70 година рада Математичког института САНУ

ПРОГГРАМ

Минисимпозијум

„Нелинеарне теоријске основе

у опису појава реалног света “

Пројекат ON174001 у Математичком институту САНУ,

Београд, 30 новембар 2016

PROGRAM

Mini-Symposium

“Non-Linear theoretical basis

in description of real world phenomena“

Project ON174001 in Mathematical Institute SASA,

Belgrade, November 30, 2016

Organizers:

dr Julijana Simonović,

Faculty of Mechanical Engineering,

University of Niš, Serbia

Acknowledgment: The Mini-Symposium "Non-Linear theoretical basis in description of real world phenomena" has been organized by Project **ON 174001** in the scope of the 70th anniversary of the Mathematical Institute of the Serbian Academy of Science and Arts. The Mini-Symposium was organized thanks to the financial support from the Serbian Ministry of Education, Science and Technological Development under the project:

ON 174001 "Dynamics of hybrid systems with complex structures. Mechanics of Materials", coordinated through Mathematical Institute of Serbian Academy of Sciences and Arts with Project Leader **Katica (Stevanović) HEDRIH.**

A WORD FROM THE ORGANIZER

"As far as the laws of mathematics refer to reality,
they are not certain, and as far as they are certain,
they do not refer to reality."
A. Einstein

The concept of linear relationship suggests that two quantities are proportional to each other: doubling one causes the other to double as well. Nonlinear relationships, in general, are any relationship which is not linear. What is important in considering nonlinear relationships is that a wider range of possible dependencies is allowed. When there is very little information to determine what the relationship is, assuming a linear relationship is simplest and thus, by Occam's razor, is a reasonable starting point. However, additional information generally reveals the need to use a nonlinear representation on the description of real world phenomena.

One of the most important modern theoretical developments has been the qualitative theory of differential equations, otherwise known as dynamical systems theory, which seeks to establish general properties of solutions from general principles without writing down any explicit solutions at all. Dynamical systems theory combines local analytic information, collected in small "neighbourhoods" around points of special interest, with global geometric and topological properties of the shape and structure of the manifold in which all the possible solutions, or paths, reside—the qualitative aspect of the theory. (A manifold, also known as the state space or phase space, is the multidimensional analog of a curved surface.) The qualitative theory of differential equations was the brainchild of the French mathematician Henri Poincaré at the end of the 19th century. Today the term chaos is used to refer to Poincaré's discovery while solving the "three-body problem". Sporadically during the 1930s and '40s and with increasing frequency in the 1960s, mathematicians and scientists began to notice that simple differential equations can sometimes possess extremely complex solutions. The American mathematician Stephen Smale, continuing to develop Poincaré's insights on qualitative properties of differential equations, proved

that in some cases the behaviour of the solutions is effectively random. Even when there is no hint of randomness in the equations, there can be genuine elements of randomness in the solutions. The Russian school of dynamicists under A. Kolmogorov, V. Arnold, A. Andronov, A. Vitt and S. Haykin developed similar ideas at much the same time. Later I.M. Babakov and A. Lyapunov with his theory of stability and A. Krylov, N. Bogolyubov and Y. Mitropolyski with theirs asymptotic method designed the directions for practical application of nonlinear theory. By the end of the 20th century, Poincaré's discovery of chaos had grown into a major discipline within mathematics, connecting with many areas of applied science. Chaos was found not just in the motion of the planets but in weather, disease epidemics, ecology, fluid flow, electrochemistry, acoustics, even quantum mechanics. The most important feature of the new viewpoint on dynamics—popularly known as chaos theory but really just a sub-discipline of dynamical systems theory—is not the realization that many processes are unpredictable. Rather, it is the development of a whole series of novel techniques for extracting useful information from apparently random behaviour.

Among the Serbian schools of nonlinear mechanics, that starts with peeoner M. Petrovic the Poincaré's student, it is worth to outline the one that have been begun with ideas of D. Raskovic which have been followed by the group of researchers with whole series of research in the field of nonlinear oscilations of deformabile bodies at Mechanical Faculty University of Nis. Starting with 1991 this group has been organized series of Mini-symposyums of nonlinear mechanics; this very Mini-symposium belongs to that serie and to this ideas.

Nonlinear theoretical basis, here encompassed, have led to the discovery of new and more efficient ways to present, examine and explaine: classes of vibro-impact systems dynamics, mechanical systems with nonlinear nonholonomic constraints, dynamics reanalysis procedures, dynamic behavior of cable net roofs, dynamic of composite laminates, flow around bluff bodies as well as response of robotic system, or to solve mathematical complexities as Lie group settings. It has even been turned into a better description of neuronal systems behavior or of moleculs of Zona Pelucida dynamics.

It was unexpected accolade and extremely honored to me have been given such an opportunity for organization of this kind of event.

dr Julijana Simonović

РЕЧ ОРГАНИЗАТОРА

"Све док закони математике описују стварност они нису поуздани, а ако су поуздани они не описују стварност"
А. Анштајн

Концепт линеарне везе два квантитета значи да су пропорционални један другоме: удвостручавање једног изазива удвостучавање и другог. Нелинеарна веза, уопштено, је било која веза која није линеарна. Оно битно у нелинеарном приступу је ширина опсега могућих зависности које су дозвољене. Када имамо на располагању мало информација да би одрадили какав је однос, претпоставља се да је линеарни однос најједноставнији, а тиме, према окамитој оштрици, и најразумнија полазна тачка. Ипак, додатне информације откривају потребу да се употребе нелиеарне везе у опису појава реалног света.

Један од најбитнијих развоја модерних теорија примењене математике је квалитативна теорија диференцијалних једначина, иначе позната као теорија динамичких система, која развија општа својства решења из општих принципа без извођења тачног решења. Теорија динамичких система комбинује информације локалних аналитичких особина, издвојених из понашања решења у блиској околини тачака од посебног интереса, са глобалним геометријским и тополошким особинама облика и структуре вишеструкости у којој се појављују сва могућа решења-што су квалитативни аспекти теорије (Вишеструкости, такође познате и као простор стања или фазни простор, су вишедимензионалне аналогије закривљених површина). Квалитативна теорија диференцијалних једначина је замисао француског математичара Х. Поенкареа са краја 19. столећа. Данас се израз хаос користи да се опише Поенкареово решење „проблема три тела". Спорадично током тридесетих и четрдесетих година прошлог века са растућом фреквенцијом од 1960, научници и математичари су почели примећивати да једноставне диференцијалне једначине могу понекад имати јако компликована решења. Амерички математичар С. Смајл, настављајући да развија Поенкареова открића квалитативних особина диференцијалних једначина, проналази да је у неким случајевима понашање решења изузетно неочекивано (случајно). Чак и када нема ни наговештаја случајности у једначини, може да постоји оригинални елемент случајности у решењу. Руска школа механичара предвођени А. Колмогоровом, В. Арнолдом, А. Витом и С. Хајкеном развијају сличне идеје скоро у исто време. Касније И.М. Бабаков и А. Љапунов са својом

теоријом стабилности као и А. Крилов, Н. Богољубов и Ј. А. Митропољски са њиховом асимптотском методом одређују правце практичних примена нелинеарне теорије динамичких система. Тако је до краја двадесетог столећа, Поенкареово откриће хаоса прерасло у главну дисциплину у области математике, повезујући је са многим областима примењених наука. Хаос је пронађен не само у кретању планета него и у променама временских прилика, епидемијама болести, екологији, струјању флуида, електрохемији, акустици, чак и у квантној механици. Најбитније својство новог становишта динамике-популарно названо теорија хаоса али заправо је само под-дисциплина теорије динамичких система-није третирање система као непредвидивих. Заправо је то развој читаве серије нових техника за издвајање корисних информација из наизглед случајног понашања.

Међу школама нелинеарне механике у Србији, које почињу са пиониром М. Петровићем Поенкареовим студентом докторантом, вредно је поменути ону која је почела са идејама Д. Рашковића, од 1967, праћена групом истраживача са читавом серијом истраживања у области нелинеарних осцилација деформабилних тела на Машинском факултету у Нишу. Почевши од 1991. год. ова група организује серије симпозијума и мини симпозијума нелинеарне механике; Мини симпозијум који се сада организује припада том низу и идејама.

Нелинеарне теоријске основе, овде обухваћене, довеле су до открића нових и ефикаснијих начина да се представе, проуче и објасне: класе динамике виброударних система, механичких система са нехономним нелинарним везама, процедуре динамичке реанализе, динамичко понашање кровова од мрежа каблова, динамика композитних ламината, опструјавање неаеродинамичких тела као и одговори роботских система, или да се реше математичке сложености као што су Лие групе. Чак су боље описана и објашњена понашања неуронских система као и динамика молекула Зоне Пелуциде.

Ово је неочекивано признање и изузетна почаст да ми се пружи могућност организације оваквог научног скупа.

