

## Chronicle

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### 16th International Conference “Mechanika”

**Prof. Dr. habil. M. Daunys**, Chairman  
**Assoc. Prof. Dr. V. Nenorta**, Scientific Secretary

International Conference “Mechanika-2011” is organized as one conference of the cycle “Science and Industry of Lithuania”. The conference “Mechanika-2011” took place on 7, 8 April at the Faculty of Mechanical Engineering and Mechatronics of Kaunas University of Technology. The Conference is organized by Kaunas University of Technology in cooperation with Lithuanian Academy of Science, IFToMM National Committee of Lithuania and the Baltic Association of Mechanical Engineering (BAME). The purposes of the conference are to discuss current problems of research, education, and industry in the country; to present results of the most recent research in specific subject areas. Among participants are the leading specialists from other institutions of higher education and scientific institutes, authorities in technical sciences and other areas, and representatives of industry and business organizations. The Conference Committee selected 72 presentations from the 102 and after the second selection 66 reports are published in the Proceedings of the 16th International Conference “Mechanika”.

The conference proceedings cover the following topics:

- strength of materials and structural elements;
- mechanical technologies;
- dynamics of mechanical systems;
- engineering materials and their application.

Besides the papers from Kaunas University of Technology, Vilnius Gediminas Technical University, Klaipėda University, Vilnius University, Lithuanian of Health Science, Lithuanian Academy of Physical Education, there were presented the papers from institutions of Baltic Region and from other countries: Silesian University of Technology (Poland), University of Bihać, (Bosnia and Herzegovina), Lappeenranta University of Technology (Finland), Central Scientific Research Institute of Structural Materials “Prometey”, Kaliningrad State Technical University (Russia), Riga Technical University (Latvia), Czech Technical University (Czech), Istanbul University (Turkey) and companies of Lithuania. There were 165 participants (from KTU – 64, other science and education institutions of Lithuania 46, Lithuanian industry – 15, foreign countries–40).

Prof. Dr. habil. M. Daunys opened the conference, congratulated the participants and explained the procedure of the Conference.

Dean of the faculty of Mechanical Engineering and Mechatronics Prof. Dr. habil. A. Fedaravicius congratulated the participants, made an overview report on scientific research activities in Kaunas University of Technology and Lithuania in the area of mechanical engineering.

In the plenary session two reports about problems in the Lithuanian science of mechanics were made.

Prof. Dr. habil. Ramutis Bansevicius who was awarded the Science Grand of Republic Lithuania this year from The Mechatronics Centre for Research, Studies and Information of Kaunas University of Technology presented the report “*Piezomechanics as a Subsystem in Mechatronics: State of the Art and Applications*”, in which the definition of Piezomechanics and structure of Active multifunctional kinematic pair were formulated. The concept of Piezomechanics (Piezoelectricity + Mechanics + Control System) describing a complex interaction of dynamic effects and precision engineered devices was presented. Piezomechanics is considered as part of the more broad philosophy of Mechatronic devices. The object and structure of Piezomechanics was described as well as the primary linear and nonlinear effects, on which energy, motion and signal transformation processes are based.

New schematics of high resolution multi DOF piezoelectric motors were presented together with applications, related to the Precise Mechatronics area: 1D and 2D laser scanning and deflecting devices, attitude control for nanosatellites, multifunctional and intelligent devices.

Some examples of several smart materials integration into one unit was described; the advantages being new properties of combined transducers, such as adaptive dampers, piezoelectric/magnetostrictive film visualizing magnetic fields, etc.

Prof. Dr. habil. Algirdas Bargelis from Department of Manufacturing Technologies presented the report “*Strategical and Structural Development of Manufacturing Systems: A Manufature Perspectives*“ in which noted that manufacturing as used in this research refers very broadly to all the activities required to create and produce products. It has been many exchanged in modern manufacturing environment when enhancing variety of products and decreasing the production volumes. High tech development in manufacturing applying laser, CNC, IT and other clean-tech dominate during past decade. Modelling of manufacturing systems using concurrent engineering and integrated approach with AI as fuzzy logic, neural network, KB and ES are widely employed in this research. Research objective is strategical and structural development of manufacturing systems.

Main tasks are as follows: excellence of engineering performance and development of strategy *make or buy* in manufacturing systems (MS), modelling of manufacturing cells, shops, divisions and itself MS.

The research on manufature perspectives as development of smart and digital factories, new hybrid manufacturing systems and rapid manufacturing developments is made.

