ISSN 1392–1207. MECHANIKA. 2014 Volume 20(4): 438–441

Chronicle

19th International Conference "Mechanika"

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

International Conference "Mechanika-2014" is organized as one conference of the cycle "Science and Industry of Lithuania". The conference "Mechanika-2014" took place on 24 - 25th of April at the Faculty of Mechanical Engineering and Design 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 85 presentations from the 98 submitted and after the second selection 58 reports were published in the Proceedings of the 19th 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 163 participants (from KTU – 88, other science and education institutions of Lithuania 37, Lithuanian industry – 3, foreign countries – 35).

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

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

Dr. Rolanas Daukševičius, Senior research associate from Institute of Mechatronics Kaunas University of Technology made the presentation "*Improving power output and operational bandwidth of vibration energy harvester at low-frequency excitation conditions".*

The plenary talk was devoted to the field of vibration energy harvesting employing piezoelectric materials. It overviewed current research results on modeling, fabrication and testing of a novel wideband vibration energy harvester with multiple impacting resonators and piezoelectric generators designed so as to deliver improved power and bandwidth performance under low-frequency excitation conditions. It was reported that a positive cumulative effect of engaging two low-frequency resonators in the impact-based frequency up-conversion process may be attained by rational selection of their natural frequencies and proper tuning of inter-beam clearances. The proposed design approach enabled the resonators to constructively contribute to the resonance amplification process during coupled vibration phase, which resulted in a considerably increased power output and bandwidth in comparison to the single-resonator arrangements traditionally used in vibration energy harvesters.

Assoc. Prof., Dr. Giedrius Janušas from Department of Mechanical Engineering of Kaunas University of Technology made the presentation "*Design, investigation and quality improvement of periodical microstructures"*

Periodical microstructures are used in various mechatronic and optical systems. They are applied both in static and dynamic as well as mechanical and optical systems, where geometrical and optical parameters of periodical microstructures are either constant or variable depending on the field of application: electronics, optoelectronics, micro-opto-electromechanical systems (MOEMS), etc. Periodical microstructures mostly are produced in the main technological steps such as origination (based on microlithography and dry etching), and replication either by UV hardening or by embossing of Ni replica in polymer. Formation of periodical microstructures by means of different approaches is a very complicated process therefore it is crucial to apply reliable direct and indirect methods for optimization and control of the process. Therefore low-cost effective characterization methodology was developed that allows indirect evaluation of mechanical, geometrical and optical parameters of periodical microstructures in the cases when traditional measurement techniques are not suitable. Proposed methods are applicable for optimization and control of technological processes. Also an aluminium vibration platform was designed in order to increase the quality of thermal replica of periodical microstructure; the piezoelectric element (PZT-19) was chosen as the source of high frequency vibrations. It was determined that high frequency excitation during the thermal embossing process of the nickel periodical microstructure (the period 4μm) increases the quality of replicas.

1. Strength of materials and structural elements

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

Two sessions took place in the section of Strength of Materials and Structural Elements and 20 presentations were made in it. More than 20 listeners participants from Czech Technical University (Czech Republic), Kaliningrad State Technical University (Russia), Silesian University of Technology and Higher School of Labour Safety Management in Katowice (Poland), University of Tuzla (Bosnia and Herzegovina), Vilnius Gediminas Technical University, and Kaunas University of Technology.

The problems of the strength and fracture of structural elements were analysed in these presentations attended this section.

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 results related to the FE modelling of human bone were presented by A. John and M. Duda from Labour Safety Management in Katowice. The newest results related to numerical analysis of the influence of the blast wave on the composite structure were presented by W. Ogierman from Silesian University of Technology.

Results of coupled fire dynamic simulation and finite element method in analyses of structures safety was presented by G. Kokot from Silesian University of Technology. Application of hybrid parallel evolutionary algorithm and gradient based method in atomic structures optimization was presented by W. Kus from Silesian University of Technology.