др Јулијана Симоновић

PROGRAM

MINI-SYMPOSIUM

"Non-Linear theoretical basis in description of real world phenomena"

Project OI174001 in Mathematical Institute of SASA
Belgrade, Serbia, November 30, 2016, from 10:30-20:00h, room II, first floor, Kneza Mihaila 36

Програм

Мини-симпозијума

„Нелинеарне теоријске основе у опису појава реалног света "

Пројекат ОИ174001 у Математичком институту САНУ
Београд, 30. новембар 2016, од 10:00-20:00h, сала II, први спрат, Кнеза Михаила 36

Organizer:
dr **Julijana Simonović**, Assistent Professor, Faculty of Mrchanical Engineering, University of Niš, Serbia

Организатор:
др **Јулијана Симоновић**, доцент, Машински факултет Универзитета у Нишу, Србија

Welcome address:

Professor **Katica (Stevanović) Hedrih**, Project Leader of Project ON174001

Opening remarks by Organizer:
"Importance of Research of Non-Linear theoretical basis in description of real world phenomena"
dr **Julijana Simonović**

Поздравна реч:
Професор **Катица (Стевановић) Хедрих,** руководилац Пројекта ОН174001

Уводна реч организатора:
„Значај истраживања у области Нелинеарних теоријских основа у опису појава реалног света "
др **Јулијана Симоновић**

* * *

* * *

First Session chair by:

Isabella Vassilopoulou, *Civil Engineer, Ph.D. School of Civil Engineering, National Technical University of Athens, Greece*
Dragan Milosavljevic, *Faculty of Engineering University of Kragujevac, Serbia*
Julijana Simonović, *Faculty of Mechanical Engineering, University of Niš, Serbia,*

First Session - *Invited Lectures 30 minutes.*

* Numerical integration of rotational quaternions using non-redundant ordinary differential equations in Lie group setting

Zdravko Terze
Faculty of Mechanical Eng. and Naval Arch.,Chair of Flight Vehicle Dynamics, Head
University of Zagreb, Croatia

Нумеричка интеграсција ротацијских кватерниона користећи нередундантне обичне диференцијалне једнаџбе у формулацији Лијевих група

Здравко Терзе
Факултет машинства и бродоградње,
Универзитета у Загребу, Хрватска

*Methodology of the investigation of a class of the vibro-impact system dynamics

Katica R. (Stevanović) Hedrih[1,2]
[1]*Department of Mechanics, Mathematical Institute of Serbian Academy of Sciences and Arts, Belgrade, Serbia*
[2]*Faculty of Mechanical Engineering, University of Niš, Serbia, E-mail: khedrih@sbb.rs*

Методологија истраживања једне класе динамике вибро-ударних система

Катица Р. (Стевановић) Хедрих[1,2,]
[1] *Одељење за механику, Математички институт САНУ, Београд, Србија, E-mail: khedrih@sbb.rs*
[2] *Машински факултет Универзитета у Нишу, Србија, E-mail: katica@masfak.ni.ac.rs*

*Dynamics of Mechanical Systems with Nonlinear Nonholonomic Constraints-Integral of Motion

Dragomir N. Zeković
Faculty of Mechanical Engineering, University of Belgrade
Kraljice Marije 16, 11120 Belgrade, Serbia, E-mail: dzekovic@mas.bg.ac.rs

Динамика механичких система са нелинеарним нехолономним везама-интеграли кретања

Драгомир Н. Зековић
Машински факултет, Универзитет у Београду,
Краљице Марије 16, 11120 Београд, Србија,
E-mail: dzekovic@mas.bg.ac.rs

Second Session chair by:
Zdravko Terze, Faculty of Mechanical Eng. and Naval Arch.,Chair of Flight Vehicle Dynamics, Head University of Zagreb
Dragomir N. Zeković, *Faculty of Mechanical Engineering, University of Belgrade*
Katica R. (Stevanović) Hedrih, *Department of Mechanics, Mathematical Institute of SASA, Belgrade and Faculty of Mechanical Engineering, University of Niš, Serbia*

Second Session. ***Invited Lectures 30 minutes.***

* Exploring nonlinearities in the dynamic behavior of cable net roofs

Isabella Vassilopoulou
Civil Engineer, Ph.D. School of Civil Engineering
National Technical University of Athens, Greece
E-mail: isabella@central.ntua.gr

Истраживање нелинеарности у динамици кровова мрежа каблова

Isabella Vassilopoulou
Грађевинска школа Националног Техничког Универзитета у Атини, Грчка
E-mail: isabella@central.ntua.gr

*Uncertainty Quantification and Simulation in Dynamics Reanalysis Procedures

Nataša Trišović and Wei Li
Faculty of Mechanical Engineering, University of Belgrade, E-mail: ntrisovic@mas.bg.ac.rs and
School of Mathematics and Statistics, Xidian University, Xi'an China
E-mail: liweilw@mail.xidian.edu.cn

Квалификација и симулација неизвесности у процесу динамичке реанализе конструкција

Наташа Тришовић и Wei Li
Машински факултет, Универзитета у Београду, E-mail: ntrisovic@mas.bg.ac.rs и
Школа Математике и статистике, Xidian Универзитет, Xi'an Кина
E-mail: liweilw@mail.xidian.edu.cn

*Multiparametric nonlinear dance of synchronization in system of orthogonal lattice of chained material particles

Julijana Simonović
Faculty of Mechanical Engineering, University of Niš, Serbia,
E-mail:simonovicjulijana@gmail.com

Вишепараметарски нелинеарни плес синхронизације у систему ортогоналне решетке ланаца материјалних тачака

Julijana Simonović
Машински факултет Универзитета у Нишу, Србија,
E-mail:simonovicjulijana@gmail.com

КОКТЕЛ - COCTAIL (approximately from 14:15-15:15h)

* * *

Third Session chair by:
Nataša Trišović, *Faculty of Mechanical Engineering, University of Belgrade, Serbia*
Jasmina Bogdanović-Jovanović, *Faculty of Mechanical Engineering University of Niš, Serbia*
Milan Cajić, *Mathematical Institute of the SASA Belgrade, Serbia*

Third Session. ***Invited Lectures 30 minutes.***

*** Dynamic behavior of composite laminates**
Dragan Milosavljević
Faculty of Engineering University of Kragujevac, Kragujevac, Serbia
E-mail: dmilos@kg.ac.rs

Динамичко понашање композитних ламината
Драган Милосављевић
Факултет инжењерских наука Универзитет у Крагујевцу, Крагујевац, Србија
E-mail: dmilos@kg.ac.rs

***Nonlinear theoretical basis in the description of the behavior of neuronal systems**
Ines Grozdanović
Faculty of Mining and geology University of Belgrade, Serbia
E-mail: ines.grozdanovic@rgf.bg.ac.rs

Нелинеарне теоријске основе у опису понашања неуронских система
Инес Гроздановић
Рударско геолошки факултет Универзитета у Београду, Србија
E-mail: ines.grozdanovic@rgf.bg.ac.rs

Fourth Session chair by:
Ines Grozdanović, *Faculty of Mining and geology University of Belgrade, Serbia*
Jasmina Bogdanović-Jovanović, *Faculty of Mechanical Engineering University of Niš, Serbia*
Andjelka Hedrih, Mathematical Institute SASA

Fourth Session, Part One - ***Invited Lectures 30 minutes***

*** Flow around bluff bodies- experimental and numerical investigations**

Jasmina Bogdanović-Jovanović
Faculty of Mechanical Engineering University of Niš, Serbia
E-mail: bminja@masfak.ni.ac.rs

Опструјавање тупих тела (неаеродинамичког облика) – експериментална и нумеричка истраживања

Јасмина Богдановић-Јовановић
Машински факултет Универзитет у Нишу, Србија
E-mail: bminja@masfak.ni.ac.rs

*** Response of a three degree of freedom robotic system with fractional order elements**

Milan Cajić
Mathematical Institute of the SASA, University of Belgrade, Serbia
E-mail: mcajic@mi.sanu.ac.rs

Одзив роботског система са три степена слободе кретања и везаним елементима фракционог реда

Милан Цајић
Математички институт САНУ, Универзитет у Београду, Србија
E-mail: mcajic@mi.sanu.ac.rs

***Non-linear dependens of stress and deformation tensor elements and specific deformation work in linearized quazi static model of Zone Pelucida**

Andjelka Hedrih[1], Katica (Stevanovic) Hedrih[1,2]
[1]Department of Mechanics, Mathematical Institute of Serbian Academy of Sciences and Arts, Belgrade, Serbia, E-mail: handjelka@hm.co.rs ,
[2]Faculty of Mechanical Engineering, University of Niš, Serbia,
E-mail: katica@masfak.ni.ac.rs

Нелинеарност промене елемената тензора напона, тензора деформације и и специфичног деформационог рада рада у линеаризованом квазистатилком моделу Зоне пелуциде

Анђелка Хедрих[1], Катица (Стевановић) Хедрих[1,2]
[1]Одељење за механику, Математички институт САНУ, Београд, Србија,
E-mail: handjelka@hm.co.rs ,
[2]Машински факултет,Универзитета у Нишу, Србија,
E-mail: katica@masfak.ni.ac.rs

dr Julijana Simonović, Mech. Eng.,

Assistant Professor Mechanical Faculty University of Nis, Serbia
Date of birth: Avg.1975
Address: Bulevar Nikole Tesle 55/16, Nis, Serbia
Tel. at work: +381-18-500-725
Mobile: +381-62-260-190
Emails: bjulijana@masfak.ni.ac.rs, simonovicjulijana@gmail.com

Work experience: **Feb. 2001 – Nov. 2016:** Teaching Assistant in the field of Mechanics (subjects: Elastodynamics, Mechanics III-Dynamics, Mechanics II-Kinematics, Mechanics I-Static and Straight of materials) Department of Mechanics, Mechanical faculty University of Nis, Serbia

***Researching Projects*: Jan. 2012–Dec 2016:** Researcher on Project OI174001- Dynamics of hybrid systems with complex structures. Mechanics of materials, project leader: Dr. Katica Hedrih , supported by the Ministry of Sciences and Environmental Protection of Republic of Serbia through Mathematical Institute SASA, Belgrade;

Jan. 2007-Dec. 2011: Researcher on Project No 144002- Theoretical and Applied Mechanics of the Rigid and Solid Bodies. Mechanics of Materials. Supported by the Ministry of Science, Technology and Development, Serbia, project leader: Prof .dr Katica (Stevanovic) Hedrih.

Jan. 2002 – Dec. 2006: Researcher on two Projects :No 1616-Real Problems of Mechanics, Mathematical Institute SASA, No 1828-Dynamics and Control of Active Constructions, University of Nis Mechanical faculty, both supported by Ministry of Science and Protected of Leaving Environment, Serbia, both leading by Prof .dr Katica (Stevanovic) Hedrih.

Education: **Dec. 2015 - Jun. 2016:** post PhD research period at Interdisciplinary Centre for Mathematical and Computational Modelling of Warsaw University on subject of Bone Tissue Advanced Modeling with Piezoelectricity. Supported by the ERASMUS MUNDUS ACTION 2 PROJECT SIGMA AGILE.

Dec 2012: public defense of doctoral dissertation: ***„ Dynamics and Stability of Dynamics Hybrid Systems",*** mentored by *Prof.dr Katica (Stevanović) Hedrih*

Sep. 2009: participant of CF SICON Event: Nonlinear Dynamics, Stability, Identification and Control of Systems and Structures at La Sapienza University of Rome.

April 2009: participant of TC4 SICON event: Advanced Nonlinear Dynamics and Chaotic Dynamical Systems, ENTPE Lyon, France.

May 2008: public defense of master thesis ***„Dynamics of Mechanical Systems of Complex Structure",*** mentored by *Prof.dr Katica (Stevanović) Hedrih*

July 2007: participant of TC1 SICON event: Stability and Bifurcations of Nonlinear Dynamical Systems, DISAT - University of L'Aquila.

