

## 30<sup>th</sup> scientific-professional meeting with International participation - HIPNEF 2006

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The 30th scientific-professional meeting with international participation - HIPNEF 2006 was held 24 - 26 May 2006, in Vrnjačka Banja. This traditional meeting of experts in oil hydraulics, pneumatics, automatic control and other related areas was organized by the Association of Mechanical and Electrical Engineers and Technicians of Serbia (SMEITS) from Belgrade. The general sponsor of the meeting was FESTO firm from Belgrade.

The assembly was greeted by Professor Dragutin Debeljković, the president of the Organizing Committee, colonel Jevtić, manager of the Breza hotel, Professor Donchev from Bulgaria, Professor Miodrag Stojiljković, president of the Section for automatization of the SMEITS and Mr Erdoglić, deputy of the community president of the Vrnjačka Banja, as the host town.

The meeting was opened by Professor Milivoje Sekulić, first president of the Section for automation formed by SMEITS back in 1969.

The opening was followed by presenting the renowned members of the SMEITS who have given significant contribution to the work and recognition of the HIPNEF with diplomas. The diplomas went to Professors Svetislav Zarić, Milivoje Sekulić and Dragutin Knežević, and also to working organizations: firm FESTO, Mechanical Faculty from Niš and firm INFORMATICA from Belgrade, who have been supporting the HIPNEF financially or otherwise over a number of years.

Out of five introductory lectures proposed and announced by the organizer, four have been presented as follows:

**HISTORY OF THE HIPNEF SCIENTIFIC-PROFESSIONAL MEETINGS**, by Milivoje Sekulić, SMEITS

In this paper, the originating and activities of the Section for automatization of the Association of Mechanical and Electrical Engineers and Technicians of Serbia (SMEITS) were presented, as well as the chronology of the meetings dedicated to the field of automatization under the name HIPNEF.

**OBSERVER DRIVEN OPTIMAL STRATEGIES FOR A CONFLICT LINEAR-QUADRATIC DIFFERENTIAL GAME**, by Zoran Gajić, Rutgers University, Piscataway, NJ 08854, USA and Dobriša Skatarić, Mechanical Faculty, Belgrade

The paper defines an observer driven linear-quadratic dynamic game with a conflict of interest and presents the corresponding linear optimal control strategies and the method for evaluating the optimal performance criteria.

**ON THE RATIONAL PLACEMENT OF ACTUATORS FOR LINEAR-QUADRATIC OPTIMAL CONTROLLERS**, by Verica Radisavljević-Gajić, Lafayette

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The performance of the linear-quadratic regulator can be improved by formally increasing the dimension of the input space to  $m+k$ , where  $m$  is the dimension of the original control input and  $k$  is an appropriate integer. The proposed change does not affect the physical description of the problem, instead, it increases formally the number of inputs only - for the purpose of solving the algebraic Riccati equation.

In the case when the system actuators can be placed in several positions, the results obtained in this paper suggest that the actuators should be placed so that for the chosen control matrix  $B$ , the rank of the matrix product  $BB^T$  is as large as possible.

**NIKOLA TESLA**, by Milivoje Sekulić, SMEITS

On the 150<sup>th</sup> anniversary of Nikola Tesla's birth, the author evokes the creative results of this genius in the field of electricity and mechanical engineering. Tesla's inventions completely fall into the activities that are the focal points of the HIPNEF.

After the plenary sessions, the meeting continued in two separate parallel sections. The papers were classified into the eight thematic areas:

- a) Hydraulics (15 papers)
- b) Pneumatics (9 papers)
- c) Electrical engineering and electronics (9 papers)
- d) Fluids (7 papers)
- e) Flexible control systems (12 papers)
- f) Flexible automation (6 papers)
- g) Exploitation and maintenance (6 papers)
- h) Military engineering (9 papers)

For the first time, the HIPNEF organized a special session under the name **MILITARY ENGINEERING**, thanks to the contributions from the Military Technical Institute. In the frame of these sessions, authors have presented significant contributions from the research domain in experimental aerodynamics performed in wind tunnels uniformed in our country. Two additional papers have been presented by the experts from the Military Technical Institute in other areas; one paper was presented in the **FLUID** session and the other in the **EXPLOITATION AND MAINTENANCE** session. Therefore, the Military Technical Institute had 9 scientific-professional, high quality papers presented becoming an institution with the largest number of presented papers on the meeting. This was noted with great pleasure during the program committee session, held before the meeting, in which the author of this report took part.

