

## Chronicle

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### 18th International Conference “Mechanika”

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

International Conference “Mechanika-2013” is organized as one conference of the cycle “Science and Industry of Lithuania”. The conference “Mechanika-2013” took place on 4 - 5th of 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 conference aims 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 its participants the leading specialists from the institutions of higher education and scientific institutes, authorities in technical sciences and other areas, and representatives of industry and business organizations were present. The Conference Committee selected 86 presentations from the 98 submitted and after the second selection 51 reports were published in the Proceedings of the 18th 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, A. Stulginskis University, Klaipeda University, there were presented the papers from the institutions of Baltic Region and other countries: Ilmenau University of Technology (Germany), Silesian University of Technology (Poland), University of Bihač, Tuzla (Bosnia and Herzegovina), Lappeenranta University of Technology (Finland), Czech Technical University (Czech) University of Science and Technology (Algeria) Kocaeli, Osmaniye Korkut Ata, Marmara University, Kirklareli, Istanbul Universities (Turkey), Belarussian National Technical University (Belarus) Central Scientific Research Institute of Structural Materials “Prometey”, Kaliningrad State Technical University (Russia), and companies of Lithuania. There were 142 participants (from KTU – 80, other science and education institutions of Lithuania 27, Lithuanian industry – 8, foreign countries – 25).

Prof. Dr. habil. V. Ostaševičius opened the conference, congratulated the participants and explained the conference work procedure.

Dean of the faculty of Mechanical Engineering and Mechatronics Dr. A. Vilkuskas congratulated the participants, made an overview report on scientific re-

search activities in Kaunas University of Technology and Lithuania in the area of mechanical engineering.

In the plenary session two reports on the problems the Lithuanian science faces in the area of mechanical engineering were made.

Prof. Dr. habil. Ramutis Bansevicius from the Mechatronics Centre for Research, Studies and Information of Kaunas University of Technology made the presentation “*Piezoelectric active bearings and supports: structures, characteristics, applications*”.

The plenary presentation was devoted to the development and application of “smart” materials in designing different systems of Precision Mechatronics, mainly piezoactive structures and components. The concept of Active bearings and supports was introduced, covering wide range of kinematic pairs with active links and allowing to generate multi-degree-of-freedom relative displacements of the elements of kinematic pair. Numerous applications were presented, including adaptable piezoelectric actuators and motors, laser beam scanning/deflecting systems, piezoelectric robots, positioning systems on the plane, attitude control devices for nanosatellites, etc.

Prof. Dr. habil. Vytautas Otaševičius from the Department of Engineering Design of Kaunas University of Technology made the presentation “*Numerical and experimental study of microsystems, vibrational cutting processes and biomechanical systems dynamics*”.

A team of scientists from the Institute for Hi-Tech Development at Faculty of Mechanical Engineering and Mechatronics have been conducting theoretical and experimental research on MEMS materials, technology and dynamics-related problems. Major research activities include computer-aided design, multiphysics simulation and dynamic characterization of rotary and elastic microstructures used in various MEMS devices such as electrostatic microswitches and micromotors, which have been designed, fabricated and tested by the group members. Research tasks are solved by applying finite element method for the analysis of coupled mechanical-electrical-fluidic interactions and noncontact vibration measurement techniques such as laser vibrometry and holographic interferometry. Current efforts are directed to the study of optical MEMS sensor structures with deformable diffraction gratings for noninvasive detection of radial artery pulsation, vibration-driven piezoelectric energy harvesters for MEMS power supply and wearable inertial sensor devices for biomechanical applications. The group specializes in the research of underlying dynamic effects characteristic to cantilever-type macro/micro-structures with specific focus on vibro-impact interactions and advantageous exploitation of higher-order vibration modes. Joint application of numerical and experimental techniques allows to optimally tailor structural responses leading to improved performance of microdevices.

One of the major research areas of Institute for Hi-Tech Development is development and analysis of active and passive vibration cutting tools for different machining processes. As a result, experimental prototypes of piezoelectrically-excited (active) vibration turning/drilling/milling tools were designed, fabricated and tested in laboratory and industrial conditions. Simulation results obtained from the developed accurate finite elements models together with data from measurements of tool vibrations, cutting forces and workpiece surface roughness enabled identification of the most effective vibration control conditions based on rational exploitation of higher-order vibration modes of the tools.