2001 – 2007: Study postgraduate on Theoretical and Applied Mechanics- 4 years study program, Department of Mechanics, with two years of absence because of brings forth two children. University of Nis Mechanical faculty, Serbia.

1994 – 2000: Graduate Mechanical Engineer (Dipl. Ing) -10 semester study program, average mark 9,38 of 10.00, Department of Hydro Engineering, University of Nis Mechanical faculty, Serbia.

1982 – 1994: Primary and Grammar School, Sarajevo, Bosnia and Herzegovina, and Nis, Serbia.

IT skills*:* Computer literate in MS Office, MatCad, Maple, Mathematica, AnSys.

Language skills: Serbian, English (advanced), French (understand and write), German (basic)

Others: Married and mother of three children in excellent health with strong and persistent work motivation. Many different hobbies: cycling, running, yoga, swimming, reading and cooking especially kneading.

Few selected references:

1. Hedrih (Stevanović) K R. and ***Simonović J***., (2015), *Structural analogies on systems of deformable bodies coupled with non-linear layers,* Int. J. Non-Linear Mech, Volume 73, July 2015, Pages 18–24.
2. ***Simonović J***., (2015), *Influence of rolling visco-elastic coupling on non-linear dynamics of double plates system,* Iranian Journal of Science and Technology, Transactions of Mechanical Engineering, ref. No. 1271, vol. 39 M1+, pp 163-173 ,(April 2015).
3. ***Simonović J.,*** Karličić D. and Cajić M., (2014), *An energy analysis of the free transverse vibrations of visco-elastically connected double-membrane system*, FACTA UNIVERSITATIS Series: Mechanical Engineering, Vol. 12, No 3, Dec. 2014, pp.325-337, ISSN: 0354-2025.
4. ***Simonović J.,*** (2013), *Synchronization in Coupled Systems with Different Type of Coupling Elements,* Differential Equations and Dynamical Systems, Volume 21, Issue 1 (2013), pp. 141-148, © Springer 2013. DOI. 10.1007/s12591-012-0130-x
5. Hedrih (Stevanović) K R. and ***Simonović J***., (2012), "*Multi-frequency analysis of the double circular plate system non-linear dynamics*", NONLINEAR DYNAMICS, (2012), vol. 67 br. 3, pp. 2299-2315, 2012 Springer.

70 years of the Mathematical Institute of SASA, Belgrade, Serbia
Mini-Symposium
"Non-Linear theoretical basis in description of real world phenomena"
Project ON 174001 in Mathematical Institute of SASA, Belgrade, Serbia, November 30, 2016

ФОТО ГАЛЕРИЈА
Међународни минисимпозијум „**Механика лома и нумеричке методе**"
Пројекат ОN174001, Београд, 16 новембар 2016

Photo Gallery
International Mini-Symposium "**Fracture Mechanics and Numerical Methods**"
Project ON174001, Belgrade, November 16, 2016
http://www.mi.sanu.ac.rs/novi_sajt/research/projects/174001a.php

Organizers: Slobodanka Boljanović, Mathematical Institute of SASA, Belgrade, Serbia
Ljubica Milović, Faculty of Technology and Metallurgy, University of Belgrade, Serbia







International Journal of Non-Linear Mechanics 73 (2015) 1

Contents lists available at ScienceDirect

International Journal of Non-Linear Mechanics

journal homepage: www.elsevier.com/locate/nlm

Preface

This Special Issue of IJNM, *A Phenomenological Conspectus on Nonlinear Dynamics*, emphasizes the notion that various and different physical phenomena can often be described by identical or similar mathematical instruments. In this regard, papers from disparate fields have been compiled in the issue.

It is noted that the concepts of Mathematical Phenomenology and Phenomenological Mappings are captured in the works of Professor Mihailo Petrović (1868–1943), a Serbian mathematician who was one of the doctoral students of Jules Henri Poincare (1854–1912). The specific title of his book in French is *Mecanismes communs aux phénomènes disparates*, Paris 1921. In this book, Petrović studied (among others) certain elements of multi-dimensional geometry, couplings between mechanisms and manifestations of phenomena, quantitative vis-à-vis qualitative images of appearances (phenomena), as well as different kinds of analogies.

It is hoped that this Special Issue comprising papers of different thematic foci will serve to highlight the role of a "phenomenological" perspective for pedagogical and investigative purposes in the field of nonlinear dynamics in physically disparate systems.

Professor, Special Issue Managing Guest Editor
Katica R. (Stevanović) Hedrih
Mathematical Institute (SANU) – Belgrade, Serbia

Professor, Special Issue Co-Editor
Ivan Kosenko
Technical University of Radio Techniques – Moscow, Russia

Professor, Special Issue Co-Editor
Pavel Krasilnikov
Moscow Aviation Institute – Moscow, Russia

Professor, Editor-in-Chief
Pol D. Spanos
Rice University – Houston, USA

Preface

This Special Issue of IJNM, A Phenomenological Conspectus on Nonlinear Dynamics, emphasizes the notion that various and different physical phenomena can often be described by identical or similar mathematical instruments.

In this regard, papers from disparate fields have been compiled in the issue. It is noted that the concepts of Mathematical Phenomenology and Phenomenological Mappings are captured in the works of Professor Mihailo Petrović (1868–1943), a Serbian mathematician who was one of the doctoral students of Jules Henri Poincare (1854–1912). The specific title of his book in French is *Mecanismes communs aux phénomènes disparates*, Paris 1921. In this book, Petrović studied (among others) certain elements of multi- dimensional geometry, couplings between mechanisms and manifestations of phenomena, quantitative vis-à-vis qualitative images of appearances (phenomena), as well as different kinds of analogies.

It is hoped that this Special Issue comprising papers of different thematic foci will serve to highlight the role of a "phenomenological" perspective for pedagogical and investigative purposes in the field of non-linear dynamics in physically disparate systems.

INTERNATIONAL JOURNAL OF
NON-LINEAR MECHANICS

Editor-in-Chief
POL D SPANOS
L. B. Ryon Chair in Engineering, M.S. 321, Rice University, 6100 Main Street, Houston, TX 77251-1892, U.S.A.

VOLUME 73 JULY 2015

CONTENTS

Indexed/abstracted in: *Appl. Mech. Rev., Cam. Sci. Abstr., Curr. Cont./Eng. Tech. & Applied Sci., Eng. Ind., Math. R., Mechanics, Res. Alert, Curr. Cont. SCISEARCH Data, SSSA/CISA/ECA/ISMEC, MSCI.*

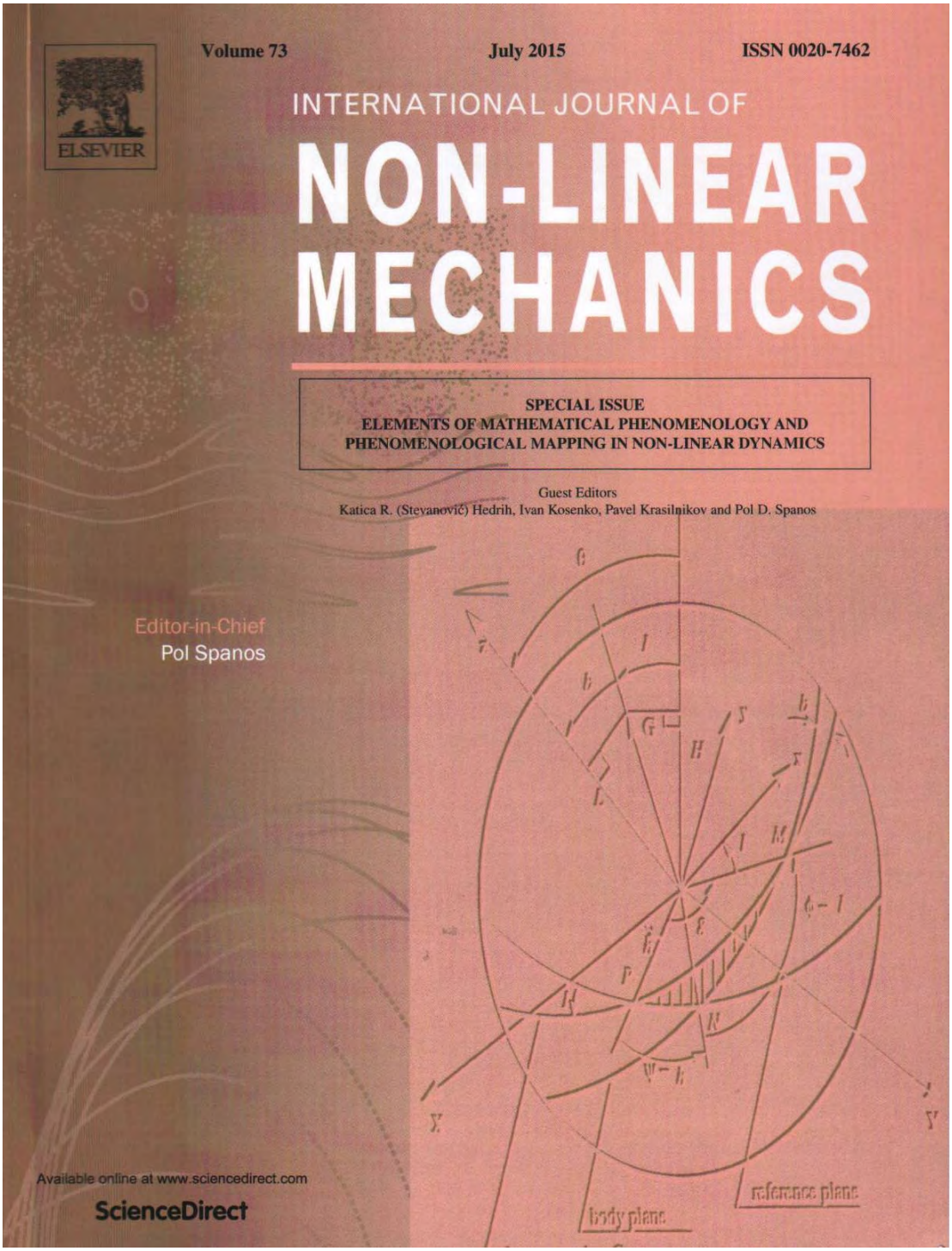
The Elsevier catalogue can now be accessed via the Internet using one of the following addresses:
http://www.elsevier.com
gopher.elsevier.com

