine mount structure is made by combining optimality criteria and the finite element method.

- *Application of computational fluid dynamics in determining the minimum drag coefficient of wing*, (M.Kozić, Military Technical Institute, Belgrade)

The results of the turbulent flow numerical simulation around the wing of the LASTA-95 airplane at level flight with maximum speed are presented. The software for numerical solving of averaged Navier-Stokes equations is used along with additional equations describing turbulence. On the basis of the calculated aerodynamic lift, drag coefficients and the known relation of the induced drag, the minimum drag coefficient is determined. The influence of the most important user-defined elements in numerical simulation on the minimum drag coefficient is analyzed.

– *Thermobaric warhead with explosive charge based on liquid nitrate and powdered metal*, (Lj.Nenadović, S.Terzić, Military Technical Institute, Belgrade)

This work presents the results of the test range examinations of warheads with thermobaric compound composed of magnesium powder and isopropyl nitrate. The thermobaric effect of the 90mm and 120mm caliber warhead is defined through the overpressure value change in the function of time (p-t diagrams) and the maximum overpressure value in the function of distance from the thermobaric cloud explosion centre. The test results of the thermobaric warhead testing are compared to available records on similar foreign warhead efficiency.

– *Cylinder test – developing the method for the determination of the gurney energy of explosives*, (V.Dzingalašević, G.Kekić, G.Antić, Z.Borković, Military Technical Institute, Belgrade)

The test results of the possibility to determine explosive brisance by using the cylinder test are presented. The components of the method are defined, the argon flash-bomb characteristics are examined, and the parameters of expansion of copper cylinders filled with different explosive charges are analyzed (based on the registered expansions by an ultrahigh-speed camera). The optimal conditions of cylinder expansion registration and their analysis have been determined in order to obtain the approved calculation of the kinetic and energetic parameters of the copper cylinder expansion, i.e. Gurney energy. The preliminary values of the Gurney energy for several explosive compounds are presented in this work. The registered expansions obtained for hexolite, octolite, plastic explosive with and without aluminum, cast HBX, cast PBX and flegmatized hexogene are analysed.

– *Analysis and choice of an optimal calibration procedure for gas chromatography determination of ethyl centralite in double base powders and propellants*, (Lj.Jelisavac, Military Technical Institute, Belgrade)

The aim of this work was to test justifiability of the single point calibration of the gas chromatography determination of ethyl centralite contents in double base powders and propellants samples. Different kinds of calibration curves were generated and the linear CI detector range was determined. By comparing the calibration curves of ethyl centralite, the single point calibration was chosen as an optimal method of calibration. The GC analysis of the calculated relative errors values of determination of the ethyl centralite content in the calibration samples verified the accuracy of the results in the entire concentration range of ethyl centralite in double base powders and propellants. The single point calibration was verified as an optimal calibration method of the GC determination of ethyl centralite content in the samples of double base powders and propellants, but some revisions related to the preparation of ethyl centralite standards and samples were needed.

– *Pulsed-doppler radar audio signal detection in the time frequency domain*, (S.Simić, Military Academy, Belgrade, A.Zejak, Institute IMTEL, Belgrade)

Too long duration of target ranging, since that is not what they were designed for, is a drawback of pulsed-Doppler radar. With carefully designed automatic detector, this time can be significantly reduced, compared to time of manual ranging. The basic detection problem solution in pulsed-Doppler radar, i.e. designing of suitable detector, is the topic of this paper. Proposed detector is tested by recorded real signals. Minimal duration value of automatic detection is established, in order to take that into account when designing new or modernizing the existing radar.

– *Concept of distributive jamming*, (M.Mišković, M.Erić, Military Technical Institute, Belgrade)

This work presents the concept of distributive jamming and estimation of jamming effects, and proves that the concept of distributive jamming is possible. The advantages of distributive jamming are presented as well as a more economical and efficient solution compared to classic jamming. The output data simulation presented in this work confirms the advantages of distributive jamming over classic jamming.

– *The effect of image segmentation methods on irradiance estimation*, (G.Dikić, B.Bondžulić, Military Academy, Belgrade)

In this paper the results of thermal video sequence processing are given. The presented analysis of the effect of image segmentation methods to irradiance estimation is used as an additional means of measurement in order to fully exploit the possibilities of IR sensors and get an improved estimate of kinematic target conditions.