A. Pritykin from Kaliningrad Technical University analysed the problems of strength and stability of perforated beams.

Conference participants from Czech Technical University have presented the newest results related to the strength of reinforced concrete. A. Pallegedara presented a sequential and progressive approach to the development of a temperature controlled weather condition emulator for testing of concrete samples during a short period of time. M. Vaitova presented a simple method for assessment of the ablation depth of a thick concrete slab when corium is poured on its surface. P. Štemberk presented a possible tool for estimation of potential risk arising from placing concrete in winter. The presented methods are based on fuzzy logic which allows consideration of the behaviour of corium as it interaction with melting concrete, controls dynamics of the Peltier systems and allows evaluating the hydration of concrete under very low temperatures. P. Tantipidok presented a simple estimation of the earliest possible time to remove a formwork of concrete corbels and continue the next step of construction.

Stress Analysis of the Cage Rotor Structural Elements was presented by K. Becic from University of Tuzla.

G. Petraitis from Vilnius Gediminas Technical University presented the results on effect of defects on cast iron stress intensity factor. The newest results related to the strength of textile reinforced concrete beams were presented by N. Partaukas from KTU.

The problem of the application of sub-modelling in structural mechanics was analysed in the presentation made by E. Narvydas from KTU. T. Micius from KTU presented static and dynamic stress analysis of front-end loader for round haylage bales.

The newest results obtained in the experimental study on deformation behaviour of RC ties were presented by E. Gudonis from VGTU. Modelling results of the Osteoporotic Lumbar Vertebrae was presented by O. Ardatov from VGTU.

One presentation was made to share the results of investigation of wire strip mechanical properties that are used in the manufacturing of single core wire ropes. The problem of the investigation is that the rope must include all wire strips with same mechanical properties. The authors of these presentations are R. Dundulis and R. Bortkevičius.

The second workshop of Section A finished with A. Jutas (KTU) presentation on the interdisciplinary research-based simultaneous testing method (STM) for foresight of natural material behaviour.

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;
- composite mechanics and biomechanics.

It was clarified that metallic and non-metallic 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. That's just as well a lot of young researches took 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 engineering technologies

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

21 research paper in the Conference section of Mechanical Engineering Technologies from Lithuania and other three foreign countries (Finland, Turkey and Belorussia) have been presented in session of this workshop. The investigation and new developments in various fields of mechanical engineering technologies have been examined. There were proposed new ideas as a development of supply chain welding network, sensing technologies in robotic welding, systems engineering in power electronics industry, modelling of surface roughness in machining process of steels and flexible machining stations modelling in high variety and low production volume cases and other high productivity methods in production engineering fields.

Exceptional research papers of mechanical engineering technologies workshop have been presented from Lappeenranta University of Technology, Finland. Finnish researchers emphasized high productivity and quality machining and welding methods in their papers. Mvola, Kah and Martikainen considered adaptive gas metal arc welding

processes searching for new possibilities to increase the work productivity. Toivanen and Martikainen created a framework of networks in welding industry assisting manufacturers and customers' collaboration in finding the best decision in orders accomplishment. Shrestha, Hiltunen et al researched sensing technologies applying robotics in manufacturing processes.

Two research papers from Karabuk University, Turkey have been presented. Colleagues Boy, Demi et al from the mentioned University analysed the effect of approach angle on cutting force and surface roughness in hard turning of the stainless steel, while Korkmaz and Gunay presented the modelling results in hard turning applying ceramic tools.

A. Sokas from Vilnius Gediminas Technical University, Lithuania analysed the equilibrium equations matrix manipulations for creation of flat steel truss automated design system. Researchers from Kaunas University of Technology presented the biggest part of research papers in this International Conference. A. Bargelis and Ausmanas developed forecasting method of manufacturing cost at the early stage of 3D printing technology process that helps searching the cheapest ways of plastic parts and components production. Another page of Bargelis, Stasiškis and Baltrušaitis discussed the problems of flexible machine station (FMS) modelling in low volumes manufacturing searching higher efficiency in order-handling manufacturing systems. Gylienė has examined the ambiguity of orthogonal turning modeling that has high productivity perspectives in the future, Baskutis et al made mechanical properties analysis of laser welded steel joints under different welding modes. The PhD and MSc students together with their advisers of KTU Mechanical Engineering and Design faculty Industrial engineering department prepared and presented 8 research papers. This is the result of their research work in accordance to the study plan and research cooperation with industry. The PhD student Toliušienė and Mankutė analysed the voice technologies for quality assurance in agile manufacturing system, PhD student Sventickas and Juzėnas made analysis of vibrations in milling of thin-walled structures.