ELSEVIER

0020-7462(201507)73:C;1-2

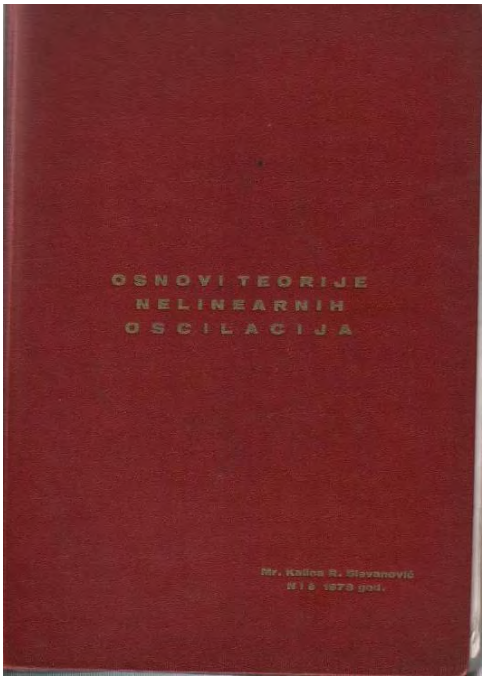
ISSN 0020-7462
73 1–128 (2015)

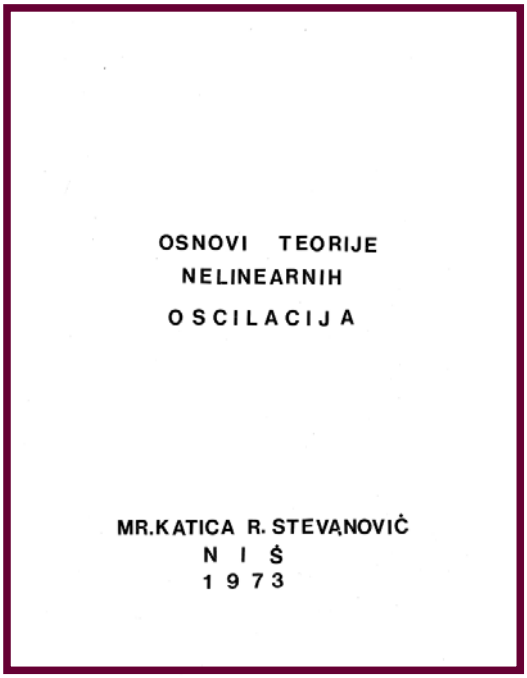
PRINTED BY POLESTAR WHEATONS LTD, EXETER, UK


Volume 73
July 2015
ISSN 0020-7462
ELSEVIER
INTERNATIONAL JOURNAL OF
NON-LINEAR MECHANICS
SPECIAL ISSUE
ELEMENTS OF MATHEMATICAL PHENOMENOLOGY AND PHENOMENOLOGICAL MAPPING IN NON-LINEAR DYNAMICS
Guest Editors
Katica R. (Stevanović) Hedrih, Ivan Kosenko, Pavel Krasilnikov and Pol D. Spanos
Editor-in-Chief
Pol Spanos
Available online at www.sciencedirect.com
ScienceDirect
body plane
reference plane

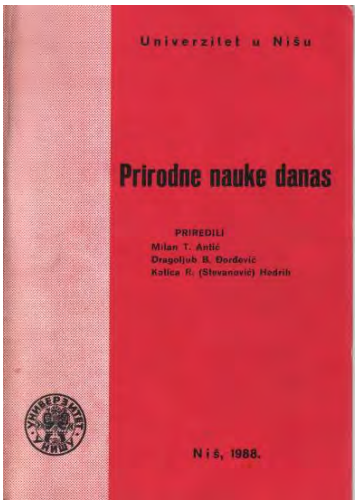
Preprint – Tiraž 20 primeraka za poslediplomce magistarskih studija (obim preprinta- strana 500); višw od 40 godina su poslediplomsci I istraživači sa Mašinskog fakulteta u Nišu sticali prva znanja iz nelinearne dinamike I metoda nelinearne mehanike iz ove publikacije; izvod iz ovog preprinta je publikovan 1975; – kompletan sadržaj ovog preprinta I ove knjige sada su dostupni u PDF fajlovima na linkovima

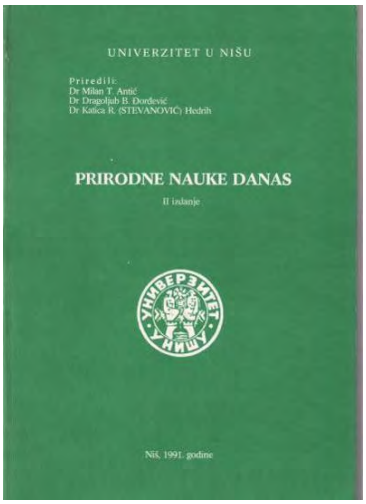
http://elibrary.matf.bg.ac.rs/ http://elibrary.matf.bg.ac.rs/handle/123456789/3768



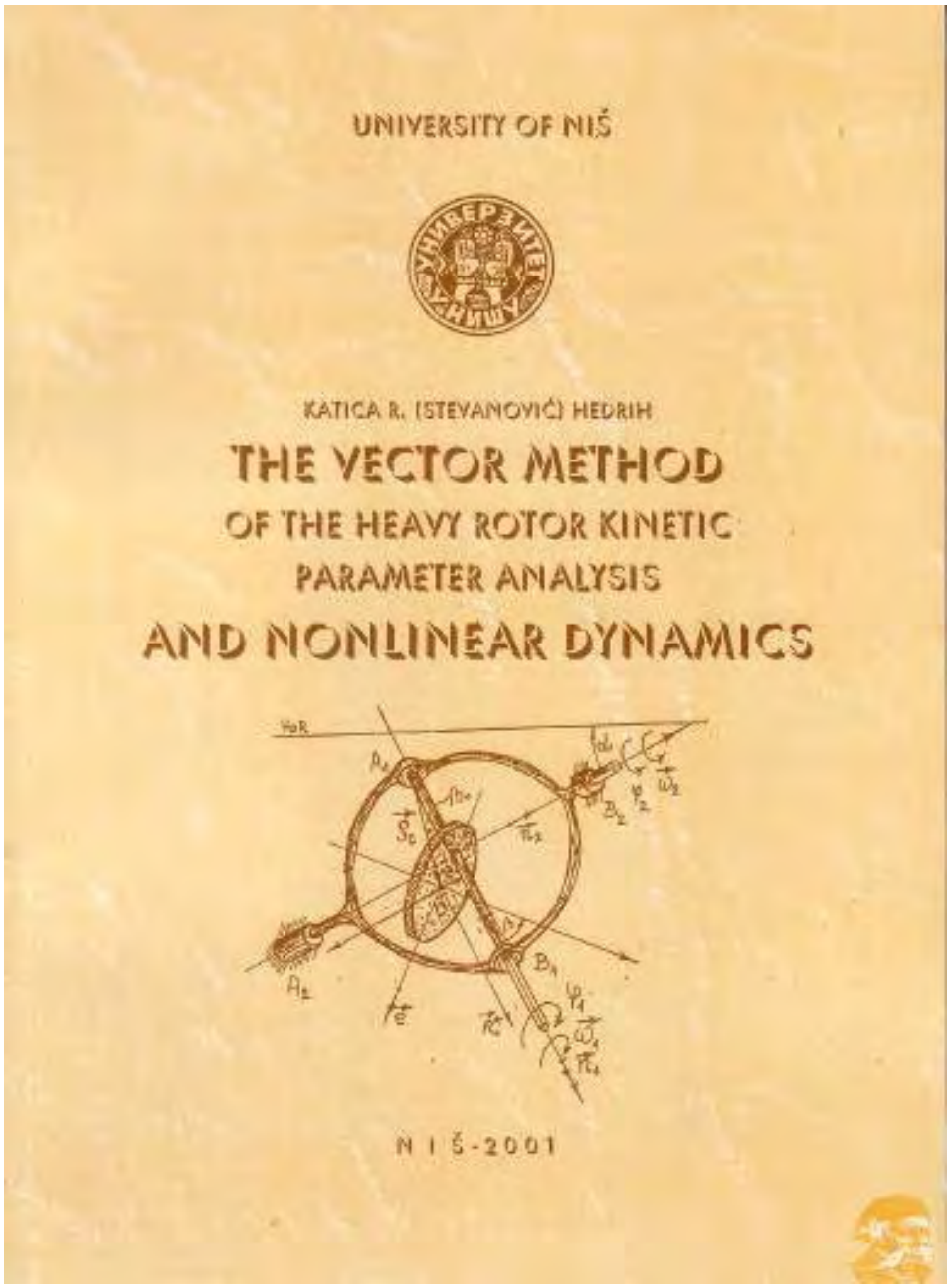


Hedrih (Stevanović) , Katica, OSNOVI TEORIJE NELINEARNIH OSCILACIJA, Niš, 1973.
http://elibrary.matf.bg.ac.rs/ http://elibrary.matf.bg.ac.rs/handle/123456789/3768