– *Anti armor missile guidance and control system optimization*, (M.Milovanović, V.Žurkić, Military Technical Institute, Belgrade)

A procedure of optimization of an anti-armor laser beam missile guidance and control (G&C) system is demonstrated. The analytic synthesis of the optimal control law, which provides a minimal zone of missile deviation from laser beam axis, is carried out. The synthesized G&C law inside the reference mathematical model of an anti armor G&C system modified by specific laser beam G&C demands is tested.

– *Laser guided bomb trajectory optimization by optimal control law application*, (M.Pavić, Military Technical Institute, Belgrade)

The work presents a laser guided bomb guidance law synthesis, based on the linear square differential game theory, where a case of one plane and two states has been considered. The Kalman filtering method has been used for noise removal from the measured signals and for estimation of missing state values needed for the optimal guidance law. Various structures of Kalman filters depending on the input of available filters have been analysed.

– *Shooting range system with the radio control – KORS: Conception and implementation of application software*, (L.Sajnkari-Velević, B.Rangelov, M.Živković, J.Kljajević, Military Technical Institute, Belgrade)

The concept of the application software controlling the operation of a contemporary radio-controlled shooting range system for infantry weapons is described. The software enables the operator to select among predefined shooting programs or to define interactively his own program, during the preparations or during the shooting itself. Registration of shooters and the times of their hits are performed automatically.

– *Analysis of characteristics of virtual private networks*, (M.Smiljanić, B.Pavlović, Military Academy, Belgrade)

In this paper the basic characteristics of VPN (Virtual Private Networks) networks are presented. VPN networks are analyzed on the second and the third level of OSI (Open System Interconnection) reference model. The realization of IP (Internet Protocol) VPN and the VPN networks within MPLS (Multi-Protocol Label Switching) environment are also explained. Special attention is given to the security of MPLS VPN networks, especially in those intended for the use in functional communication systems, such as military communication systems.



The youngest participant of OTEH-2007
Cadet of the Military Academy of SERBIA Milenko Smiljanić

– *Advantages of a unique coordinate system in determining the position of spatial elements*, (A.Ilić, Military Geographic Institute, Belgrade)

The advantages of the unique coordinate system for the territory of the Republic of Serbia regarding determination and presentation of spatial phenomena are explained. The demands required from the coordinate system as a mathematical base for positional presenting of objects and phenomena are also discussed. The advantages of this coordinate system are emphasized on the operational and strategic level of command.

– *Topographic map at the scale 1:250 000 - first map in army of Serbia produced according to the NATO standards*, (R.Banković, S.Tatomirović, Military Geographic Institute, Belgrade)

The implementation of modern technological solutions in the process of producing a Topographic map at the scale 1:250 000 according to the NATO standards is given in this paper. With the production of this topographic map in versions for both land and air forces, we provide a standardized and more efficient geoinformational support to joint operational forces.

– *Contribution to the study of shear and flow forming of thin-walled rocket components made of Al alloys*, (M.Nikačević, Lj.Radović, Military Technical Institute, Belgrade)

The influences of the spinning (shear and flow forming) and Mg content in the Al-Mg alloys on the mechanical properties of the formed components were studied. The spinning, the deep drawing and machining were compared. The results obtained through this study strongly suggest

that the spinning technology is the best choice for producing conical and cylindrical rocket components made of Al alloys.

– *Cloaking power of polymer films in the close IR part of the spectrum*, (B.Milošević, Military Technical Institute, Belgrade)

The problem of cloaking power of polymer films in the visible part and the close IR part of the spectrum was analyzed from both theoretical and practical aspect. Based on experimental measurements following an original methodology, the evaluation criteria for the cloaking power of films in the IR part of the spectrum depending on the layer thickness were established. The basic significance of the research activities described in this paper is that the conventional film thickness of cloaking paints should be significantly increased from current 30 nm.

– *Weldability of high strength steel*, (V.Grabulov, I.Blačić, Z.Burzić, I.Radisavljević, Military Technical Institute, Belgrade)

The paper presents the results of a global evaluation of the weldability of the high strength steel known by its commercial name Nionikral 70 (HY 100 class), designed for floating structures, primarily submarines. Weldability evaluation included basic mechanical and structural properties of welded joints, welded joint susceptibility to hot and cold cracking and to lamellar tearing, as well as susceptibility to the ductile-to-brittle transition behavior of welded joints and their constituents.

– *Resistance and efficiency of respirator cartridge filters in the presence of solid radioactive aerosols*, (M.Filipović, N.Lazarević, Military Technical Institute, Belgrade)

The aim of this paper is to experimentally test the changes of pressure and efficiency of particle filters in combined filters and basic filtration materials out of which filters which are put into combined filters are made by fluting. The presence of solid radioactive particles in the air was simulated with the presence of NaCl solid aerosol particles, which by size distribution correspond to radioactive particles. The experimental results are in good agreement with equations from the literature.