The research on the early stage of creation innovative products and processes, and relation between man-

robotic cooperation is emphasized. Three stages of man-robotic work are classified: manual, man-robotics and robotics-software work. There are developed CAPP system based on man-machine approach, DFMA and DFPC interfaces and AI functional models for CAPP system applying fuzzy logic, evidence theory and neural network. It was possible to create systematic approach for innovative processes development going out from trials and errors method applying integrated design of technical systems and processes methodology and algorithms. These algorithms on classification of technical systems (TS) and their design features (DF) are based and appropriate mathematical formalization of manufacturing processes and drawings applying graph theory.

The forecasting of manufacturing processes and their cost at the early design stage of TS or new order engineering stage is urgent going to further decision making of production capability. The framework of TS process and its cost forecasting have been developed. TS 3D CAD model and main materials as input data for process and cost forecasting alternatives have been used. Forecasted alternatives have been evaluated and ranked by productivity and other effectiveness indices. The developed forecasting model has been tested and validated in industrial companies according to accuracy of forecasted and practical results. Manufacturing cost and quality indices are main factors selecting TS process alternative for its batch production.

Rapid manufacturing that applies newest achievements of rapid prototyping (RP) and rapid tooling (RT) during past decade becoming very important factor seeking advantages in new and innovative TS development and delivering to the market. The research of traditional and RP and RT technologies was carried out in current presentation. There were emphasized TS types and peculiarities which are more worth to develop and produce exploring RP and RT methods.

At the last stage of a presentation the international and national projects made by author and his team of Integrated Processes Laboratory during past 5 years have been surveyed. The biggest part of them was granted by EC and projects' results have been implemented in industry and training of employees and students in universities.

Main points of conclusions as creation of knowledge-based innovation in TS and its processes, creativity and collaboration enhancing for development of innovative TS and technologies, new human-robot interactive collaboration approach in advanced manufacturing systems are main key factors for increase productivity in Manufature.

## 1. Strength of materials and structural elements

**Prof. Dr. habil. A. Ziliukas**, Chairman  
**Assoc. Prof. Dr. V. Leisis**, Secretary

Two sessions took place in the section of Strength of Materials and Structural Elements and 24 presentations were made in it. More than 51 listeners participated in this section from Czech Technical University (Czech), Kaliningrad State Technical University (Russia), Silesian University of Technology (Poland), Riga Technical University (Latvia), Vilnius Gediminas Technical University and Kaunas University of Technology.

The problems of the strength and fracture of structural elements were analyzed in these presentations. The newest methods of evaluation of materials and calculation of structural elements were presented. The problems of composite mechanics and biomechanics were solved.

I. Pritykin from Kaliningrad Technical University analyzed the problems of strength and stability of perforated beams.

The specific strength problems of prestressed concrete sleepers were investigated by J. Bartova, J. Sykrova and P. Štemberk from Czech Technical University. Prestressed concrete sleepers are among the most common structural components of the railway tracks. Since the production speed is of a great importance nowadays, a variety of production technologies have been proposed, however, the decisive factor remains with the hydration of concrete. The objective of these investigations was to describe such production technologies and to propose a possible method for assessment of prestress loss and to analyze the effect of the extreme loading conditions. Based on the structural analysis, the optimized shape of the sleeper was proposed and the necessary parameters of the fatigue assessment of the prestressed concrete sleeper was established

The specific biomechanics issues were investigated by A. John, M. Dziejowski, M. Jasinski and E. Majchrzak from Silesian University of Technology.

The fatigue fracture analysis of structural elements was presented by M. Leonavičius, A. Krenevičius and E. Stupak from Vilnius Gediminas Technical University and by R. Česnavičius from Kaunas University of Technology.

The newest results related to the strength of reinforced concrete beams were presented by V. Gribniak, R. Jakubovskis and L. Linkutė from VGTU and by J. Vaičiūnas from KTU.

Results on influence of turns deformation features at bending of the threaded connection were presented by Ž. Juchnevičius from VGTU. When bending is applied to tight studs, one side of the turns is in loading process and turns in the opposite side of the neutrall line are unloaded. Author presents results on the influence of turn pair unloading effect upon the load distribution on the turns at bending of the threaded connection.

R. Janavičiūtė (KTU) presented the investigation of concrete surface nanomorphology and microhardness.

M. Urbas from Kaunas University of Technology presented results on modeling of welded connections in SolidWorks Simulation 2010.

R. Bortkevičius from KTU presented investigation of relevancy of nonproportional over constant blank holding forces in stamping metal sheet part made from steel grades 45 and 45H.

