

1st scientific meeting OTEH 2005

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The paper presents the first scientific meeting of defence technologies researchers from Serbia and Montenegro, "OTEH 2005," that was held December 6 – 7, 2005, in Belgrade. OTEH is an acronym that stands for "Ođbrambene TEHnologije" (Defence Technologies). The meeting objectives were: to revise both the current trends and scientific foundation of defence technologies, as well as to conceptualise the possible further development trends. Some of most interesting papers from the sessions are presented, as well.

THE 1st scientific meeting OTEH 2005. was held December 6–7, 2005. in Belgrade. OTEH is an acronym that stands for Ođbrambene TEHnologije (Defence Technologies). This was the meeting of defence technologies researchers that is due every two years. The Ministry of Defence of the state union of Serbia and Montenegro entrusted the organisation of the 1st meeting to the Military Academy in Belgrade. The main sponsor of the meeting was "Yugoimport – SDPR".

The meeting was opened by Lieutenant General Ljubiša Jokić, the Chief of General Staff of Serbian and Montenegrin Army. The audience was also addressed by Colonel Vlado Radić, the head of The Defence Technologies Department within the Ministry of Defence of the state union of Serbia and Montenegro. The organizer provided four plenaries: DEFENCE TECHNOLOGY AND SCIENCE by Vlado Radić, the Defence Technologies Department within the Ministry of Defence of the state union of Serbia and Montenegro; HUMANOID ROBOTS OF HIGH PERFORMANCES: BEGINNINGS, PRESENT STATE AND NEAR FUTURE, by Miomir Vukobratović, SANU, Belgrade; TECHNOLOGY AND STRATEGY, NOW AND IN THE FUTURE, by Spasoje Mućibabić, retired Lieutenant General and DEVELOPMENT LEVEL OF DEFENCE TECHNOLOGIES, INFLUENCE OF C^{nk} AND FCS ON THE ACTUAL GLOBAL PROCESSES, by Momčilo Milinović, Faculty of Mechanical Engineering, Belgrade.

After the plenary sessions, the meeting continued in four parallel sections. There was also an exhibition of weaponry systems and military equipment, as well as an exhibition of the latest books issued by the Military Academy in Belgrade.

The meeting objectives were: to revise both the current trends and scientific foundation of defence technologies, as well as to conceptualise the possible further development trends. The opportunity to exchange ideas and to get acquainted with the work of the colleagues in complementary fields was of great importance for most of the participants of the meeting. About 260 authors and co-authors from almost 40 organizations submitted more than 160 papers published on the CD with the Proceedings. Among the authors there were academics, members of military and civilian institutes, Military Academy, technical

faculties, as well as industry and units of Serbian and Montenegrin Army. Most papers were presented by members of the Military Technical Institute, Military Academy and TOC, all from Belgrade. Among the civilian institutions the most papers were presented by members of IMTEL from Belgrade, the Faculty of Electronics from Niš, and the Faculty of Mechanical Engineering, Belgrade.

The papers were presented in 14 sections grouped into four thematic areas:

1. Arms, ammunition, combat platforms and protection
2. Electronic systems, C⁴I² (Command, Control, Communications, Computer, Intelligence and Imaging) and fire control systems
3. Logistics, quality, standardization and metrology
4. New technologies and materials

The most interesting papers from the sessions are presented here and some of them are expected to be published in full in the Scientific-Technical Review. Readers can obtain the list of all authors and their papers on the official OTEH web site: www.oteh.mod.gov.yu.

In the paper OPTIMIZATION OF INTERIOR BALLISTICS PARAMETERS IN THE PHASE OF PROJECTION OF WEAPONS, by Ljubiša Tančić, Military Academy, Belgrade, a solution for interior ballistic projection of weapons for a particular calibre by Chujev analytical method which uses the price of artillery weapons as a criterion was presented. The optimal solution is based on the selection of the best physical - chemical and ballistic characteristics of powder, mass powder, powder chamber and other characteristics relevant for execution of interior ballistics calculation on the computer. The solution is compared with other existing solutions and certain conclusions are drawn.