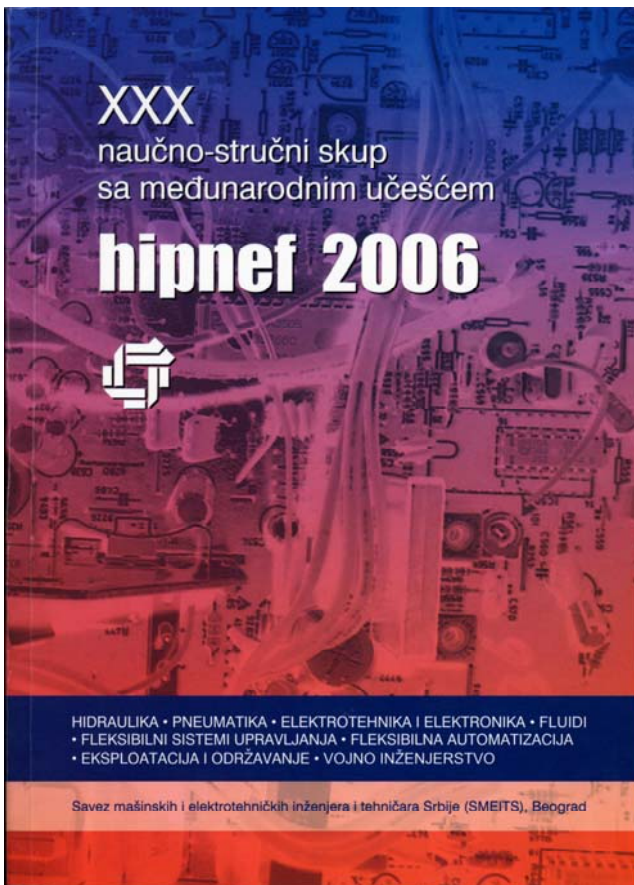
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It should be noted that apart from four introductory lectures from abroad, 7 papers were from Bulgaria and one from Ukraine, written in English. Furthermore, representatives of former Yugoslav republics, Bosnia and Herzegovina, Slovenia and Montenegro also submitted their papers.

The 587 pages of the proceedings included all reviewed papers, whether they were presented on the meeting or not. Five introductory papers followed by 73 published papers, were classified in 8 thematic areas in the same order as presented on the meeting.

The presentation of the firm FESTO, as general sponsor, was especially interesting. The FESTO has 10.500 employed in 78 firms around the world and has in its production a program of about 78.000 components. From 2.5 billion Euros of GNP per year, the FESTO gives 10% for development. Special attention is given to investing in the education of the new generation of employees to be engaged in developing new components.

The most important papers from that could be of interest to the readers of the Scientific Technical Review will be presented here.



**LIFETIME OF HYDRAULIC DEVICES – CALCULATION BASED ON TECHNICAL AND ECONOMIC CRITERIA**, by Radan Durković, Faculty of Mechanical Engineering, Podgorica

The paper deals with the lifetime of hydraulic devices as the time required to reach a lifetime state when further exploitation is not possible or it is not economically feasible. This paper presents a calculation of lifetime of device elements prior to breakdown due to fatigue. The calculation involves an application of linear hypothesis and damage accumulation of the material. Subsequently, it is shown how to determine the lifetime and limiting values of the device working parameters based on their nominal

values. Finally, a variation of the device volume efficiency during exploitation and determining optimal lifetime according to economic criteria is also presented.

**INVESTIGATION OF THE PNEUMATIC SYSTEMS IN TERMS OF ENERGY EFFICIENCY IN THE SERBIAN INDUSTRY**, by Dragan Šešlija, Bojan Lagod, Faculty of Technical Sciences, Novi Sad

Some results of investigation of current state of the art compressed air systems are shown in this paper. Main measures used for the improvement of energy efficiency are given, as well as their area of application. Sources of decreased efficiency in pneumatic systems are noted and appropriate conclusions proposed.

**OPTICAL SIGNAL POWER MEASUREMENT**, by A. Milinski, M. Živanov, M. Slankamenac, Faculty of Technical Sciences, Novi Sad

In this paper, the principles of power measurement of optical signals and bases of optical time domain reflectometry are shown. Modern light sources, their characteristics and output power are also discussed. Power measurement of two optical sources on different wavelengths was done. Two types of detectors were used for signal detection. Detailed analysis of measurement results, depending on the used optical light sources and limitations in their use, are also described.