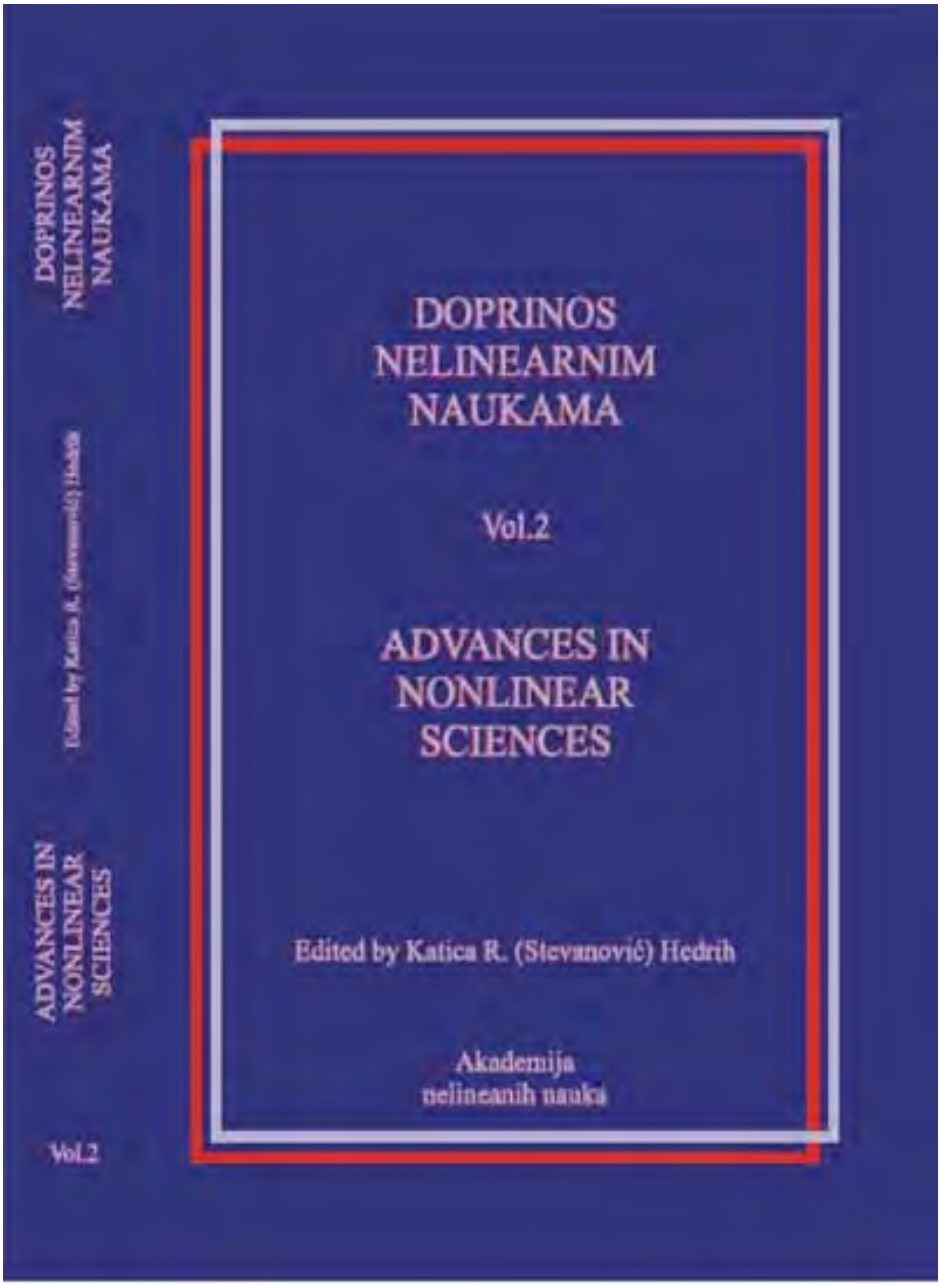


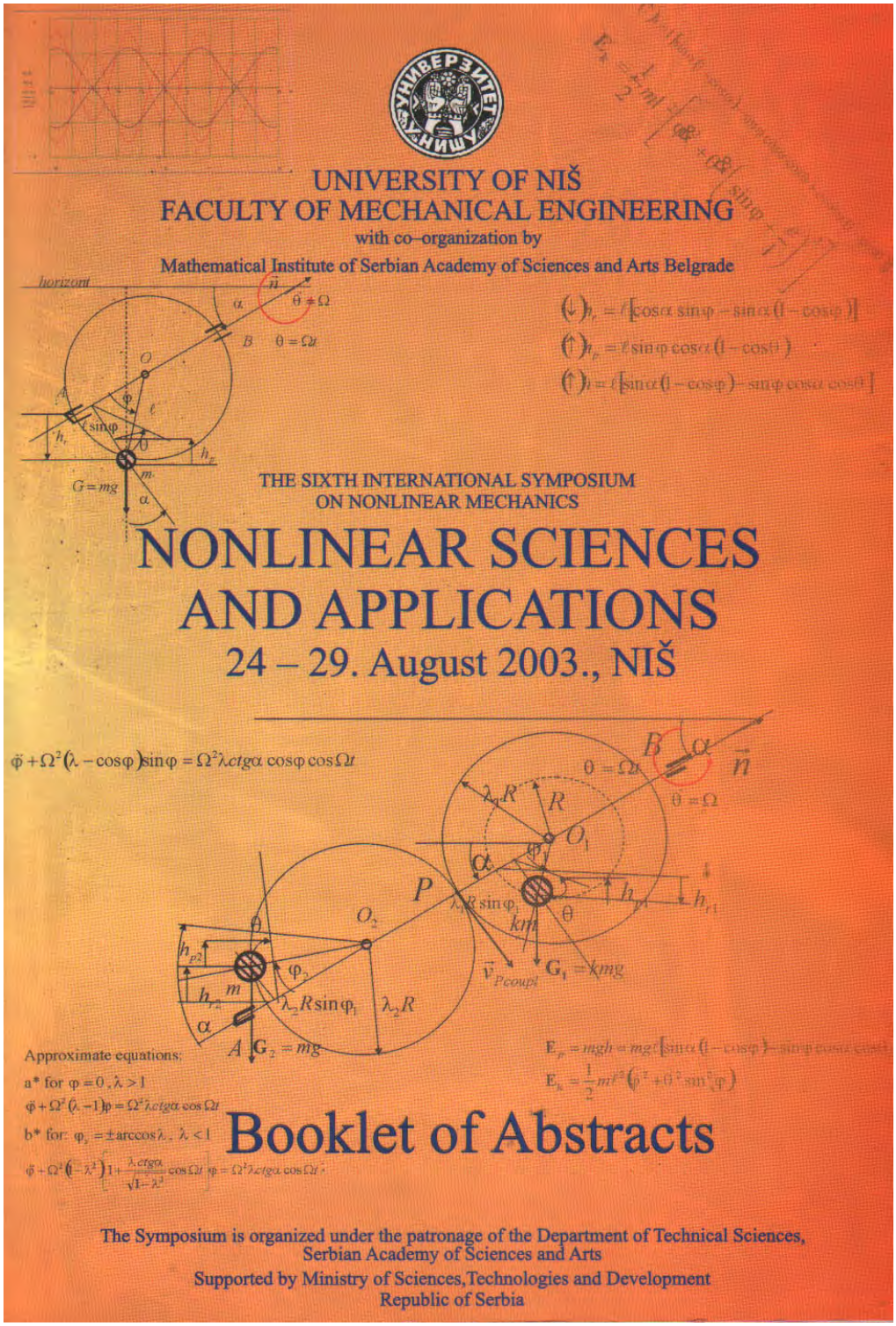


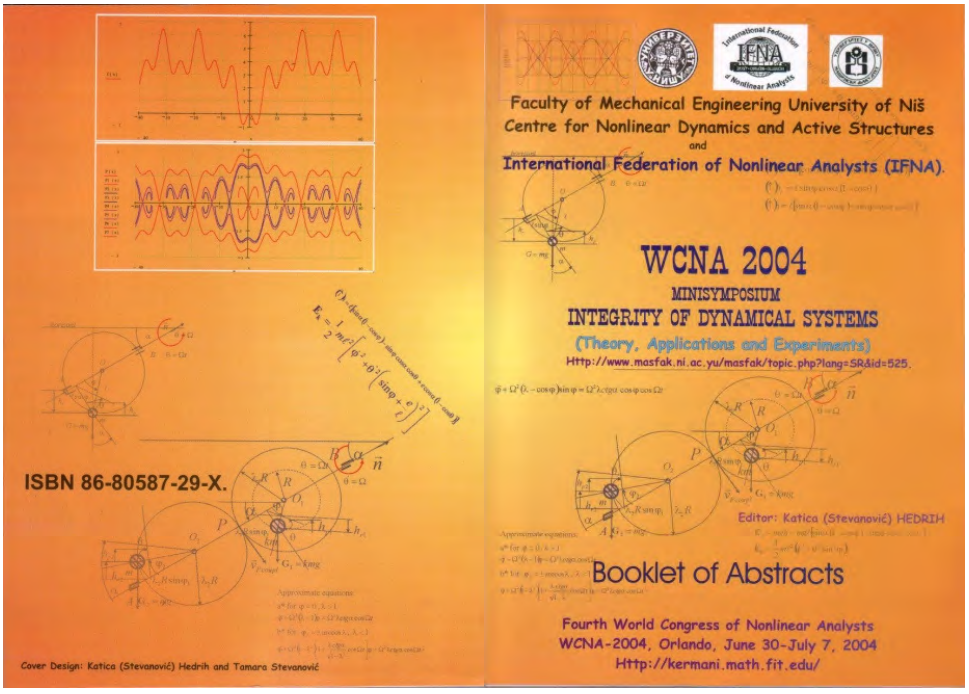
Hedrih (Stevanović) Katica,
IZABRANA POGLAVLJA TEORIJE NELINEARNIH OSCILACIJA,
Univerzitet u Nišu, (Niš , 1975) ; http://elibrary.matf.bg.ac.rs/
http://elibrary.matf.bg.ac.rs/handle/123456789/3767