In the paper WEAR MECHANISM IN A PROJECTILE ROTATING BAND BASED ON STRUCTURAL AND MECHANICAL PROPERTIES, by Miodrag Lisov, Milutin Nikačević and Ljubica Radović, Military Technical Institute, Belgrade, thermal and mechanical loads of artillery projectile rotating band were considered. Examination of their mechanical and structural properties after projectile shooting under high pressure was shown. Wear process in a projectile rotating band was evaluated by

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means of both macro and microstructure, hardness of the contact surface and dimension changes. Actual normal forces and compressive stresses were identified as the main cause of erosion, abrasion and local overheating (melting) of the rotating band. Also, the rotating band wear model was proposed.

In the paper ANALYZING OF GEOMETRICAL PARAMETERS' INFLUENCE ON THE SOLID ROCKET PROPELLANT IGNITION PROCESS, by Dragan Lemić, Military Technical Institute, Belgrade, the influence of geometrical characteristics (surface irregularities, sharp edges etc.) on the process of solid rocket propellants' ignition is analyzed. Mathematical model for propellant heated by external head flux with the existence of internal heat source due to the exothermal chemical reaction is developed. Governing equations are numerically solved using finite difference method. The calculated results are in good agreement with the results found in references.

In the paper ARTILLERY GUNS FIRE SUPPORT SYSTEM FUNCTIONAL MODEL, Zvonko Maričić, Mićo Banović, Livona d.o.o. Beograd the potential usage of geoinformational technologies for upgrading and supporting various functions of the artillery gun-fire process was presented. The development of the functional model of Artillery Gun-fire Support System resulted in a number of improvements and automation of classic routine procedures, such as shorter preparation time and overall handling of artillery gun-fire as well as improving the planning and decision making procedures.

In the paper COMBAT STIFFNESS CRITERION MODELLING FOR MLRS UNDER IMPULSE SHOCK WAVES, by Aleksandar Kari, Military Academy, Belgrade and Momčilo Milinović, Faculty of Mechanical Engineering, Belgrade the basic performances of combat stiffness for MLRS of short tactical ranges was considered. Mathematical model takes impulse shock wave loading caused by HE projectile at the given distances from the launcher on self propelled system in combat conditions. Different shock wave amplitudes initiate the threshold forces and moments acting on lateral side of MLRS and disturbing launcher stability and rocket ammunition safety. The model provides analyses of the mentioned effects and compares them with the current military standards.

In the paper THE ANALYSIS OF THE INCREASED OPERATIONAL PERIOD OF TRACK ELEMENTS, by Novak Vukčević and Sreten Joksimović, TOC Belgrade the ways of increasing the endurance of track movers by contributing to the increase of their operational period were presented. The increased operational period depends on the construction, i.e. the type of the tracks and operating conditions. The analysis of the increased operational period of the track elements has been the result of extensive tests regarding different constructions of track elements performed on the testing tables and in real working conditions.

In the paper CONVERSION OF ARMOURED COMBAT VEHICLES INTO SPECIAL PURPOSE VEHICLES, by Mladen Pantić, Goran Janković and Milenko Tajević, Military Technical Institute, Belgrade, the conversion technology of armoured combat vehicles (ACV) that is widely used nowadays was presented. There is a need for the conversion due to the fact that there are a number of these vehicles, which can be used for other purposes after conversion. The characteristics of armoured combat vehicles conversion are presented in the paper and the T-55 main battle tank converted into the VEU-55

„MUNJA“ universal engineering vehicle is given as an example.

