National Technical University "Kharkiv Polytechnic Institute"

Department of Continuum Mechanics and Strength of Materials

We provide all forms of training for Bachelor's and Master's qualifying degrees in

APPLIED MECHANICS

with the specialization in

COMPUTER MODELING OF THERMAL AND MECHANICAL PROCESSES

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Originally named Department of Strength of Materials, our chair is one of the eldest in the University and is proud of its history in education and research.

Since its foundation in 1886, the problems of material and structural strength, rigidity and reliability have traditionally been area of research at our Department. In the newer time the focus of scientific interest in this field has been enlarged to occupy new promising applications such as:

- Synthesis and optimization of metal cutting processes including tool wear prediction;
- Nonlinear dynamics of mechanical systems;
- Strength and dynamics of aerospace elements and structures;
- Analysis and optimization of working parts of agricultural equipment.

We are interested in establishing of mutually beneficial contacts and prolific collaborations with educational and research institutions both in Ukraine and abroad. In the following a brief description of the above mentioned research activities will be given.

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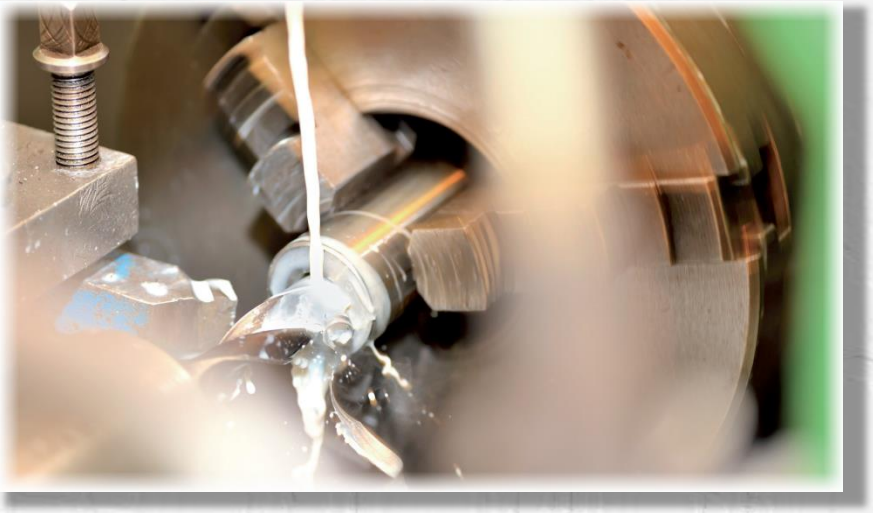
Synthesis and optimization of metal cutting processes including tool wear prediction



One of the key elements in creation of an effective control system for a technological machining process is the optimization stage to determine the optimal working modes of equipment ensuring its optimal operation according to the chosen objective criteria.

It requires solution of optimal control tasks of edge cutting operations obtained by the minimization of the objective function defining the costs of the unit material volume processing within the machine tool lifetime – the reduced costs. The main operational parameters such as cutting speed, width and feed are effectively varied by this method during the lifetime of the cutting tool with special account for its wear.

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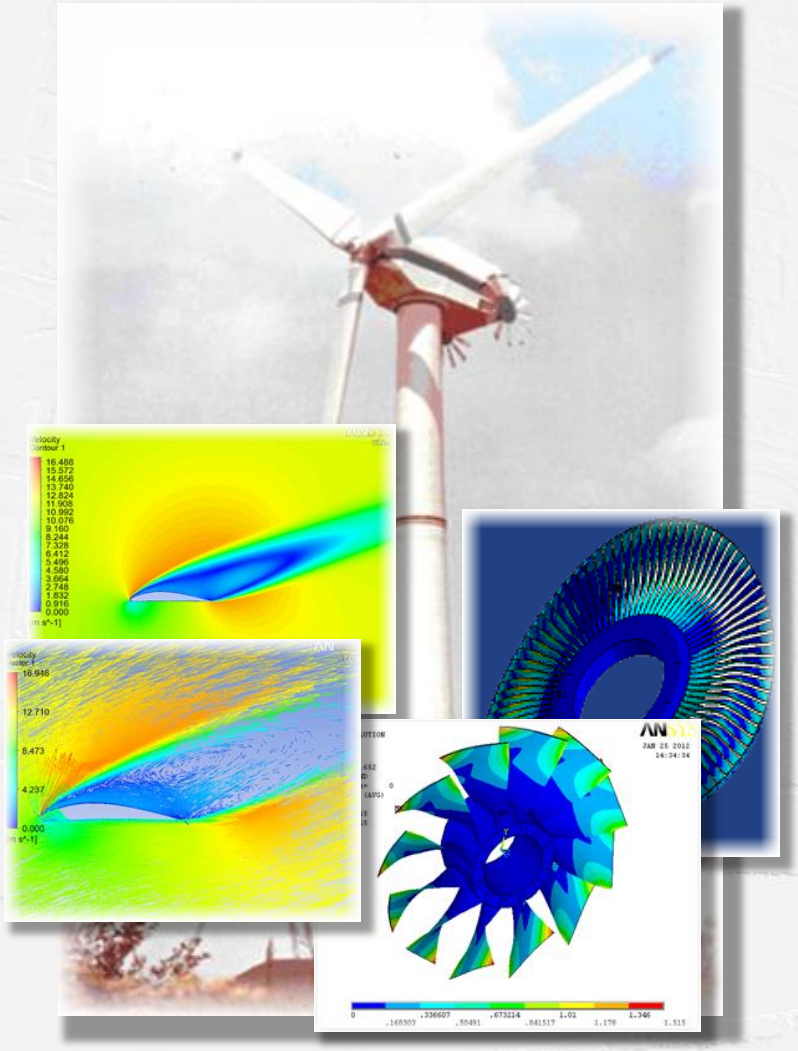
Nonlinear dynamics of mechanical systems