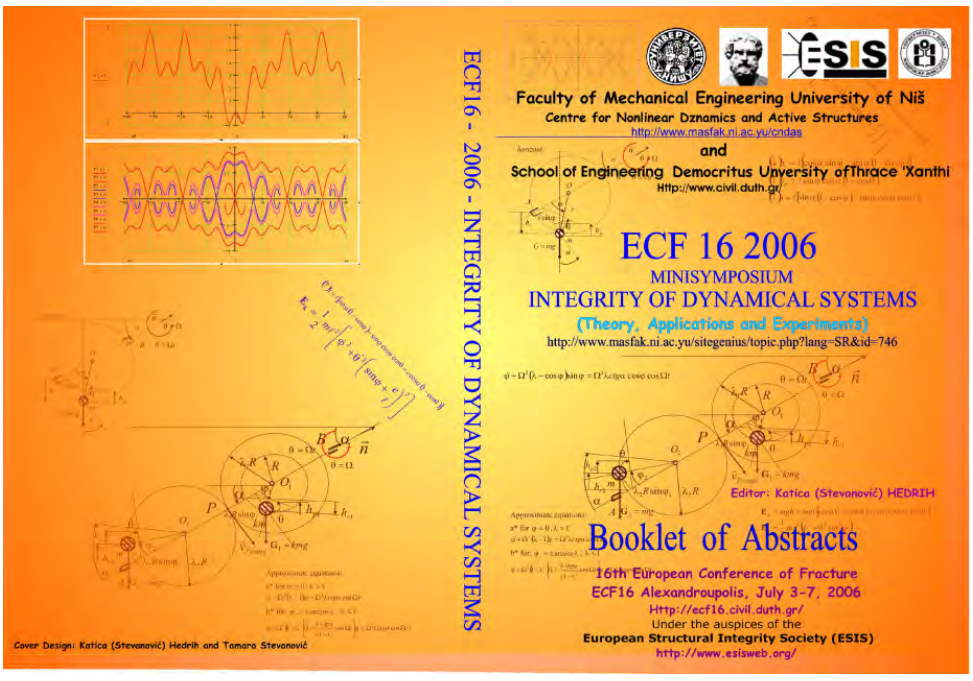


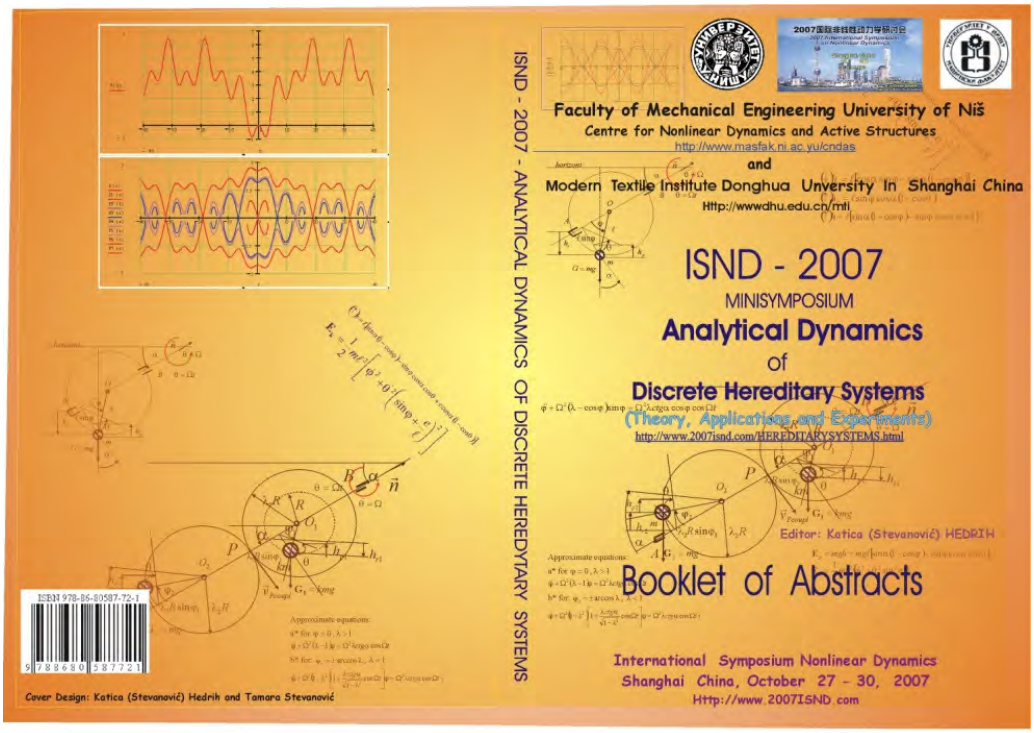
Katica (Stevanović) Hedrih: Vector Method of the Heavy Rotor Kinetic Parameter Analysis and Nonlinear Dynamics, University of Niš 2001,Monograph, p. 252. (in English), (Reviewers: Academician NANU Ju. A. Mitropolskiy, Ukraina, academician ANN Veljko Vujčić, academicina UHEAS Oleg Aleksandrovič Goroshko, Ukraina, and prof. dr Vlatko Brčič), YU ISBN 86-7181-046-1 UDC 531.38:514.742.4

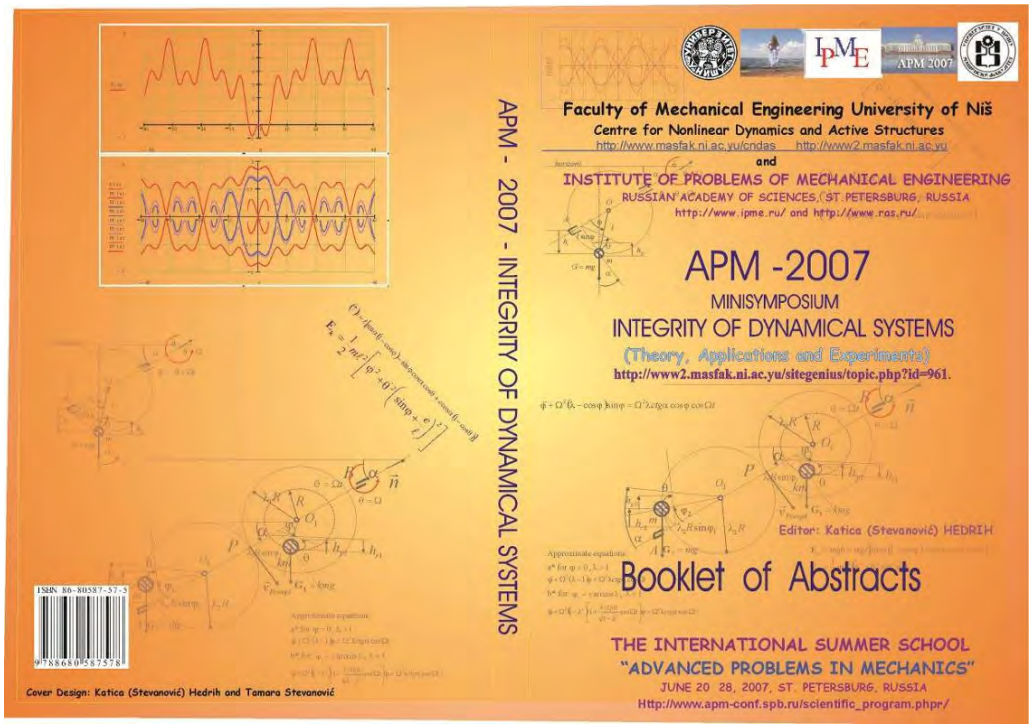

DOPRINOS NELINEARNIM NAUKAMA
DOPRINOS NELINEARNIM NAUKAMA
Vol.2
ADVANCES IN NONLINEAR SCIENCES
Edited by Katica R. (Stevanović) Hedrih
Akademija nelineanih nauka
ADVANCES IN NONLINEAR SCIENCES
Vol.2

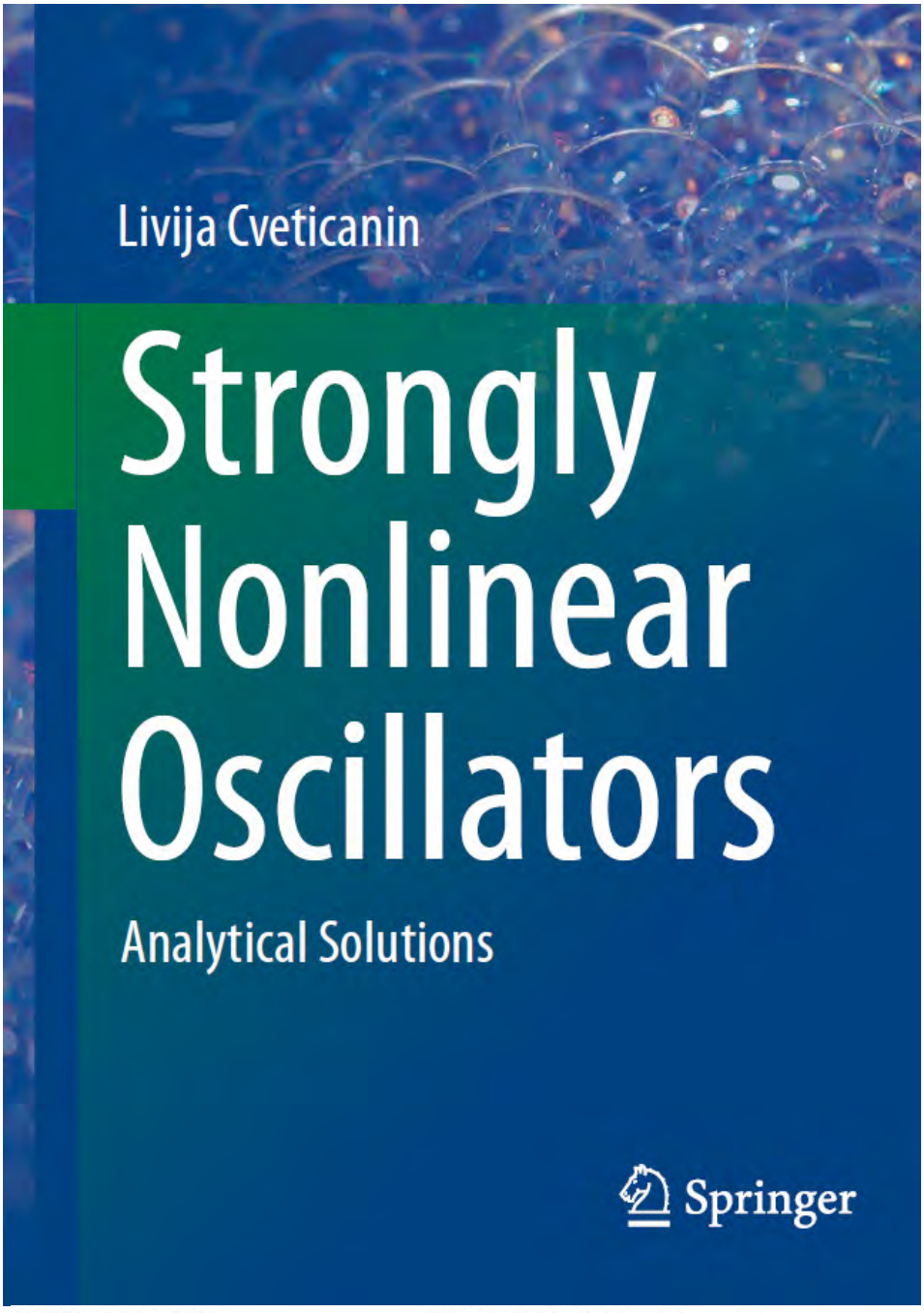

UNIVERSITY OF NIŠ
FACULTY OF MECHANICAL ENGINEERING
with co–organization by
Mathematical Institute of Serbian Academy of Sciences and Arts Belgrade
THE SIXTH INTERNATIONAL SYMPOSIUM
ON NONLINEAR MECHANICS
NONLINEAR SCIENCES
AND APPLICATIONS
24 – 29. August 2003., NIŠ
Booklet of Abstracts
The Symposium is organized under the patronage of the Department of Technical Sciences,
Serbian Academy of Sciences and Arts
Supported by Ministry of Sciences,Technologies and Development
Republic of Serbia