The second workshop of Section A finished with E. Narvydas (KTU) presenting results on simplified simulation of cooling jacket shell hydroforming. Results shows that the simulation results of a cooling jacked hydroforming process, expressed by shell displacements, had a good agreement with the results of prototype testing. The isotropic and kinematic strain hardening rules in that model did not demonstrate the significant difference in the results.

In conclusion, the presented studies highlighted the actual problems of strength and fracture mechanics of materials and structural elements:

- strength and fracture mechanics;

- experimental measurements and computational methods application for structure strength and durability assessment;
- composites mechanics and biomechanics.

It was clarified that metallic and nonmetallic composite materials are widely used but specific attention it must be taken into account to assess their durability and reliability. The questions of reliability assessment are relevant. A large part of scientific problems are solved using computer software and numerical methods. Therefore, the finance for experimental base is inadequate and the experimental tests are simplistic. That's just as well a lot of young researchers take part in the conference. Both the scientific value and perspective allows us to foresee that the higher strides will be reached in the domain of strength and fracture mechanics.

## 2. Mechanical technologies

**Prof. Dr. habil. A. Bargelis, Chairman**  
**Assoc. Prof. Dr. R. Mankutė, Secretary**

The 18 research papers in the section of Mechanical Technologies from Lithuania and other three foreign European countries and Brazil have been presented in session of this workshop. The investigation and new developments in various fields of mechanical technologies has been examined. There were proposed new ideas as a product modular design and module-based shape optimization, investigations of welding technologies, peculiarities of fabrication technologies as high speed wood milling, bio adaptive polymers and so on. New concepts of Manu future and human-robotic cooperation and application in hybrid manufacturing systems have been presented also. Exceptional research papers of mechanical technologies workshop have been given from Finland, Russia and Belarus, and also from Lithuanian universities and research centres.

The colleagues from Lappeenranta University of Technology (Finland) presented 6 research papers by 8 researchers. T. Kassi and M. Lehtovaara examined the effects of modular design process of small-scale products for bio energy users; J. Martikainen with co-authors presented research for development of large steel structures applying modularization. P. Kah with colleagues emphasized the methods of evaluating weld quality in modern production systems. J. Martikainen presented research of precise and quality welding processes in sheet metal industry applying laser and other high technologies. E. Hiltunen illustrated mechanical-metallurgical approach to prediction of crack initiation in light alloys.

The researches from Vilnius Gediminas Technical University presented two papers for the experimental investigation of heat sources temperature fields (A. Barauskas, R. Lazdinas, T. Snukiškis) and research of informative 2D scales of measurements systems design and metrological characteristics (K. Bardauskas, A. Kasperaitis, G. Zakas).

The scientists from Klaipėda University introduced the analysis of parameters the crank-slide-block kinematic mechanism (J. Grigonienė, A. Masiulis) for ship industry and students education.

Researchers from Kaunas University of Technology delivered 7 presentations in various research fields. There were analysis of choosing turning tools with indexable inserts manufactured on codes of metal cutting tools companies and determination of their cutting parameters (A. Bražėnas, D. Garuckas), investigation of surface roughness and micro-hardness after electromechanical hardening (S. Markauskas, V. Jurėnas, G. Riška), investigation of the effect the sanding time and abrasive grit size on surface roughness of pine wood (K. Cikanas and G. Keturakis). These research topics are interesting for industrial companies which are willing for cooperation. Investigation and analysis of the clerical errors in engineering process (K. Bendoraitis, G. Ambrulaitienė and M. Gramlich) are involved in computerized of industrial processes. The interesting research of bio adaptive polymers for MEMS and microhardness and surface morphology analysis of micro membrane have been made PhD students S. Ponelytė and K. Malinauskas together with their adviser Prof V. Ostasevičius and other coauthors.

The scientists of KTU and other Lithuanian universities actively participated in the workshop. The useful discussions together with their colleagues from foreign countries have been arranged and close co-operation planned. Many questions and discussions among workshop participants were pointed out. The second day of workshop has been divided for foreign guests' visits in two industrial companies of Alytus.

## 3. Dynamics of mechanical systems

**Prof. Dr. Habil. A. Fedaravičius, Chairman**  
**Prof. Dr. R. T. Toločka, Secretary**

At the Section of Mechanical Systems Dynamics sixteen reports by forty nine authors and co-authors were presented.

The presentations were given by the guests from University from Bihač (Bosnia and Herzegovina), Riga Technical University (Latvia), Kirklareli University, General Directorate of Bogazici Electricity Distribution Inc. Co. (Turkey), Vilnius Gediminas Technical University (Lithuania); nine reports by Kaunas University of Technology (Lithuania) were presented. The fundamental problems and results of applied research of mechanical, electromechanical and mechatronics systems were presented in the reports. It is worth mentioning that not only experienced researchers from Lithuania and foreign countries but young colleagues-master and doctoral students-participated as well.