– *Determination of military garment resistance to burning mixture*, (Z.Senić, M.Jevremović, Military Technical Institute, Belgrade; R.Karaklić, Technical Test Center, Belgrade)

The results of testing the thermal characteristics of military garment (undershirts, shirts, blouses) and NBC protective equipment materials (multilayer systems) upon effects of burning napalm mixture (BNM) are presented. The testing was done on sixteen variants of materials with and without air space between garment and NBC personal protection products.

– *Telemedicine – multimedial telecommunication network application*, (D.Baranac, Airforce and Anti-air Defense Command, Zemun, Z.Vuksanović, QUEST SOFTWARE, Belgrade, S.Laketa, M.Momčilović, PUPIN TELEKOM DKTS, Belgrade)

This work describes a complex and multidisciplinary issue of organizing a telecommunication network system (Network) with purpose – “telemedicine”. Here the conception, a possible technical solution and the requirements referring to the quality of services have been explained. The possibility to apply the multimedia telecommunication network within the existing Serbian Armed Forces communication system resources utilizing commercially available equipment, and, partially, IT equipment already in use, has been shown. The Network

has been organized by adapting the existing Local Computer Network (LAN) by adding and installing the qualitative systems for multimedia communication (speech, graphic, data, video). Computer networking has been realized by utilizing resources of the existing stationary communication systems. The network enables realization of numerous telemedical services mentioned in this work.

– *Protection of eye and skin tissue from UV radiation*, (M.Nikolić, Military Technical Institute, Belgrade)

This paper adequately and understandably familiarizes the reader with: UV radiation sources, spectral bands of EM spectrum relating to the UV wavelength, UV radiation influence on eye and skin tissue, defining the relevant parameters that determine the protection level on the basis of international standards, calculating of permissible exposure levels, preventive and protective measures, and protective equipment. The medical news about hazard prevention is presented. The standardized sensors, radiation level measurement systems and hazard testing systems are also listed.

– *Consequences of NATO strikes on agribusiness in Serbia*, (B.Tešanović, S.Jović, Military Academy, Belgrade)

The records are presented about catastrophic consequences on agribusiness in Serbia caused by NATO bombings. Before 1999, food production was based on ecologically pure natural resources and such production processes that do not endanger living environment and health of the population, which presented a significant comparative component for increase of organic production and export of so-called “health food” to the markets of

highly developed countries. With ecological pollution of cultivable land in Serbia, western countries of the NATO alliance denied themselves the possibility to obtain, through import, healthy food from immediate environment.

– *The protection against the biological weapon*, (S.Lazić, M.Cobeljić, R.Cekanac, Military Medical Academy, Belgrade)

After the introduction on biological weapons, this text deals with bioterrorism that can be individual, group and state. The basic measures and procedures for protection and recovery from consequences of bioterrorism necessary to undertake if such accidents occur are presented. The most important protection measures against biological weapons are the early recognition of attack, detection and identification of biological agents, casualty management and treatment and decontamination.

After three days of presenting a number of quality papers, the Second Scientific and Expert Conference OTEH-2007 was closed with awarding the Archimedes plaques and the MTI sign plaques. Apart from high-quality papers and good organization, this conference will be remembered by an increased number of young researchers who deal with military technologies in their work. The conference was closed with the desire to get an international character in two years' time.

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Drugi naučno-stručni skup OTEX-2007

Dat je prikaz rada drugog naučnog skupa istraživača koji se bave odbrambenim tehnologijama, a koji je u organizaciji Vojnotehničkog instituta iz Beograda održan od 03 - 05. oktobra 2007. godine. Nakon prikaza toka skupa, predstavljeni su neki od ukupno 179 prihvaćenih radova koji su po opštem mišljenju pobudili najviše interesovanja.



La seconde conférence scientifique et d'experts OTEH 2007

Un compte-rendu sur les activités lors de la seconde conférence scientifique des chercheurs qui travaillent dans le domaine de la technologie de défense est présenté dans cet article. La conférence, organisée par l'Institut militaire technique de Belgrade, a eu lieu du 3 au 5 octobre 2007. Après le compte-rendu sur cette réunion scientifique, on a présenté certains de 179 travaux acceptés qui, selon l'opinion générale, ont attiré la plus grande attention.