Institute for Hi-Tech Development has been active in the research and development of vibration-based diagnostic principles and M(O)EMS-based sensor devices for biomechanical and biomedical applications.

### 1. Strength of materials and structural elements

**Prof. Dr. habil. A. Žiliukas**, Chairman  
**Assoc. Prof. Dr. V. Leišis**, Secretary

One session took place in the section of Strength of Materials and Structural Elements and 16 presentations were made in it. More than 12 participants from Czech Technical University (Czech Republic), Kaliningrad State Technical University (Russia), Silesian University of Technology (Poland), University of Tuzla (Bosnia and Herzegovina), Vilnius Gediminas Technical University and Kaunas University of Technology took part in this section.

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. Very interesting presentations was made by the colleagues from Poland. The specific FE modelling of human bone was presented by G. Kokot, P. Makowski, A. John, and W. Kus from Silesian University of Technology.

The numerical simulation of dynamic load acting on a protective cabin structure using LS-Dyna was presented by G. Kokot

A. Pritykin from Kaliningrad Technical University analyzed the problems of strength and stability of simply supported I-beams with Flexible Web. Also the newest results obtained in the experimental study of perforated beam were presented by K. Emelyanov and A. Pritykin .

Experimentally and numerically investigated response of base-isolated structures subjected to seismic loading with application of the digital image processing was presented by M. Petric from Czech Technical University.

Testing the strength of brazed joints on the cage of rotor on high voltage motors was presented by K. Becic from University of Tuzla.

G. Petraitis from Vilnius Gediminas Technical University presented the results on crack formation peculiarities at the notches of eccentric tension specimens.

J. Tretjakovas (VGTU) presented the suggested model which can describe the method of determining the pressure acting on the diaphragm during its static rupture. The obtained pressure-time curve will be applied in future

research to simulate the dynamic behaviour of the diaphragm's model.

The newest results related to the local stress at the root of threads were presented by J. Selivovec from VGTU.

The results on determination of non-stability force of slopping plates were presented by M. Kukis from KTU. The results presented by the author show that the data obtained can be used in the creation of the lightweight pressure vessels.

The extent of irregular stress distribution in a two-layer cylindrical bars subjected to the change of temperature were analysed in the presentation made by N. Partaukas from KTU.

The acceptability to use probabilistic design of rolled and welded steel beams on long term lateral-torsional stability under large static or dynamic capacity actions was presented by O. Lukoševičienė from KTU.

The workshop of Section A finished by A. Jutas (KTU) presenting results on the limits of elastic state for BCC- lattice at timeless strain axis.

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;
- composites mechanics and biomechanics.

It was clarified that metallic and nonmetallic composite materials are widely used but specific attention must be taken into account to assess their durability and reliability. A large part of scientific problems are solved using computer software and numerical methods. 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 23 research papers in the Conference section of Mechanical Technologies from Lithuania and other four foreign countries (Germany, Turkey, Finland, Bosnia and Herzegovina) have been presented in the session of this workshop. The investigation and new developments in various fields of mechanical technologies have been examined. New ideas such as a development of rope climbing robot, magnetic braking and speed stabilization, baguette drilling process and mechanism construction, etc. were proposed.

Exceptional research papers of mechanical technologies workshop have been given from Finland, Turkey and Germany, and also from Lithuanian universities and research centres.

V. Henkel with colleagues from Ilmenau University of Technology (Germany) presented the Digital Mechanism and Gear Library, supporting design engineers in finding ideas for design solutions in the field of motion systems.

Researchers from two Turkey Universities – Kocaeli University and Osmaniye Korkut Ata University –

presented 6 research papers. Colleagues from Kocaeli University analysed development of rope climbing robot with caterpillar (F. Kose et al), magnetic braking and speed stabilization problems (H.E. Güner et al.), presented image processing based low cost range finder (S. Karakaya et al.), image processing based on olive separation machine (M. Kuncan et al.) and a DSPIC based real time position control of a DC motor using PID and Fuzzy Logic controller (G. Taşçi et al.). E. Balei with colleagues from Osmaniye Korkut Ata University analysed production and characterization of a functional Graded material Reinforced with alumina.