In the paper THE DEVELOPMENT OF STRAPDOWN INERTIAL NAVIGATION SYSTEM, by Vladimir Vukmirica, Ivana Trajkovski, Nenad Cakić and Nada Asanović, Military Technical Institute, Belgrade, a description of the realized model of strapdown inertial system with two options for the computer unit was presented. In the first case the inertial measurement unit is connected to industrial computer and in the second to a special purpose developed computer based on LPC 2294 microcontroller. The description of the developed software and the testing results are also given.

In the paper THE POSSIBILITIES OF TESTING AIRPLANE PERFORMANCES – TAKE OFF AND LANDING USING DIFFERENTIAL GPS SYSTEM, by Nikola Hinić and Đorđe Jankuloski, VOC Batajnica, an attempt to check the validity of measuring airplane position in space using Differential GPS system during testing airplane performances - takeoff and landing was presented. Examination was done by simultaneous measurements of the flight profile by optotheodolites and DGPS system with post processing data reduction.

In the paper LASTA – AN AIRPLANE FOR BASIC TRAINING OF FIGHTING AIRCRAFT PILOTS, by Milan Bajović, Kosta Velimirović and Vojimir Molović, Military Technical Institute, Belgrade, a presentation of a new concept of pilot training based in the objective to provide the required level of piloting skills with minimal operational costs is given. Within this concept, a specific accent is given to the position of the piston engine of the LASTA airplane for basic pilot training, as well as the required flying quality of this airplane. The presentation of the T-35 wind tunnel results has given proof of the way in which the obtained aerodynamic results meet the required flying quality.

In the paper RECORDING OF THE SHAPE OF THE DETONATION WAVE FRONT IN POWDER CHARGES USING IMACON 790 CAMERA, by Gordana Kekić, Military Technical Institute, Belgrade and Radenko Dimitrijević, Military Academy Belgrade, an investigation of the shape of the detonation wave front in powder charges by means of the digital recording technique using ultra high speed Imacon 790 camera is shown. No such investigations have been performed until now. The shape of the detonation wave front is clearly noticeable on the record, as well as the dependence of the shape of the detonation wave front in the form and magnitude of the powder elements in the powder charge. From each record the velocity of the detonation wave is determined and compared to the detonation velocity value determined theoretically for the corresponding powder.

In the paper INVESTIGATION OF CONTEMPORARY FILTROSORPTION PROTECTIVE CLOTHING BY PHYSIOLOGICAL COMPLIANCE, by Radovan Karkalić, TOC Belgrade, Branka Amidžić, Health centre, Kruševac, Rade Biočanin, MoD of the SMAF and Sonja Radaković, VMA, Belgrade, a new Nuclear, Biological & Chemical (NBC) combat clothing offers the opportunity of substantial cost savings by eliminating the need for additional, expensive NBC overgarments, whose high weight and poor permeability may also cause a physiological overload of the soldier. NBC combat clothing made of Saratoga™ has been designed for the soldier of the 21st century, increasing his battlefield efficiency and reducing costs. For researching physiological compliance of the NBC overgarments two

investigation profiles was realized and people included in the test; the investigations were performed at the climatic chamber and in cross country conditions, where they worked on primary missions (based on telemetry observing). The physiological research in laboratory conditions determined the basic anthropometry parameters. The investigation of thermoregulatory characteristics for four models of NBC overgarments enabled their characterization according to physiologic compliance: skin and tympanic temperature, heart frequency and sweat intensity.

The paper TETRA MILITARY APPLICATIONS, by Milorad Obradović, FTN Novi Sad and Radimir Gordić, VLATACOM Ltd., Belgrade, argues the commercially available mobile radio communications used for military applications should be sophisticated, highly complex, secure and digital radio communication systems. This paper also proposes that military representatives should consider the suitability of the TETRA open standard for many of their peacekeeping and enforcing requirements. It has attempted to show how the new features address some of the specific military operational needs and proposed that military representatives should be more actively involved in what is a major opportunity for industrial and individual application.