The foreign guests I. Karagebovič, E Husak, S. Vojič and A. Hodzic, D. Hodzic, H. Rivic from Bihač University (Bosnia and Herzegovina) analyzed the problems of Cost-Effectiveness of Industrial Robot Application in the Welding Process and Modelling and Simulation of Wood Drying Process. The problems of Investigation of Mechanical Properties of Composite Materials Using the Method of Acoustic Emission and the Effect of Vibropressing Process on the Strength of Concrete by researches from Riga Technical University A. Urbach, M. Banov, Y. Harbuz, V. Turko, Y. Fechchuk, N. Khodos, J. Auzins, A. Kovalska were presented.

Traditionally there were made a number of interesting presentations on the problems of vibratory and

acoustic diagnostics and monitoring of machines and mechanisms and the problems of vibrations and noise in rotor systems (T.C. Akinci, Ö. Yilmaz, T. Kaynas, M. Özgüray, S. Seker; Turkey), V. Bučinskas, E. Šutinys (VGTU), V. Ostaševičius, V. Jurėnas, R. Jonušas, E. Juzėnas, G. Rimša (KTU) and others.

Some presentations were oriented technological problems. The Effect of Vibropressing Process on the strength of Concrete, Influence of Applied High Frequency Vibrations on Torque and Cutting Force Measurements during Drilling Process and Research of Vibratory Press – fit Connection by J. Auzins, A. Kovalska (Riga Technical University), V. Ostaševičius, V. Jurėnas, B. Bakšys and others were presented.

I should be mentioned that the presentations made at the section Dynamics of Mechanical Systems were of high scientific and practical application level, a great number of questions were asked on the presentations themes, the scientific discussion were active and useful for the conference participants.

#### 4. Engineering of materials and their application

**Prof. Dr. Habil. S. Bočkus**, Chairman  
**Assoc. Prof. Dr. A. Čiuplys**, Secretary

24 participants took part in the meeting of this section. They represented Kaunas University of Technology, Vilnius University, Klaipėda University, Institute of Materials Science and Riga Technical University (Latvia). There were 6 presentations in this section. The problems of materials science, welding, physical metallurgy and foundry were considered.

V. Gutakovskis and G. Bunga gave experimental data about the processing of high chrome content steel in their presentation. The results of this experiment revealed machining results of different structure stainless steel type effect on the machining parameters. A. Milinavičiūtė, V. Jankauskaitė, E. Fataraitė and P. Narmontas gave the results of the investigation of novel photopolymer compositions for microrelief formation by UV-embossing. The study revealed that PHP 3 and PHP 4 are the most effective photopolymer compositions for microrelief replication on their

coatings when periodical structures with the highest quality are embossed using defined parameters of replication process. R. Jarimavičiūtė-Ūvalionienė, I. Prosyčėvas and S. Lapinskas have considered about the mechanical and optical properties of electrochemically produced black porous silicon. The investigation showed that the photoluminescence intensity of porous silicon, which was produced electrochemically at current density including and excluding ultrasound excitation, increased as current density increased to 105 mA/cm<sup>2</sup> and decreased for the samples produced by higher current density. The pores were narrower when higher current density was used and the photoluminescence intensity decreased, because pores in n-type porous silicon were more closed and screened the light emission.

The presentation of S. Bočkus and G. Žaldarys was from the field of foundry. They gave analysis of the pearlite structure in ductile iron in their presentation. The study of the microstructure showed that the effect of the kind of inoculant on the content of pearlite is significant only for regular specimen sizes. It was found that the microhardness of pearlite of small size specimens is higher than this one of large size specimens. J. Vilys and V. Kvedaras have considered about the influence of nitriding temperature and time on the fatigue strength of steel. The results of experimental investigations showed that efficiency of gas nitriding (with the purpose to improve fatigue strength of steel) depends on treatment technological parameters such as the nitriding temperature and the time. After nitriding by different temperatures (from 475°C to 700°C) and nitriding times (from 3 to 12 hours) fatigue strength of 45XH steel varying widely.

One work was from the field of welding. P. Ambroza, T. Pilkaitė and E. Pupelis have considered about the influence of tempering temperature and laser beam on hardness and wear of the overlay welded layers. Investigation showed that the laser beam treated alloyed layers did not always increase wear resistance and it depends from the hardness of impact zone and microstructure.

After the conference, the problems of materials science and perspective of future investigations were discussed.