Mr M. Pirinen with colleagues from Lappeenranta University of Technology (LUT, Finland) presented the research of the challenges and possibilities for the welding industry in the Arctic area.

A. Sokas from Vilnius Gediminas Technical University analysed graphical methods for designing steel truss nodes sheets in the engineering drawings.

Researchers from Kaunas University of Technology presented the biggest part of research papers. Prof. A. Bargelis et al. discussed the problems of vocational educational training of industrial employees and presented virtual and distance labs.

The PhD and MSc students of KTU Mechanical Engineering and Mechatronics faculty prepared and presented 5 research papers. It is a result of their research work in accordance with the study plan. The PhD student N. Toliušienė with colleagues analysed the quality management system for agile manufacturing. The MSc students A. Kleiva, G. Balevičius, J. Navickas, V. Koryzna are involved in research of various industrial problems of packaging, drilling and rapid prototyping processes. A. Kleiva presented the research of KTU colleagues – analysis of packing the single units and sets of the single units. G. Balevičius et al. investigated the influence of water absorption to the properties of photopolymer used in PolyJet process. The interesting research – investigation of baguette drilling process and mechanism construction was presented by V. Koryzna et al.

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.

### 3. Dynamics of mechanical systems

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

This year about 30 scientists participated in section's activities in two workshops. 26 reports were presented including 13 prepared by the conference organizers – representatives from Kaunas University of Technology. Reports were delivered by guests from Belarusian National Technical University, University of Science and Technology Algeria, University of Tuzla (Bosnia and Hercegovina), Kırklareli University, Istanbul University (Turkey), Silesian University of Technology (Poland), French-German Research Institute of Saint Louis (France) and other higher education institutions and research centres of Lithuania – Vilnius Gediminas Technical University, Klaipėda Univer-

sity, Vytautas Magnus University, company „Precizika Metrology“. These papers analyzed both fundamental and applied problems urgent to the national economy.

A large group of speakers from foreign institutions introduced the researches of mechanical systems dynamics as well as characteristics of related vibration processes. Such reports include the ones made by guests from Belarussia, Bosnia and Hercegovina, Poland, Turkey and other foreign countries. The fundamental issues of the mechanical systems dynamics were investigated in the reports of A. Bogdanchuk, T. Stepanenko „Determination of Magnetomechanical Parameters of Materials using Standing Wave Ultrasonic Method, T.C. Akinci, S. Karabeyoglu, O. Yilmaz, E. Guseinoviene, S. Seker „Analysis of Vibration Data at Properly Working Washing Machine with Time Frequency Method“, V.P. Czech „The use of DWT Analysis and PNN Neural Networks in Diagnostics of Gasket under Engine Head Damage“ and others.

We can separate a group of reports, which investigate the dynamics of the printing machines and processes (authors V. Turla, P. Ragauskas, J. Sidaravičius, S. Grigaliūnienė and others).

Traditionally, the participants developing their activities in the fields of pjezoelectric actuators and precision pjezoelectric mechanisms: active pjezoelectric actuators, high precision piezoelectric angular positioning systems, piezoelectric cantilever type energy harvester and other piezoelectric systems. Investigations in this area are presented by prof. R. Bansevicius, prof. G. Kulvietis, Dr. V. Jurėnas, prof. R. Gaidys and others scientists.

The reports presented by research groups supervised by prof. B. Bakšys analyzed the problems of automated assembly using vibration processes and investigations of suspension of magnetic nanoparticles in a stress of liquid environment.

Prof. V. Ostaševičius, prof. R. Gaidys and other authors presented the investigation results of Vibrational Cutting process. The first report analyzed the turning tool modal analysis for creating smart tool. The second report dealt with the dynamics of vibrational cutting active and passive tools structures.

The section activities were summarized by its chairman prof. A. Fedaravičius, who noted that many reports presented at the workshops were interesting, significant and topical. The conference was especially useful for young scientists. They became acquainted with the achievements of scientists from various institutions and listened to critical and valuable proposals.