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. Many questions and discussions among workshop participants were pointed out.

3. Dynamics of mechanical systems

Prof. Dr. habil. A. Fedaravičius, Chairman
Assoc. Prof. Dr. L. Patašienė, Secretary

This year about 25 researchers participated in workshop activities of the section at which 21 reports were presented. These reports were delivered by the guests from, Silesian University of Technology (Poland), University of Bihac (Bosnia and Herzegovina), Istanbul University (Turkey), the University of Edinburgh (UK), Fraunhofer Institute (Aachen, Germany) and the researchers from Lithuanian higher education institutions - Vilnius Gediminas Technical University, Klaipeda University, Kaunas University of Technology. Fundamental and applied aspects of Dynamical problems at the frontier of scientific achievements researching dynamical systems in the field of engineering and technologies development were covered in the presented papers.

A group of speakers from the gest institutions presented their results and achievements in research of mechanical systems dynamics related to innovations in technological processes, transport, and machinery diagnostics. G John from Silesian University of Technology presented the novel concept of automated garage and the results of traffic flow simulation in it, his colleague from the same university W. Mucha gave the Review of Applications and possibilities of Real time computations using FEM, the researchers from Istanbul University presented their latest results on the investigation of Fault detection problem of washing machine using Discrete Wavelet method. The representative of Fraunhofer Institute C. Dicke Introduced the achievements in the development of the novel „100kHz Ultrasonic Vibration System for Machining of Hardened steel" which were obtained in strong cooperation with the Institute of Mechatronics (Kaunas University of Technology) under the leadership of prof. V. Ostaševičius. The report „Self-organising Patterns based on Nonlinear Models of Statistical Mechanics For secure Communication Algorithms" made by young researcher T. Ragulskis from University of Edinburgh represents the fundamental issue of dynamical systems research.

Traditionally, there was a group of presentations on developments in the fields of piezoelectric actuators and precision piezoelectric mechanisms: active piezoelectric pairs, high precision ultrasonic drive systems, piezoelectric cantilever type energy harvester and other piezoelectric systems. Investigations in this area are presented by PhD students R. Šakalys, I. Grybas and other group of young researchers supervised by prof. R. Bansevičius.

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

Prof. V. Barzdaitis (Kaunas University of Technology) and his young colleagues explained the obtained latest results in the area of their expertise - the problems of rotor dynamics and bearing diagnostics.

R. Klemka (Kaunas University of Technology) presented the results obtained in mathematical modelling of mobile platform in case of static and dynamical regimes of its motion;

A group of young researchers – PhD and master students working under the leadership of prof. V. Ostaševičius were concentrated of innovations in smart tool development.

As the topic of special interest the results in research and development of rocket type targets for training of the operators of the air defence systems presented by prof. A. Fedaravičius who leads the research group in this area can be highlighted.

Chairman of the section prof. A. Fedaravičius summarized results of the section workshop. , He emphasized that the reports were interesting, significant and topical. The conference was of special use for young scientists. They had a good opportunity to learn about the achievements of scientists from various institutions and listened to critics and valuable proposals.

4. Engineering of materials and their application

Prof. Dr. habil. S. Bočkus, Chairman
Assoc. Prof. Dr. A. Čiuplys, Secretary

18 participants took part in the meeting of this section. They represented Kaunas University of Technology (Lithuania), CRISM "Prometey" (Russia), Aleksandras Stulginskis University (Lithuania), Baltic State Academy for Fishing Fleet (Russia), Belarusian State Technological University (Belarus) and Tashkent State Technical University (Uzbekistan). There were 10 presentations in this section. The problems of materials science, nanocomposites, welding, corrosion and coatings were considered.

