

Project ON144002 -Theoretical and Applied Mechanics of the Rigid and Solid Bodies. Mechanics of Materials (2006-2010)

Support: **Ministry of Sciences and Environmental Protection of Republic of Serbia**

Institution Coordinator: **Mathematical Institute Serbian Academy of Sciences and Arts.**

Project Leader: **Katica (Stevanović) Hedrih**

Researchers: 37.

Researcher months: **approximately 160 months.**

Report – Research Results in 2006.

Short Abstract:

Today, it seems generally accepted that nonlinear dynamical problems should be cooperatively addressed through the combined use of analytical, computational, geometrical and experimental approach (see Refs. [1-16]).

Further, interaction between nonlinear dynamics and control, as well as energy transfer between subsystems, plays an important role in advanced engineering systems in order to obtain desired dynamics behavior and improved reliability during operation [11]. The nonlinear deterministic and stochastic dynamics [1] and control of processes in complex mechanical systems are subject of our project research results.

New mathematical and phenomenological knowledge is a advances to theoretical and applied mechanics of the rigid and solid bodies and complex hybrid structures [2-5] and [8] and dynamical [6-7] systems with applications in mechanical engineering. Mechanics of materials with coupled fields is also subject of project research [12].

Seminar for Nonlinear Dynamics – Milutin Milanković was spontaneously organized by the Project researchers as a forum for scientific research results evaluations and is working at Faculty of Mechanical Engineering in Nish supported by researchers from other Serbian Universities and by visiting professors from all the Wolrd.. There are two main tasks. First is to contribute to yang researchers in the Project field, and second

Partial and partial fractional differential equations of creeping and vibrations of double plate system [2, 3, 8] and axially moving double belt system [5] are derived. A fractional-differential operator with the creep material parameters are introduced. Plate material is elastic or creeping and constitutive relation of stress-strain state is expressed through fractional derivatives.

The finite number of coupled partial fractional order differential equations of transversal vibrations of a creeping connected multi plate homogeneous system and multi belt system [5] have been derived. The analytical solution of the system of coupled partial fractional order differential equations of corresponding dynamical free and forced processes are obtained. It is also obtained time series functions as a particular components of the solution.

The influence of rotatory inertia of beam cross section and transverse shear of beam cross section under the transverse force, and the corresponding members in the partial differential equation are taken into account and by use Ariaratnam's idea the expression for Lyapunov exponents are obtained and the stochastic stability of beam deformable forms and processes are investigated. The partial differential equations of transversal stochastic vibrations of a parametrically excited beam graded by pure elastic material or by hereditary material or by creep material, was derived. The influence of rotatory inertia of beam cross section and transverse shear of beam cross section under the transverse force, and the corresponding members in the partial differential equation are taken into account. The asymptotic averaged method is used for obtaining the first approximation of corresponding Itô stochastic differential equations. By using idea Ariratnam, for all three cases of beam material, the sets of Lyapunov exponents are obtained in the function of the Bessel functions [1]

Using Krilov – Bogolyubov - Mitropolskiy's asymptotic method, both the solutions in the first approximation and the system of nonlinear coupled differential equations for the corresponding number of excited amplitudes and phases, for multifrequency vibrations of a hybrid system are derived and the analysis of energy transfer between modes is also performed..

The measures of integrity of dynamical systems and dynamical system processes by which is possible made to conclude whether the system possesses integrity or whether that system loses integrity are investigated and defined [6] and [7]. Models, dynamics and stability of vibroimpact systems are investigated [9,10,16,17]. New contribution to the mechanics of materials with rheological properties, with crack or with coupled fields [12, 13, 14]. Contributions in the form of mathematical description of deterministic and stochastic dynamics of the sandwich multibelt, multibeam or multiplate systems with rheological or hereditary properties and stability of its deformable shape are present [2-8].

Project Leader give series of the Plenary or Invited lectures and was member of scientific Committees or Organizer of Minisymposia or invited participant as session chairman in area of Project research results at following European or international scientific meetings:

1* The 16th European Conference of Fracture – *Integrity of Dynamical Systems* Alexandroupolis Greece 2006;

2* IFNA – Elsevier Journal Nonlinear Analysis Symposia – *Hybrid Systems and Applications*, University of Luisiana, Lafayette, USA 2006;

3* The 9th International Conference on Tensor Society on *Differential Geometry, Functional and Complex Informatics and their Applications*, Sapporo, September 4-8, 2006. Hokkaido Tokai University Sapporo;

4* Conference *Applied Mathematics and Mechanics* KPH, Kharkov 2006;

5* 2nd IFAC Workshop on *Fractional Differentiation and its Applications*, 19-21 July, 2006, Porto, Portugal,

as well as Contributed Lectures:

6* Euiromech - *European Solid Mechanics Conference* ESMC 2006 – Budapestm Hungary;

7* SEECM 06 –First South-East European Conference on *Computational Mechanics*, Kagu javac 2006.

WEB of the Project: <http://www.mi.sanu.ac.yu/projects/projects.htm>

WEB of the Project Seminar: <http://www.masfak.ni.ac.yu/sitegenius/topic.php?id=863>

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