In the paper UNIVERSAL MODEM FOR DATA TRANSMISSION IN INTENDED SYSTEMS, by Dragan Đurić, Miljko Erić and Desimir Vučić, Military Technical Institute, Belgrade, a modern, software based realization of the universal modem was presented. Its basic characteristics are given and some possible applications of this modem are presented as well. The modem is designed to provide reliable digital data communications over short or long-haul HF channels, line-of-sight (LOS) UHF channels and wire-line services. To ensure maximum performance, the modem uses the approved military Standard waveforms. Equipment is a compact, single package integrated solution to current and future (radio & wire) data transmission requirements.



In the paper AN APPROACH TO THE MANAGEMENT SUBSYSTEM APPLICATION FOR INTEGRATED MILITARY TELECOMMUNICATION NETWORK, by Radonja Terzić, Military Technical Institute, Belgrade, an

approach of management subsystem application for integrated military telecommunication network was presented. The approach based on the SMART TMN model which advocates a pragmatic approach to standards, with an emphasis on end-to-end operational automation rather than single-point solutions, and application of practical technologies that are affordable, available and applicable. The author has concluded that to adequately support the many and varied operational support systems of the military ISV or network operator, a combination of informational technologies is needed by used TIM (Technology Integration Map).

In the paper RADAR INTERCEPTION DEVICES AS A PASSIVE RADAR SYSTEM, by Svetozar Vujčić, Military Academy Belgrade, Čedomir Gacović, SDPR, and Aleksa Zejak, IMTEL, a survey of position and role of the device for detection of radar emission in the formation of passive radar devices is given, as well as the importance of this device application on the platforms of ground forces.

In the paper THE POSSIBILITY OF ANTENNA PATTERNS MEASUREMENTS OF RADAR ANTENNAS, by Alojz Žibert and Nikola Lekić, Military Academy, Belgrade, the high performance radar antennas that have induced the development of high performance antenna testing techniques were presented. The possibility of antenna pattern measurements of radar antennas is also described. Various advantages and limitations of each technique is presented.

In the paper IORP-1 – INFORMATION SYSTEM FOR OF RADAR SITES DETERMINATION AND EVALUATION, by Dejan Rančić, A. Dimitrijević, A. Milosavljević, S. Đorđević-Kajan, ELFAK Niš and A. Kostić, Faculty of Electrical Engineering, Belgrade, the automation of radar sites determination and evaluation using IORP-1 system was described. The system is designed for efficient radar coverage area prediction on the bases of the known radar model, target model, atmosphere model and digital terrain model. The application of the proposed solution will simplify radar setting and minimize time and cost needed for radar network configuration.

In the paper WIDEBAND RECEIVER FOR RADAR SIGNAL INTERCEPTION, by Zoran Golubičić and Petar Janković, IMTEL, Belgrade a wideband microwave receiver intended for radar signal interception was described. The receiver covers frequency spectrum from 8GHz to 18GHz. It is designed as a device integrated with antenna system. Minimum number of components enables significant simplification of the production process. Unique low noise amplifier, mixer and local oscillator are applied to cover full frequency band. The receiver is suitable as analogue functional block for various intercept receivers in X and Ku bands.

In the paper THE PARAMETRIC AND FUZZY LOGIC APPROACHES TO RADAR TARGET CLASSIFICATION, by Milenko Andrić and Bojan Zrnić, Military Academy Belgrade and Željko Đurović, Faculty of Electrical Engineering, Belgrade, the parametric and fuzzy logic approaches to the automatic classification of moving target detected by ground surveillance radar were presented. The real audio Doppler signatures of various targets are analyzed by spectrogram. The parametric classifier based on the spectral properties of audio Doppler signal is designed. In order to build simple linear classifier, the reduction of dimension is performed. The two target classes (pedestrian and wheeled vehicle) are successfully classified. As a result of analysis, input and output variables

with the corresponding membership function are defined. The set of fuzzy rules is established. The defuzzification of the output fuzzy set is performed by computing the "fuzzy centroid". The three target classes (walking man, running man and wheeled vehicle) are successfully classified.

