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Program of Mechanics Colloquium – APRIL 2011

Sreda (Wednesday), 6 april (April 6) 2011 u 18 sati (18h) **Lecture No. 1149**

Prof dr **Đorše Mušicki**, Matemtical Institute SANU Belgrade

Noether's theorem for quasi conservative mechanical systems

If Lagrange's equations for nonconservative systems by introducing a Lagrangian, which is equal to product of some function of time $f(t)$ and primary Lagrangian, can be reduced to Euler-Lagrange's equations, such mechanical systems are named quasiconservative ones. The condition that some momconservative system can be considered as quasi--conservative one is the existence of at least one particular solution, which results from a system of n differential equations with one unknown function -- the cited function $f(t)$. For such systems the energy relations are studied on the basis of corresponding Lagrange's equations, and iti si demonstrated that under certain conditions, the some integrals of motion equivalent to Vujanovi\' c's energy like conservation laws are valid.

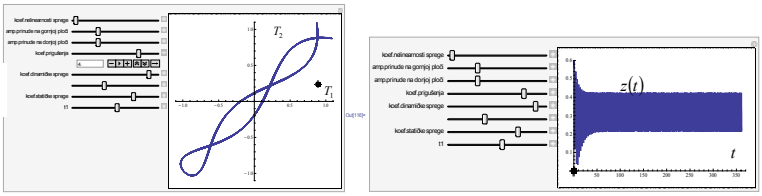
In this communication the corresponding energy relations are studied from a different, more general variant, on the basis of the corresponding accomodated Noether's theorem. Such Noether's theorem for quasiconservative systems is formulated, starting from the total variation of action and the corresponding Lagrange's equations and repeating the usual procedure. It differs from the usual Noether's theorem only by presence of the new Lagrangian, extended from the primary one by the function $f(t)$ and by means of which the corersponding condition for the existence of the integrals of motion (the so-called basic Noether's identity) is formulated. It is transformed to a more suitable form, from which under certain conditions the corresponding integrals of motions are obtained, and for their existence, it is necessary that at least one particular solution of one partial fifferential equation exists. The obtained results are in full accordance with the results obtained on the basis of Lagrange's equations, and so modified Noether's theorem is equivalent to Vujanović-Djukić's formulation of this theorem for nonconservative systems, obtained by transformation of D'Alambert-Lagrange's principle.

Sreda (Wednesday), 13 april (April 13) 2011 u 18 sati (18h) **Lecture No. 1150**

Mr Julijana Simonović, dipl.maš.ing. Faculty of Mechanical Engineering, University of Niš, Serbia

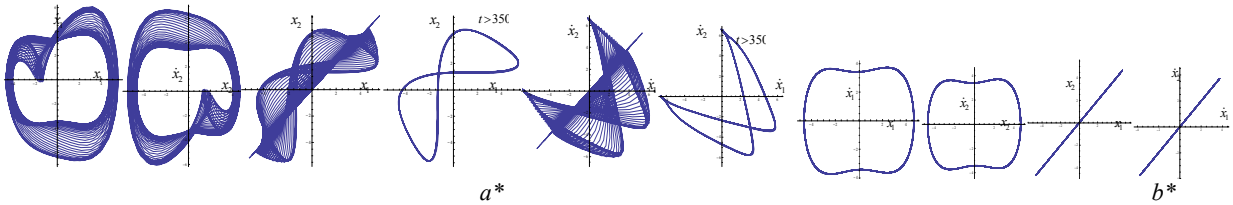
Synchronization and Resynchronization in Coupled Systems with Different type of coupling elements

Summary. The interesting property of coupling systems is the subsystems interaction and its representation. On this lectture the synchronization and resynchronization will be lighted like one of that subsystems interaction possibility. The treated model of coupling system are models of coupled linear and nonlinear oscillators with elements of static and dynamic coupling and two circular plates connected with rolling visco-elastic nonlinear layer. Mathematical model of such a system is built up using the D'Alamberts principle and Bernoulli's method of particular integrals. Obtained system of coupled differential nonlinear non homogeneous equations are the start points in numerical investigation of synchronization in modelled system. It will be present the marvelous possibilities of identical synchronization in these classes of so called hybrid systems. Depending of coefficient of coupling the synchronization effect is less or more present. The analyses will be done by presentation of numerical simulation in the phase plane of output variables of coupled systems Fig.1 a*, like as through synchronization error diagrams Fig.1b*. Concluding remarks will consists of conclusions about nature of coupling like as interaction of coupling coefficients properties: static, dynamic, nonlinearity, damping and influence of external forces strength which are needed and enough for identical synchronization in the particular hybrid systems.