A wide variety of research topics are studied within this area, in particular:

- **Nonlinear shapes of vibrations;**
- **Bifurcations and stability of mechanical systems;**
- **Geometrically nonlinear deformation of plates and shells;**
- **Aeroelastic vibrations of thin-walled structures;**
- **Dynamics of nanostructures;**
- **Nonlinear rotor dynamics;**
- **Nonlinear dynamics of transmissions and power gears.**

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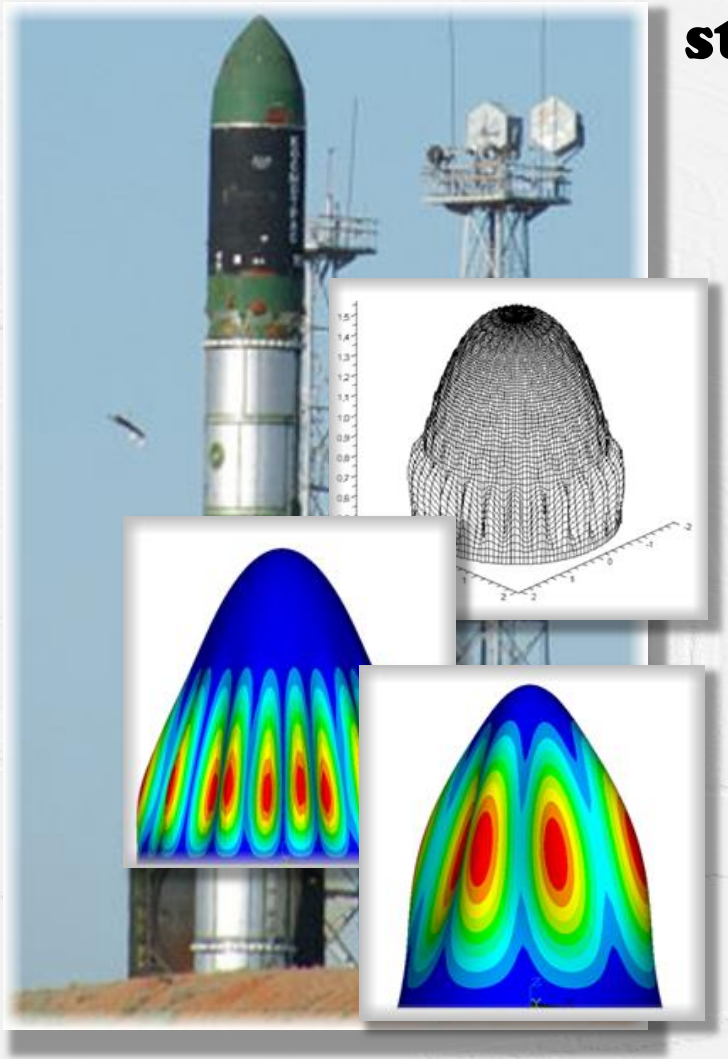
Strength and dynamics of aerospace elements and structures



Within this field of research numerous activities are performed, such as:

- Analysis of strength and failure loads of thin-walled carrier rocket shells;
- Vibrations of carrier rocket fuel pipelines;
- Dynamics and aeroelasticity of fairings;
- Aerodynamics of space launchers;
- Analysis of acoustic loads in launcher vehicles.