### 4. Engineering of materials and their application

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

17 participants took part in the meeting of this section. They represented Kaunas University of Technology, SRI Center for Physical Sciences and Technology Textile Institute, Vilnius Gediminas Technical University and CRISM “Prometey” (St. Petersburg, Russia). There were 14 presentations in this section. The problems of materials science, welding, nanomaterials, corrosion and coatings were considered.

Presentations of materials science field predominated. There were seven such presentations. I. Padleckienė,

A. Abraitienė, L. Valasevičiūtė, S. Krauledas, R. Puodžiūnienė and L. Jovaišienė gave in their presentation the results about mechanical and thermal properties of meta-aramid, viscose FR and polyester FR knitted materials. Their experimental results showed that it is possible to achieve the higher level of the protection from flame and heat and to increase mechanical resistance of protective clothing by using structure of the developed knitted materials. J. Dargienė, A. Širvaitienė, P. Bekampienė, J. Domskienė and V. Jankauskaitė analyzed relaxation of pre-tensioned natural fabric reinforced composite. Investigations have shown that the properly chosen pre-tension strain not only improves the strength and rigidity of bio-composite, but determines slight dimensional changes (up to 0.5%) and high strain distribution uniformity in sample. Z. Bazaras, B. Timofeev, N. Vasilieva and V. Fedorova have considered in their work the questions related the damage of the power equipment as a result of the decrease of austenitic stainless steel strength. It was established, that occurrence of cracks of intercrystalline corrosion fracture type in the austenitic stainless steel welded joint heat-affected zone is caused by 3 factors: the certain degree of base metal sensitization, high operating voltage level and increased (in comparison with the normative documentation at operation) oxygen concentration in the heat-carrying agent. G. Urbonaitė, E. Kibirskštis and V. Miliūnas analyzed the 3D print technologies. G. Busilienė, A. Penkauskaitė, E. Strazdienė and V. Urbelis have considered about the investigation results of flexible polymer materials bonded seams mechanical behavior under biaxial tension. K. Krikštanavičienė, S. Stanys and V. Jonaitienė have considered about the mechanical properties of melt spun polypropylene multifilament yarns. A. Stančikas, V. Stona and G. Keturakis presented the investigation results of TiN-coated HSS tools wear during MDF milling.

Three presentations were from the field of welding. I. Višniakas discussed about the properties and microstructure of titanium alloy BT 6 welded connections. It was established that breaking of the welded connection begins

simultaneously in several places. Usually initiation of fracture (crack formation) is observed in the dilution zone with the multilayer welding. The formation of many cracks requires high expenditure of energy; therefore this destruction is slow and cannot be noticed. This prevents emergency structural failure. E. Pupelis, P. Ambroza, G. Keturakis and T. Pilkaitė showed the research results of renovation and production of new tools with overlay welding. L. Kavaliauskienė and P. Ambroza have considered about the investigation results of overlaying welding of workparts and tools with the materials powder and steel cutting wastes.

There were also three presentations from the field of nanomaterials. E. Jazukevičiūtė, E. Kibirskštis, V. Miliūnas and E. Jačionytė analyzed the main tendencies of nanotechnologies in packaging technologies and presented the examples of practical application of nanoparticles. The reviewed applications showed that nanotechnologies and smart materials are emerging as a new way in printing and packaging industries that offer possibilities for enhanced packed products safety, quality or even anti-counterfeiting protection. The further investigations of nano and smart materials lead to new applications in printing and packaging technologies. J. Puišo, V. Baltrušaitis, S. Ponelytė, I. Prosyčevas and A. Guobienė gave the research results about Ag/PVA nanocomposite formation and its application in microsystem devices. It was noticed that Ag/PVA nanocomposite material with its exceptional properties is an excellent tool in designing humidity sensors, special purpose membranes and may be employed in other optical sensors in microsystem devices.

The presentation of A. Čiuplys, R. Abraitis, E. Blaževičius and S. Bočkus was from the field of foundry. They presented methodology of investigation of the products of foundry sand drying process.

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