ISBN 86-80587-29-X.
Cover Design: Katica (Stevanović) Hedrih and Tamara Stevanović
Faculty of Mechanical Engineering University of Niš
Centre for Nonlinear Dynamics and Active Structures
and
International Federation of Nonlinear Analysts (IFNA).
WCNA 2004
MINISYMPOSIUM
INTEGRITY OF DYNAMICAL SYSTEMS
(Theory, Applications and Experiments)
Http://www.masfak.ni.ac.yu/masfak/topic.php?lang=SR&id=525.
Editor: Katica (Stevanović) HEDRIH
Booklet of Abstracts
Fourth World Congress of Nonlinear Analysts
WCNA-2004, Orlando, June 30-July 7, 2004
Http://kermani.math.fit.edu/

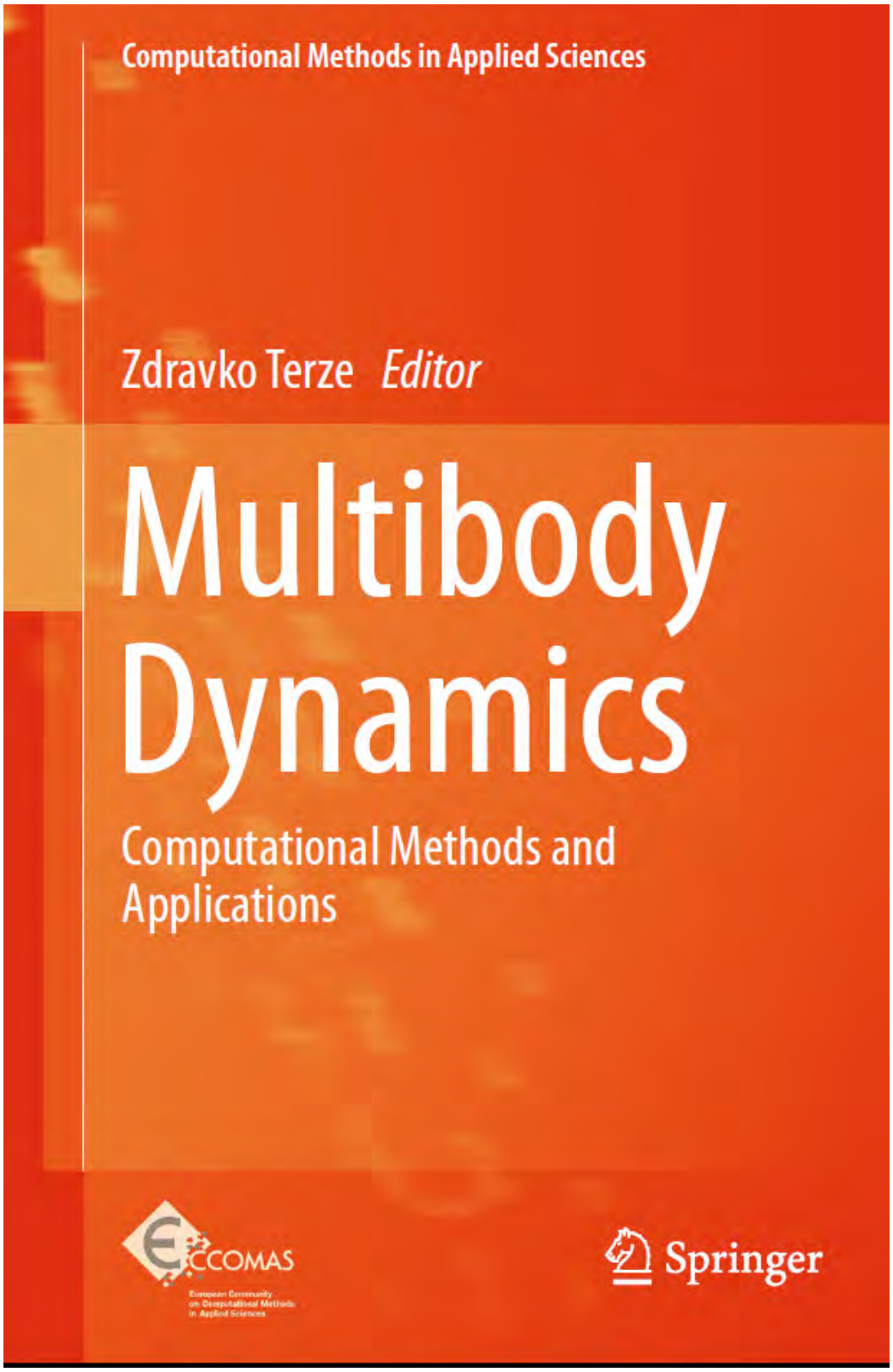

ECF16 - 2006 - INTEGRITY OF DYNAMICAL SYSTEMS
Cover Design: Katica (Stevanović) Hedrih and Tamara Stevanović
Faculty of Mechanical Engineering University of Niš
Centre for Nonlinear Dznamics and Active Structures
http://www.masfak.ni.ac.yu/cndas
and
School of Engineering Democritus University ofThrace 'Xanthi
Http://www.civil.duth.gr/
ECF 16 2006
MINISYMPOSIUM
INTEGRITY OF DYNAMICAL SYSTEMS
(Theory, Applications and Experiments)
http://www.masfak.ni.ac.yu/sitegenius/topic.php?lang=SR&id=746
Editor: Katica (Stevanović) HEDRIH
Booklet of Abstracts
16th European Conference of Fracture
ECF16 Alexandroupolis, July 3-7, 2006
Http://ecf16.civil.duth.gr/
Under the auspices of the
European Structural Integrity Society (ESIS)
http://www.esisweb.org/

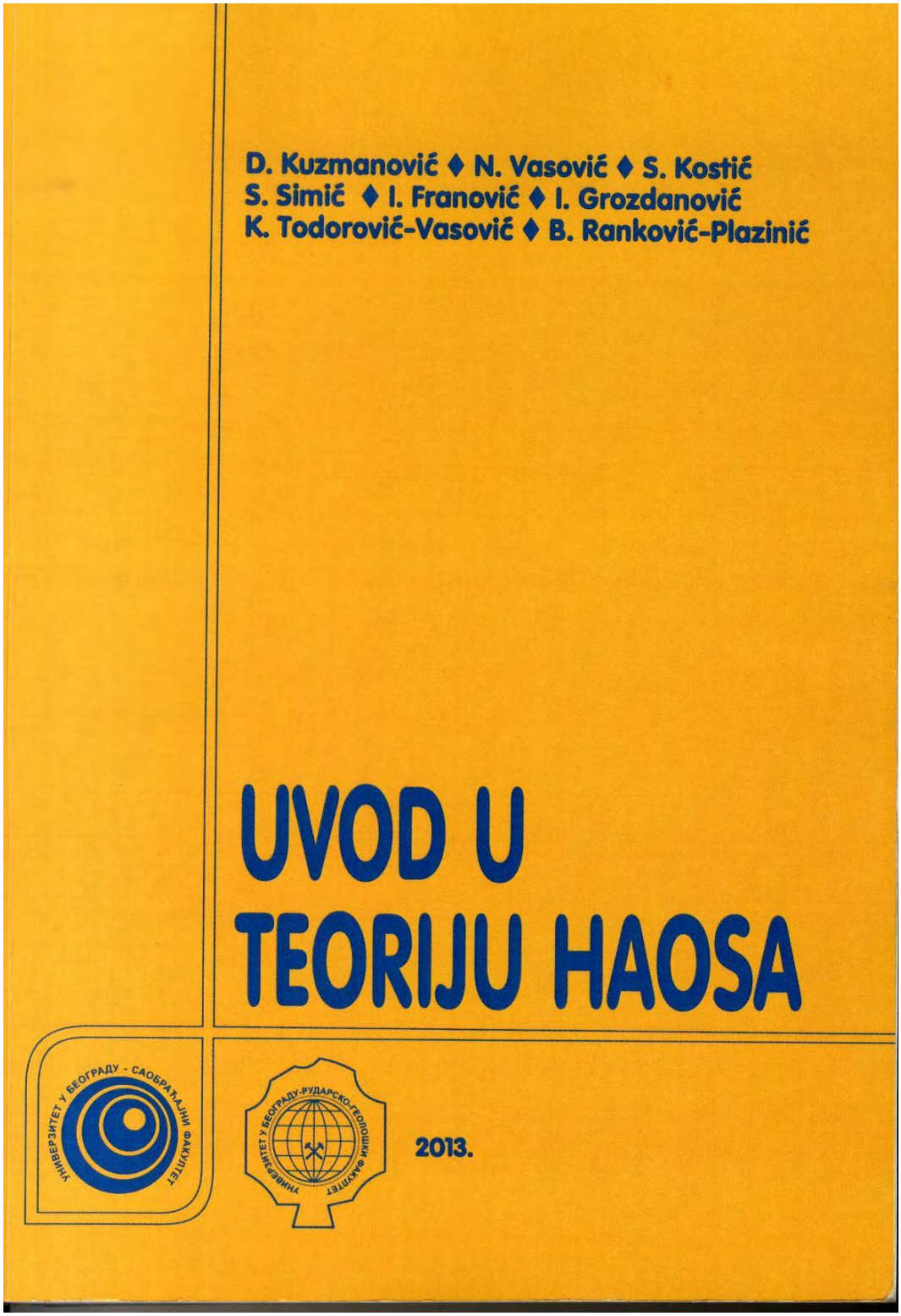

ISND - 2007 - ANALYTICAL DYNAMICS OF DISCRETE HEREDITARY SYSTEMS
Faculty of Mechanical Engineering University of Niš
Centre for Nonlinear Dynamics and Active Structures
http://www.masfak.ni.ac.yu/cndas
and
Modern Textile Institute Donghua University In Shanghai China
Http://wwwdhu.edu.cn/mti
ISND - 2007
MINISYMPOSIUM
Analytical Dynamics
of
Discrete Hereditary Systems
(Theory, Applications and Experiments)
http://www.2007isnd.com/HEREDITARYSYSTEMS.html
Editor: Katica (Stevanović) HEDRIH
Booklet of Abstracts
International Symposium Nonlinear Dynamics
Shanghai China, October 27 - 30, 2007
Http://www.2007ISND.com
Cover Design: Katica (Stevanović) Hedrih and Tamara Stevanović