In the paper **DIGITAL TERRAIN MODELS AND THEIR MILITARY APPLICATION**, by Mirko Borisov, MGI Belgrade, Dragoljub Sekulović, Military Academy Belgrade and Radoje Banković, MGI Belgrade, the 3D models and their military application are presented. Methods of data modelling and data organization are described in detail. Qualitative and quantitative characteristics of the 3D models are also given.

In the paper **ANTI ARMOUR GUIDED MISSILE: GUIDANCE LAW SYNTHESIS AND CLOSED LOOP FLIGHT SIMULATION**, by Bojan Pavković, Military Technical Institute, Belgrade, the linear mathematical model of short range anti armour guided missile and a method of cascade compensation are given. The characteristics of the compensated closed loop are also given. The program "Simbum" for 6 degrees of freedom and guidance system simulation is introduced. The program verifies the guidance law.

In the paper **ELEKTROOPTICAL AND COMPUTER SACLOS GUIDANCE SUBSYSTEM FOR ANTI-ARMOUR MISSILES**, by Nenad Cakić, Military Technical Institute, Belgrade, the realization of SACLOS (Semi-Automatic Command to Line-of-Sight) guidance subsystem for short range anti-armour guided missiles (AAGM) is presented. The subsystem is composed of elektrooptical flare, CCD sensors, flare localiser with digital video processing electronic unit and digital guidance computer. The subsystem is comparatively analyzed with classical AAGMs guidance systems. Also, the subsystem's capability to guide medium range AAGMs with pyrotechnical flare is considered. Some field test results for both AAGMs are presented.

In the paper **TARGET RANGE ESTIMATION BASED ON EXTENDED MEASUREMENT VECTOR OF TWO PASSIVE INFRARED SENSORS**, by Goran Dikić, Military Academy, Belgrade, Željko Đurović and Branko Kovačević, Faculty of Electrical Engineering, Belgrade, the improved triangulation principle is presented. The improvement is achieved by introducing the ratio of infrared energy adsorbed at the end of a baseline in a measurement vector within Extended Kalman Filter. Solution is combined with the recursive estimator for extinction coefficient that describes the influence of atmosphere. This combination resulted in a new adaptive structure for estimating the target kinematical states together with simple and efficient estimation of atmospheric parameters.

In the paper **THE THRESHOLD FOR CHANGE DETECTION ON THE IMAGE OF A SCENE**, by Žarko Barbarić, Faculty of Electrical Engineering, Belgrade and Boban Bondžulić, Military Academy Belgrade, some methods for image difference thresholding are described. Methods are tested on real sequences of images. The sequences are extracted by stationary TV and thermovision cameras.

In the paper **THE QUALITY OF HIGH EDUCATION AT THE MILITARY ACADEMY**, by Dušan Regodić and Ljubiša Tančić, Military Academy Belgrade and Branko Đedović, Department for logistic systems, MoD of the SMAF, the aims of high military education are shown as multi-dimensional and contributing to the development of

human resources in the defence of the member states Serbia and Montenegro, the development of defence technology, society, culture and the officer cadre. High military education primarily bears upon the main components of the defence system and is of national significance. The policy of quality and training at the Military academy is an integral part of its business policy and represents a means in the management of the organization that leads to the performance upgrading. Its main tasks are living up to the needs and expectations of the Ministry of Defence, the SMAF General Staff, and all interested parties, in terms of quality, educated cadre as well as superb services in the area of education, permanent improvement of business quality, diversifying in terms of services in the area of education and creating trademark cadre at the regional level.

