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Program of Mechanics Colloquium – MARCH 2012

Start of each lecture is at each Wednesday at 18,00 h in room 301 F at Mathematical Institute SANU, street Knez Mihailova 36/III.

Sreda (Wednesday), 7 mart (March 7) 2012 u 18 sati (18h) **Lecture No. 1181**

Teaching Assistant dr med. **Andjelka Hedrih**, Department for biomedical science, State University of Novi Pazar, Novi Pazar, Serbia. (Projekat ON174001)

Modeling oscillations of a zona pelucida before and after fertilization - ENOC Yang Scientist Prize 2011– EuroMech Society

Zona pellucida (ZP), acellular mantel of mammalian oocite, changes its thickness and elastic properties before and after fertilization. To describe changes in mechanical properties of *ZP*, we use the method of discreet continuum and model *ZP* as a discreet spherical net with non-linear elastic and visco-elastic connections. Elements in this discreet spherical net correspond to *ZP* proteins. Oscillatory spherical net Model of mouse *ZP* could explain its' non-linear oscillatory behaviour. A mathematical model of non-linear free and forced vibrations is presented. Before fertilisation discreet ZP net consists of elements that have ideally non-linear-elastic properties and ZP net has ideally non-linear-elastic properties. After fertilisation this model is modified in the following way: material particles (ZP proteins) are interconnected with standard light hereditary elements with visco-non-linear-elastic properties.

Ideally non-linear-elastic spherical ZP net that envelops a non-fertilised oocite has oscillatory properties. It oscillates as a system with 3n degrees of freedom and with 3n eigen circular frequencies. On a distortion caused by spermatozoa, material particles, in general case, each oscillates in a 3n-frequency regime. Mechanical impact of spermatozoa causes distortion of equilibrium state of the ZP elastic network and it starts to oscillate. It can be considered that spermatozoa transfer a part of its kinetic energy to the ZP network that is used for changing its initial state.

To describe oscilatory behaviour of ZP under free and force regime we made three independent sets of coupled non-linear differential equations. First set of the non-linear differential equations contains n independent non-linear differential equations of Georg Duffing type. For solving three independent subsystems of non-linear differential equations we use two methods, Lagranges method of variation constants as well as asymptotic method of Krilov Bogolyubov-Mitropolyskiy for obtaining system of the first approximation for corresponding number of amplitudes and phases.

Material particles in the net move in three orthogonal directions and in each of directions are multifrequency vibrations asynchronous, and resultant of nonlinear dynamics are space trajectory in the form of the generalized Lissajus curves.

Model could explain oscillations of the ZP network in the fertilization process- diameter and consistency change. It is possible that in *ZP* before fertilization appears different type of multifrequency regime of oscillations: from pure periodic to pure chaotic-like regimes. Synchronized regimes of the knot's mass particle motion in the sphere *ZP* net are favorable kinetic states for possible successful penetration of spermatozoid trough *ZP* and fertilization. Chaotic-like motion of *ZP* glycoproteins is an unfavorable kinetic state for spermatozoids penetration of *ZP*.

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Sreda (Wednesday), 14 mart (March 14) 2012 u 18 sati (18h) **Lecture No. 1182**

Mr **Željko R. Đurišić,** assistant, Electrotechnical Faculty, University of Belgrade and
ptof. dr **Dušan Mikičić** (retired person) Electrotechnical Faculty, University of Belgrade and Mathematical Institute SANU (Project ON174001)

Analysis of wind characteristics in the south Bamat Region and conductions associated with wind power integration in powersystem of Serbia

The paper analyses typical generation profiles of the perspective wind plants in South Banat region obtained on the basis of multiannual dedicated wind speed measurements in the target region and realistic wind turbine characteristics. In addition to this, it analyses the correlation level between the average EPS daily load profile and the wind plant generation diagrams. It also consider the energy balancing conditions within the system under abrupt wind speed changes in the target region. On the basis of the statistic analysis of wind speed data, it examines the wind plant outage probability within the target region due to strong wind. Executed analyses will provide for the consideration of the technical issues occurring during wind plant integration into the Serbian power system and aid the assessment of realistic wind plant capacities acceptable by the system.

Sreda (Wednesday), 21 mart (March 21) 2012 u 18 sati (18h) **Lecture No. 1183**

Prof. dr **Veljko A. Vujičić,** (retired person)**,** Natural-mathematical Favulty University of Belgrade and Mathematical Institute SANU (Project ON 174020)

A contribution to MOND Theory – Modification of Newtonian Dynamics.
(to appear)

Sreda (Wednesday), 28 mart (March 28) 2012 u 18 sati (18h) **Lecture No. 1184**

Mr **Julijana Simonović**, dipl.maš.ing, ascistant, Faculty of Mechanical Engineering, University of Niš, Serbia
(Projekat ON174001)

Models of hybrid dynamical system and its analogy

Series of models of the hybrid multi- plates, beams or belts system dynamics will be presented. Structure of such a systems contain a number of thin deformable plates, beams or belts all with the same boundary conditions and coupled by layers containing continually distributed discrete standard elements. The layers are homogeneous and different type. The layer type differs with the properties of discrete elements structure. The standard light linear and nonlinear ideally elastic, visco-elastic hereditary, fractional order, standard rolling visco-elastic and standard Amontons-Coulomb's type friction elements will be used to modeled homogeneous layers in the presented models of the hybrid multi system dynamics.

Constitutive relations of the corresponding listed standard element will be presented. By analysis kinetic and material properties of the subsystems of the hybrid multi-plates, beams or belts systems it is possible to form series of the systems (partial differential or partial integro-differential or partial fractional order differential) equations describing the dynamical equilibrium of system dynamics. This will be presented in one chosen example of the plates system. The phenomenological mapping and mathematical analogy between the systems of different type could be discussed and mathematical modeled.

Based on presented results and analogy some main properties of different hybrid multi system dynamics will be described and pointed out in the concluding comets.

Key words: *multi-plates, beams or belts systems, standard rolling visco-elastic elements, standard light linear and nonlinear ideally elastic element.*

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Предавања ће се одржавати средом са почетком у 18.00 часова, у сали 301 F на трећем спрату зграде Математичког института САНУ, Кнез Михаилова 36/III, (зграда преко пута главне зграде САНУ).

Позив научницима и истраживачима да пријаве сцоја предавања
Пријава потенцијалног предавача треба да садржи апстракт предавања до једне странице на српском језику ћирилицом и превод на енглески јесик, као и CV обима до две странице. Пријаву послати на адресу управника Одељења за механику у виду Word DOC на адресу: khedrih@eunet.rs

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Announcement and Invitation

Start of each lecture is at each Wednesday at 18,00 h in room 301 F at Mathematical Institute SANU, street Knez Mihailova 36/III.

All scientists and researchers in area of Mechanics are invited to contribute to the Program of Mechanics Colloquium of Mathematical Institute of Serbian Academy of Sciences and Arts. One page Abstract of proposed Lecture with short CV is necessary to submit in world doc to Head of Department of Mechanics (address: khedrih@eunet.rs), one month before first day in the next moth.

Катица (Стевановић) Хедрих

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