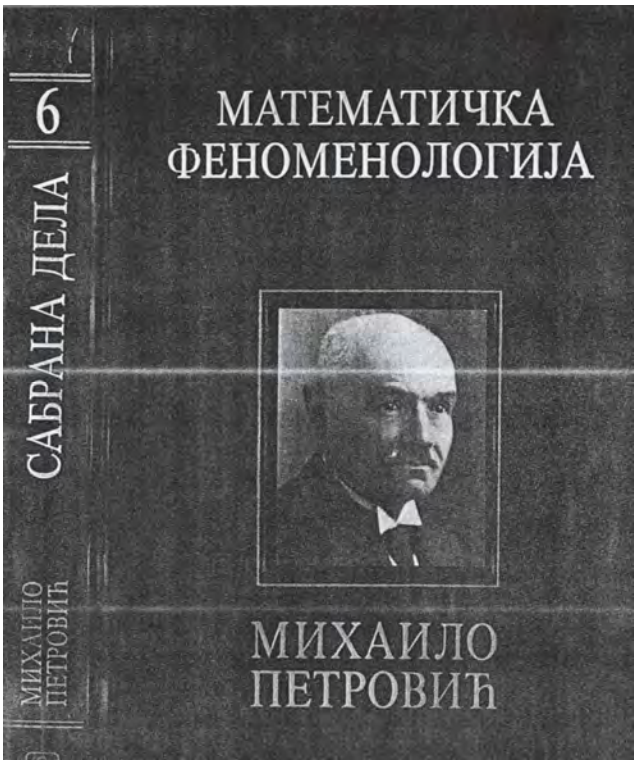

APM - 2007 - INTEGRITY OF DYNAMICAL SYSTEMS
Faculty of Mechanical Engineering University of Niš
Centre for Nonlinear Dynamics and Active Structures
http://www.masfak.ni.ac.yu/cndas http://www2.masfak.ni.ac.yu
and
INSTITUTE OF PROBLEMS OF MECHANICAL ENGINEERING
RUSSIAN ACADEMY OF SCIENCES, ST.PETERSBURG, RUSSIA
http://www.ipme.ru/ and http://www.ras.ru/
APM -2007
MINISYMPOSIUM
INTEGRITY OF DYNAMICAL SYSTEMS
(Theory, Applications and Experiments)
http://www2.masfak.ni.ac.yu/sitegenius/topic.php?id=961.
Editor: Katica (Stevanović) HEDRIH
Booklet of Abstracts
THE INTERNATIONAL SUMMER SCHOOL
"ADVANCED PROBLEMS IN MECHANICS"
JUNE 20 28, 2007, ST. PETERSBURG, RUSSIA
Http://www.apm-conf.spb.ru/scientific_program.phpr/
Cover Design: Katica (Stevanović) Hedrih and Tamara Stevanović

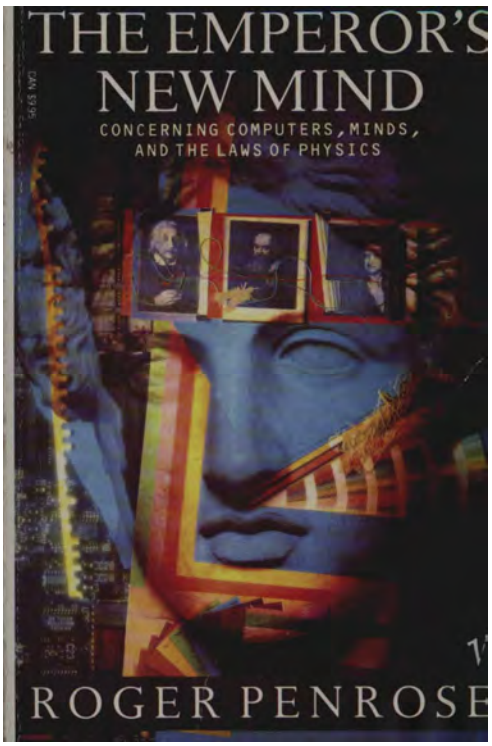


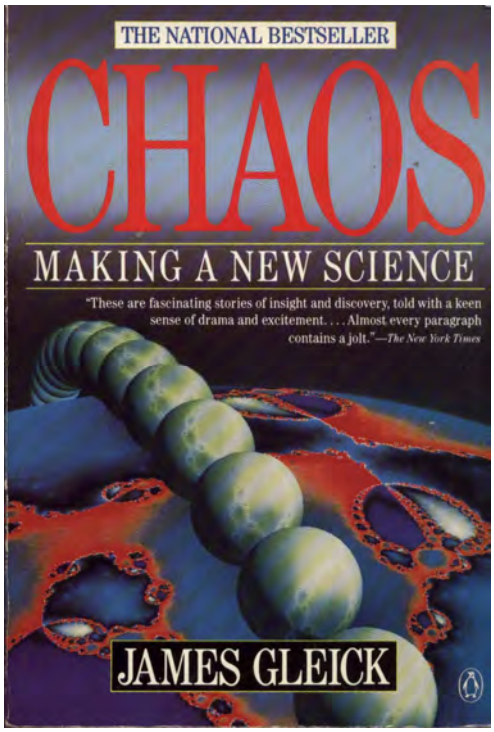
ISSN 2192-4791 ISSN 2192-4805 (electronic)
ISBN 978-3-319-05271-7 ISBN 978-3-319-05272-4 (eBook)
DOI 10.1007/978-3-319-05272-4
Springer Cham Heidelberg New York Dordrecht London


Computational Methods in Applied Sciences
Zdravko Terze Editor
Multibody Dynamics
Computational Methods and Applications
ECCOMAS
Springer

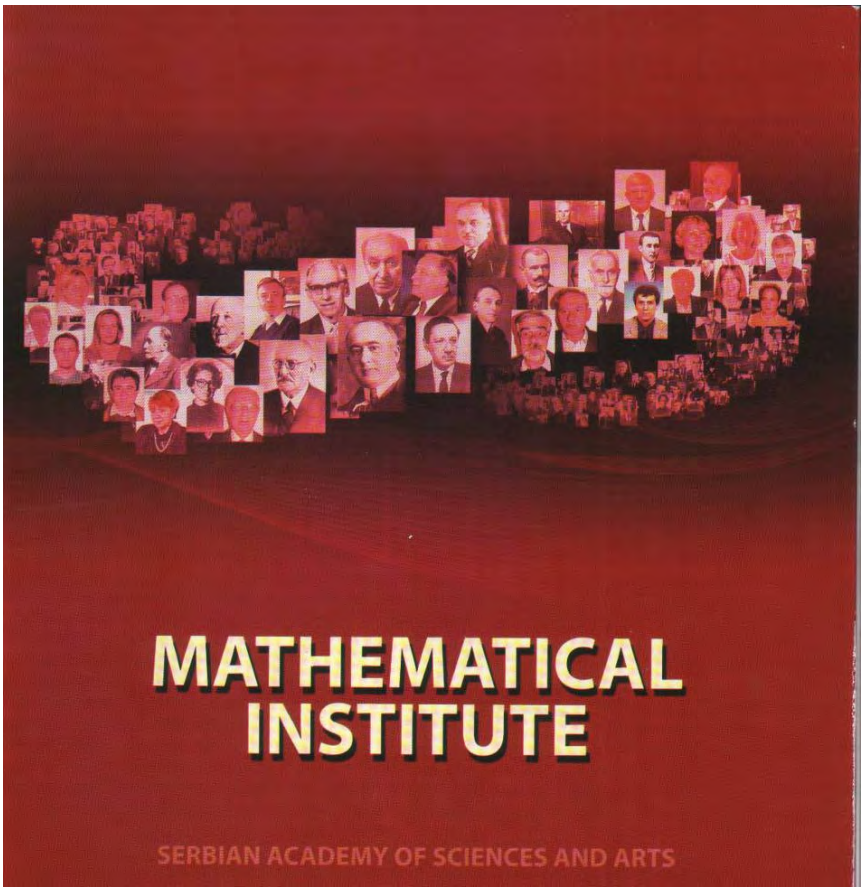

D. Kuzmanović ♦ N. Vasović ♦ S. Kostić
S. Simić ♦ I. Franović ♦ I. Grozdanović
K. Todorović-Vasović ♦ B. Ranković-Plazinić
UVOD U
TEORIJU HAOSA
2013.


6
САБРАНА ДЕЛА
МИХАИЛО ПЕТРОВИЋ
МАТЕМАТИЧКА ФЕНОМЕНОЛОГИЈА
МИХАИЛО ПЕТРОВИЋ


THE EMPEROR'S NEW MIND
CONCERNING COMPUTERS, MINDS, AND THE LAWS OF PHYSICS
ROGER PENROSE


THE NATIONAL BESTSELLER
CHAOS
MAKING A NEW SCIENCE
"These are fascinating stories of insight and discovery, told with a keen sense of drama and excitement. . . . Almost every paragraph contains a jolt."—The New York Times
JAMES GLEICK


The Founders of the Institute
Dr. Bilimovič Anton
Dr. Kašanin Radivoj
Dr. Gavrilović Bogdan
Dr. Milanković Milutin
Dr. Mišković Vojislav
Dr. Saltikov Nikola
Dr. Karamata Jovan



ГОДИНА
МАТЕМАТИЧКОГ
ИНСТИТУТА САНУ

Издавачи:
Пројекат ОН174001 у Математичком институту САНУ
http://www.mi.sanu.ac.rs/novi_sajt/research/projects/174001a.php

СВЕН – Ниш

Штампа: Штампарија СВЕН – Ниш- 2016
Тираж: 100 примерака

Уредник свеске: Јулијана Симоновић

Главни и одговорни уредник: Катица (Стевановић) Хедрих,
РУКОВОДИЛАЦ ПројектА ОН174001