Presentations of materials science field predominated. There were four such presentations. I. Pritykin discussed about regularities of the corrosion wear of the fishing ship's hulls using photo-optical method. Results of the research were presented in the form of curve distribution probabilities of pitting's depth and in the forms of correlation function and spectral density. Author stated that the obtained results can be used in calculation of the stress concentration factor of corroded plates and shells. K.T. Narkulova, J.E. Safarov and M.M. Mamatkulov described engineering calculation method of vacuum dryer with infrared heat, determination of communication form with material, calculation of vacuum chamber choice, calculation and selection of Infrared emitters and its location. Their research resulted in the suggestion of rational parameters of operation of the dryer for mini productions. A. Volochko, D. Kuis, A. Shegidevich and N. Svidunovich presented the casting-deforming technology intended to produce cast aluminum composites and items from them which involves stirring of charge powder components and mechanical activation of an obtained mixture, extrusion of charge with producing the ligature and production of composite materials based on aluminum matrix with the aid of casting (in-situ technology). The investigation of the effect of mechanical activation of a charge containing these carbon forms has been made as well as of intensive plastic deformation on the possibility of their structure rearrangement and creation of new forms (glass carbon and diamond-like carbon particles) with the aim of their use in in-situ casting technologies. L. Gegeckienė, E. Kibirkštis and V. Miliūnas gave in their presentation the research results of the selection of the polymeric packaging materials. It was determined that only in two films of the tested all, the harmful residual stresses were observed. Also the effect of different temperatures (18°C, 4°C and -37°C) was evaluated and it was stated that the change of temperature does not have serious effect on inner stresses of polymeric films.

Two presentations were form the field of welding. P. Krasauskas, R. Česnavičius and J. Jaloveckas have considered the investigation results of non-traditional metal joining technique applied to welding of thin-walled sheet constructions without electrodes, using special shape friction stir spot welding tool. Experimental investigation of aluminum alloy 5754 plates with the thickness of 1 mm friction stir spot welding showed that axial welding force reaches peak value when the pin face touches upper plate surface but during dwell time the force slightly decreases. Analysis of the experimental data has shown that welding force during dwell time remains quite stable independently of tool rotation speed and tool plunge rate. Z. Bazaras, B. Timofeev and N. Vasilieva presented the steel type 08Cr18Ni10Ti welded joint microstructures before and during some operation time of NPPs WWER. It was shown that the microstructure of all searching materials is duplex austenitic-ferritic structure with determined δ-ferrite content which varies depending on the base metal conditions (deform or cast) and welded joint metal.

There were also two presentations from the field of coatings. M. Jakubelskas, G. Keturakis, P. Rudak and D. Kuis discussed about investigation results of TiCrN-coated HSS tools wear during MDF milling. The research helped to determine the influence of the cutting path, cutting and feed speeds on the durability of the milling tools not covered by any coating and covered by TiCrN coating. It was determined how the values of cutting edge recession and cutting power are changing when the cutting path, cutting and feed speeds are increased. S. Latushkina, D. Kuis, A. Zhizhchenko, N. Svidunovich, P. Rudak, O. Posylkina and O. Piskunova have considered the protective of nanocomposite vacuum coatings deposited by separated plasma flows.

The presentation of D. Kulikauskas, Ž. Tunaitis, K. Cikanas G. Keturakis and A. Baltrušaitis was about eccentric wood sanding efficiency. The analysis of the results allowed noticing that when the sanding time increases, the efficiency of sanding material decreases. The most intensive decrease in the efficiency was seen during the first 15 min at various values of grit size and sanding speed. Sanding continuation from 15 to 25 min showed slower decrease in efficiency of sanding material and the effect becomes rather negligible during the period from 25 to 30 min. D. Metrikaitė, J. Padgurskas, R. Rukuiža and R. Bansevičius discussed about tribology of ultrasonic motors (USM), more focusing on materials and motion parameter. They noticed that dynamic properties of USM depend on the optimum frictional materials. Properties of the USM depended on environmental pressure and tangential elasticity of the contact layer.

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