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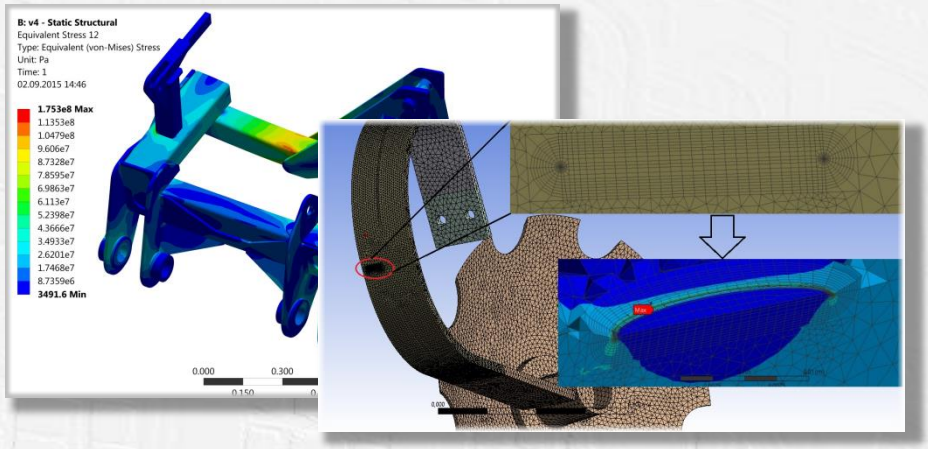
Analysis and optimization of working parts of agricultural equipment



An essential step in design of agricultural machinery is to conduct the strength analysis (static and dynamic) of working elements, frames of agricultural tools such as disc harrows, cultivators, etc.

These problems are being solved numerically using various software packages based on the grid (Finite Element Method) and non-grid methods. Such approach in assessing the strength of elements of agricultural tools makes it possible to obtain correct distribution of parameters of the stress-strain state. In connection with the strength analysis the dynamic behavior of the working tools in contact with the environment is also considered in order to ensure optimal process of soil crumbling and loosening.

Recent publications:

1. Khavin V. et al. Machine cutting optimization based on tool wear prediction (in Russian). Saarbruecken: LAP LAMBERT Academic Publishing, 2016.
2. Khavin V. et al. Synthesis of technological processes of machine cutting: artificial intelligence methods (in Russian). Saarbruecken: LAP LAMBERT Academic Publishing, 2013.
3. Symonova A., Verezub O., Sycheva A., Verezub N., Havin V., Kaptay G. Surface grain coarsening and surface softening during machining of ultra-fine grained titanium. Journal of Mining and Metallurgy, Section B: Metallurgy, vol. 48(3)B, 2012, p. 449-459.
4. Khavin V. et al. Optimal control by operations of machine work at fabrication of polymer workpieces (in Russian). Problemy Mashinostroeniya i Avtomatizazii, vol. 1 (2009), p. 80-85.
5. Verezub N., Khavina I., Dmytrenko V., Verezub O., Khavin V. System support decision-making for optimization of technological process of machining of optical products (in Russian). Problemy Mashinostroeniya i Avtomatizazii, vol. 4 (2009), p. 118-124.

6. Avramov K., Filipkovsky S., Pirog V., Tonkonogenko A., Klimenko D. Nonlinear Longitudinal Oscillations of Fuel in Space Rockets Pipelines with Dampers. Acta Astronautica 120(2016), p. 20-29.
7. Avramov K.V. Bifurcation behavior of steady vibrations of cantilever plates with geometrical nonlinearities interacting with three-dimensional inviscid potential flow. Journal of Vibration and Control 2016, Vol. 22(5), p. 1198-1216.
8. Avramov K., Chernobryvko M., Kazachenko O., Batutina T. Dynamic instability of parabolic shells in supersonic gas stream. Meccanica, 2016, Vol. 51, No. 4, p. 939-950.
9. Avramov K., Shulzhenko N., Borisuk A., Pierre C. Influence of periodic excitation on self-sustained vibrations of asymmetrical one disk rotors in arbitrary length journals bearings. International Journal of Nonlinear Mechanics Vol. 77, p. 274-280, 2015.
10. Uspensky B., Avramov K. On nonlinear normal modes of piecewise linear systems free vibrations, Journal of Sound and Vibration 333, 2014, p. 3252-3256.

11. Chernobryvko M., Avramov K., Romanenko V., Batutina T., Tonkonogenko A. Free linear vibrations of parabolic shells. Meccanica, 2014, Vol. 49, No.8, 2014, p. 14-21.

12. Breslavsky I., Avramov K. Effect of boundary conditions nonlinearities on free large-amplitude vibrations of rectangular plates. Nonlinear Dynamics Vol 73, No 3, 2013, p. 567- 579.

13. Avramov K., Mihlin Yu. Review of applications of nonlinear normal modes for vibrating mechanical systems. Applied Mechanical Reviewer 65 (2), 2013, 20 pages.

14. Avramov K., Borisuk A. Self-sustained vibrations of one disk rotor in two arbitrary length journals bearing. Mechanism and Machine Theory, 2013, Vol.70, p. 474-486.

15. Yagudin D., Simson E., Avtonomova L. Estimation of structural strength of the specialized machining instrument (in Russian). Vestnik NTU KhPI, 2015, No. 4, p. 162-165.

16. Yagudin D. Modeling of interaction of the specialized machining tool with the fractured media (in Russian). Economics, science, education: integration and synergy – Bratislava, Slovak Republic, 2016.