In the paper **A POSSIBLE APPROACH TO THE LOGISTIC SUPPORT SYSTEM PROJECTING WITHIN THE PROCESS OF DEFENCE SYSTEM TRANSFORMATION**, by Zoran Patić, Department for material resources, MoD of the SMAF and Marko Andrejić, Military Academy, Belgrade, a possible approach to the problem of logistic support system projecting within the process of transformation that characterizes a defence system by way of joining „Partnership for Peace” programme and admission to NATO was presented. The paper includes the description of the basic algorithm for projecting and re-projecting of the logistic support system, as well as the approach to the problem of criteria defining, variants generating and selection of an optimal solution.

In the paper **THE APPLICATION OF THE Brüel & Kjør LATEST GENERATION SYSTEM IN MONITORING AIRCRAFT NOISE**, by Milorad Pavlović and Gordana Jurin, VOC Belgrade, the noise effects and noise descriptors were presented along with the possibilities of its measurement and control at and in the vicinity of an airfield with Brüel & Kjør system of the latest generation for the purpose of emphasizing the importance of protection of the population from noise.

In the paper **MEASUREMENTS OF COMPROMISING RADIATION FROM PC UNITS: AN EAVESDROPPING RISK**, by Lučić Branislav, TOC Belgrade, the results of research into the possibility of eavesdropping on video display units, by picking up and decoding the electromagnetic interference produced by this type of equipment was presented. The current widespread interest and anxiety over electromagnetic radiation (EMR) and electromagnetic eavesdropping might suggest that these are phenomena of not such a recent date. For more than twenty years, international military and intelligence agencies have been aware of the fact that all electronic equipment without suitable shielding generates high levels of radio frequency (RF) signals that can be intercepted and reconstituted into intelligible information.

In the paper **HUMAN ASPECTS OF MODERN TECHNOLOGIES APPLICATION**, by Vasilije Mišković, Military Academy, Belgrade, the human aspects of modern technologies, i.e. the influence of using modern technologies on people and society as a whole were presented. It is emphasized that modern technologies unquestionably influence not only the human society as a whole, as well as individuals, but also the entire environment of the planet.

In the paper **ADVANCED LEARNING SYSTEM**, by Srećko Joksimović, Đuro Alfirević and Borko Đurić, Military Academy, Belgrade, the argument that learning as

a concept represents a subject that is increasingly in the focus of interest nowadays is given. Many attempts are made to upgrade learning to a highly professional level, a project representing an attempt leading to full automatization.

In the paper ENDOSCOPIC DIAGNOSTICS IN ON-CONDITION MAINTENANCE OF TECHNICAL SYSTEMS, by Stefan Janković, Aeronautical Plant "Moma Stanojlović" Batajnica, and Miroljub Jovanović, Airport "Nikola Tesla", Belgrade, the basic principles of on-condition technical diagnostics with regards to the possibilities of rendered by the advanced endoscopic diagnostics, all for the purpose of increasing the reliability and efficiency of technical systems was presented.

One of the most reliable methods of systems technical diagnostics, that does not require its disassembling, is endoscopic diagnostics. Examples of shown damages on parts are taken from the Diagnostic Centre of the Aeronautical Plant "Moma Stanojlović".

In the paper LOADING RATE EFFECT ON FRACTURE RESISTANCE OF ARMOR STEELS

WELDS, by Vencislav Grabulov and Zoran Odanović, Military Technical Institute, Belgrade, the results of evaluation of brittle fracture behaviour in order to assess the effect of the loading rate on the fracture resistance of armoured vehicles (battle tanks) and shipbuilding steel, especially for submarines were given. Three different testing methods (instrumented impact, explosion crack starter and fracture mechanics tests) had been applied for brittle fracture behaviours of base metal and welded joints, produced by manual arc welding.

The Organizing Committee of OTEH has suggested that the gathering of researches in the defence sciences fields should be organized every second year. It was also suggested that the Ministry of Defence of the state union of Serbia and Montenegro should entrust the organisation of the next gathering to the Military Technical Institute.

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