**INFLUENCE OF NUMERICAL MESH QUALITY NEXT TO WING ON NAVIER-STOKES SOLUTIONS**, by Mirko Kozić, Military Technical Institute, Belgrade

This paper has been related to analysis of influence of the numerical mesh quality next to wing surface of the aircraft on solving of the Navier – Stokes equations. The flow field around the wing of the LASTA-95 airplane was modelled for Reynolds number equal to  $2 \cdot 10^6$ , at near stall angles of attack, at which flow separation appears on the upper wing surface. The results were obtained for an unstructured, coarse and a structured, fine mesh. The large differences for aerodynamic coefficient values were noticed, especially for drag coefficient and it was shown that mesh next to the solid surface has to be fine enough in order to obtain reliable results for complex flows.

**HEALTH MANAGEMENT SYSTEMS FOR AIRCRAFT ENGINE MAINTENANCE**, by Dragoljub Vujić, Military Technical Institute, Belgrade

This paper deals with a new system generation for health management of high performance aircraft engines. The general concept of the system, based on traditional complementary monitoring techniques used over the past twenty years in the military and as well as commercial aircraft, is presented. It is shown that by fusion of data from a variety of sources, enhanced diagnostic and prognostic information regarding the health of the engine can be achieved in the future.

**EXPERIMENTAL AND NUMERICAL  $C_p$  DETERMINATION OF HYDROFOIL IN STEADY AND UNSTEADY FLOW**, by S. Ristić, D. Matić, J. Isaković, M. Samardžić, Military Technical Institute, Belgrade

Experimental and numerical results for the pressure coefficient  $C_p$  of high speed axial pump hydrofoil are presented. The experiment is carried out in the water-cavitations tunnel in the Military Technical Institute. The velocity vectors distribution is measured around the central profile of the straight profile grid, for  $\alpha = 0^\circ$  and  $25^\circ$ , and the velocity in the free stream of  $5.32 \text{ m/s}$ . The results of LDA measurements have been used as data for defining the boundary conditions for numerical simulation and  $C_p$

calculation executed in the Fluent. The flow visualization was performed using aniline dyes and air bubbles. The main goal of the test was to investigate the possibilities of LDA in stationary and unstationary conditions of hydrodynamic researches.

REVIEW OF TENSOMETRICS TRANSDUCERS USED IN THE VTI ŽARKOVO WIND TUNNELS, by M. Samardžić, D. Marinkovski, Z. Anastasijević, Military Technical Institute (VTI), Belgrade

Strain gauges force and moment transducers used in the Military Technical Institute (VTI) in Belgrade are described. This paper deals with internal strain gauge balances from one-component balances up to six-components balances. Internal monobloc six-component balances represent the highest level of design and manufacturing strain gauges based transducers in the VTI Experimental Aerodynamics Division.

ROTATING BALANCES FOR MEASUREMENT OF FORCES AND MOMENTS ON PROPELLERS OF A MOTORIZED WIND TUNNEL MODEL, by Đorđe Vuković, Military Technical Institute, Belgrade

In order to experimentally determine loads on propellers of a motorized wind tunnel model of an aircraft, a pair of rotating balances, housed in propeller hubs, were designed, built and installed. The requirement that balances should be installed with minimum modifications of the existing aircraft model required high accuracy of measurements and miniature dimensions of the space available for balances, resulting in some specific solutions in design, production

technology and calibration. Balances were equipped with a data acquisition and wireless data relaying systems designed and produced by external associates. During the production, calibration and use of the balances, the validity of the selected design was confirmed and some shortcomings that have to be avoided in future projects of this type noticed.

### Conclusion

The 30<sup>th</sup> jubilee of the scientific-professional meeting, HIPNEF 2006 brought together experts from the areas of oil hydraulics, pneumatics, automatic control and other related disciplines who presented very interesting papers in the domains of research, development, design, technology, testing and maintenance of hydraulic, pneumatic, electric and electronic components and systems. It was an excellent opportunity for experts from universities, scientific-research institutes, and colleges, private and state-owned firms, from the country and abroad to come together and share experiences. The presented papers were of substantial content and high scientific and professional level. The organizational level of the meeting deserves high praise. Despite the fact that the country is in a transitional phase, as are the neighbouring countries, the general impression was that this traditional meeting was successful and that it met the organizers' expectations.

Received: 28.06.2006.