a^* b^*

Figure 1. *The diagram* $T_1(t), T_2(t)$ of time functions of double plates systems transversal oscillations and *synchronization error function* $z(t)$ *for coefficients of rolling visco-elastic nonlinear coupling:* $\widetilde{a}_{(i)}^2 = 0.0468$, $\kappa_1 = \kappa_2 = 0.835$, $\widetilde{\beta}_i = 0.1$ *and* $2\widetilde{\delta}_{(i)} = 4$ *with initial conditions* $T_1(0) = 0.8; \dot{T}_1(0) = 0.8; T_2(0) = 0.4; \dot{T}_2(0) = 0.4$



a^* b^*

Figure 2. *Phase portraits of forced hybrid systems with nonlinear subsystems statically coupled. With statically coefficients of coupling: a** $a_1^2 = 0.8$ *and b** $a_1^2 = 0.87$ *with same initial conditions* $x_1(0) = 2.49, \dot{x}_1(0) = -0.2$ *and* $x_2(0) = 2.5, \dot{x}_2(0) = -0.2$

Some of the property of such a system are existence of different coexisting attractors of synchronization and resynchronization Fig. 1 a*, with function of synchronization error like a quasi periodic functions Fig. 1 b*, like as conclusion that the two nonlinear subsystems statically coupled with chaotic attractors are easier to synchronize, for comparison ten times less coupling coefficient is necessary then in case of statically element connection of one linear and one nonlinear subsystems.

Acknowledgment. *All my special and sincerely thanks to Professor Katica (Stevanović) Hedrih supervisor of my Doctoral thesis, where the presented paper are consisting part, for all her comments and motivation that she gave to me. Parts of this research were supported by the Ministry of Sciences and Environmental Protection of Republic of Serbia through Mathematical Institute SANU Belgrade Grant ON144002 and Faculty of Mechanical Engineering University of Nis.*

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Sreda (Wednesday), 20 april (April 20) 2011 u 18 sati (18h) **Lecture No. 1151**

Dr Andjelka N. Hedrih, Doctor of Medicine, Assistant, *State University of Novi Pazar, Department of bio-chemical science and medicine, Novi Pazar, Serbia*

Mechanical Models of the double DNA Chains

ABSTRACT: DNA is a biological polymer which basic function in the cell is to encode the genetic material. DNA molecules can be considered to be a mechanical structure on the nanolevel. There are different approaches to studding the mechanical properties of the DNA molecule (experimental, theoretical modeling). A number of mechanical models of the DNA double helix have been proposed so far. Different models are focusing on

different aspects of the DNA molecule (biological, physical and chemical processes in which DNA is involved). A number of models have been constructed to describe different kinds of movements in a DNA molecule: asymmetric and symmetric motion; movements of long and short segments; twisting and stretching of dsDNA, twist-opening conditions. Some models have, for example, been made for circular double-stranded DNA molecules in viral capsids. We are discussing here **polymer models, elastic rod models, network models, torsional springs models, soliton -existence supporting models and multi pendulum/multi chain models,** emphasizing specifities of each model. Hedrih (Stevanović) and Hedrih, gave several mechanical models of double DNA. In their models DNA is in a form of homogenous multi-chain/ multi-pendulum system which oscillatory signals can be considered trough a system with fixed and with free ends. The models differ in the way of coupling between the material (mass) particles. They're several types of these models: **Model with ideally elastic properties, Model with hereditary properties and Fractional order model.**

Key words: DNA models, elasticity, visc-oelasticity, mechanical hereditary elements, signals, eigen modes.

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Sreda (Wednesday), 27 april (April 207) 2011 u 18 sati (18h) **Lecture No. 1152**

Prof. dr Dušan Mikičić**,** Matemtical Institute SANU Belgrade

Wind as Renewable Energy Source

Abstract: Kinetic energy contained in the motion of air has always attracted attention of researches. The main reasons are: 1) Unlimited energy supply. 2) Possibility of easy conversion into mechanical and electrical energy by means of wind turbines. 3) Environmentally friendly method of energy generation without CO_2, SO_2, NO_x, and without polluted of air, water and land. 4) Nowadays (2011) Worlds production of the electrical energy is 17000 TWh/a. Renewable energy has share of 4000 TWh/a. There are predictions for the year 2030 that total Worlds production would be 23000 TWh/a, and the distribution of renewable production would be as follows: Hydro – 4000, Wind – 4500, PV – 1000, Biomass – 1700, ST – 1000 TWh/a. In this paper shall be presented the main practical results for utilization of wind energy in the World, Europe and Serbia in the period (1980-2010).

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 српско језику ћирилицом и превод на енглески језик, као и ЦВ 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.

Katica R. (Stevanovic) Hedrih
Head of Department of Mechanics