

# **Proceedings**

**The 7th International Congress  
of Serbian Society of Mechanics**

**Sremski Karlovci, June 24-26, 2019**

**Edited by:**

**Mihailo Lazarević  
Srboljub Simić  
Damir Madjarević  
Ivana Atanasovska  
Andjelka Hedrih  
Bojan Jeremić**

## **The 7th International Congress of Serbian Society of Mechanics**

### **Editors:**

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Anđelka Hedrih  
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**Table of Contents**

<b>Technical Program</b>	1
<b>List of Contributions</b>	6
General Mechanics (G)	6
Mechanics of Solid Bodies (S)	7
Fluid Mechanics (F)	10
Control and Robotics (C)	10
Interdisciplinary Areas (I)	11
Mini-symposium – Nonlinear Dynamics (M1)	12
Mini-symposium – Bioengineering (M2)	14
Mini-symposium – Turbulence (M3)	16
Mini-symposium – Waves and diffusion in complex media (M4)	18
Mini-symposium – Biomechanics and Mathematical Biology (M5)	19
<b>Plenary Lectures</b>	21
P-1 Walter Lacarbonara, Asymptotic response of systems and materials with hysteresis	21
P-2 Zdravko Terze, et al., Lie group dynamics of multibody system in vortical fluid flow	22
P-3 HongGuang Sun, Yong Zhang, Anomalous diffusion: modeling and application	30
P-4 Peter Van, Continuum mechanics and nonequilibrium thermodynamics	31
P-5 G. Karanasiou, D. Fotiadis, In silico clinical trials: multiscale models and stent industry transformation	42
P-6 Dušan. Zorica, Hereditariness and non-locality in wave propagation modelling	45
P-7 Nemanja Zorić, Integration and identification of active vibration control system for smart flexible structures	54
P-8 Bojan Medjo et al., Micromechanical criteria of steel weldments ductile fracture	74
<b>Award „Rastko Stojanovic”</b>	
RSA Candidate	92
RSA Candidate	93
<b>Abstracts</b>	<b>98</b>
General Mechanics (G)	98
Mechanics of Solid Bodies (S)	107
Fluid Mechanics (F)	118
Control and Robotics (C)	119
Interdisciplinary and Multidisciplinary Problems (I)	120
Mini-symposium – Nonlinear Dynamics (M1)	124
Mini-symposium – Bioengineering (M2)	145
Mini-symposium – Turbulence (M3)	185
Mini-symposium – Waves and diffusion in complex media (M4)	189
Mini-symposium – Biomechanics and Mathematical Biology (M5)	210
The History of the Serbian and Yugoslav Society and of Mechanics	219

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Srboljub Simić, (Co-chair)  
Damir Madjarević,  
Ivana Atanasovska  
Anđelka Hedrih  
Bojan Jeremić

## Foreward

The present volume contains plenary lectures, abstracts and papers of young authors competing for the „*Rastko Stojanović*” award at the 7th International Congress of Serbian Society of Mechanics. The objectives of this Congress, to be held at in Sremski Karlovci during the period 24<sup>th</sup> -26<sup>th</sup> June 2019, are to review and discuss some of the latest trends in various fields of theoretical and applied mechanics as well as it aims to bring together the scientific communities of theoretical and applied mechanics in an effort to facilitate the exchange of ideas on topics of mutual interests, and to serve as a platform for establishing links between research groups with complementary activities.

We are happy to report that the number of accepted papers to be presented at the 7th Congress is 119. In addition, among them, 8 invited plenary lectures were presented by the authors from Italy, China, Greece, Croatia, Hungary and Serbia. Also, we have 4 invited speakers for Mini-Symposia. Accepted papers were grouped in the following sections General Mechanics, Fluid Mechanics, Mechanics of Solid Bodies, Control and Robotics, and Interdisciplinary and Multidisciplinary Areas. Also, the three Minisymposia were organized with following topics: Nonlinear Dynamics, Bioengineering, Turbulence, Waves and diffusion in complex media and Biomechanics and Mathematical Biology.

The Editors would like to express their thanks to all participants of the 7th Congress of Mechanics. First, to the authors of the papers whose quality work is the essence of this event. Next, to of the papers whose distinguished invited lecturers who kindly accepted the invitation to come to Congress and helped make it success. We owe great thanks to the reviewers of the papers, to the members of the Scientific and Organizing Committee. Also, special thanks to the organizers of the Mini-symposia on Nonlinear Dynamics, Bioengineering, Turbulence, Waves and diffusion in complex media and Biomechanics and Mathematical Biology. The support of the members of Steering Committee of Serbian Society of Mechanics in organizing this event is also appreciated. Finally, special thanks are also due to those organizations which supported financially this Congress: Serbian Society of Mechanics, Ministry of Education, Science and Technological Development of the Republic of Serbia, Faculty of Mechanical Engineering, University of Belgrade, Belgrade and Serbian Academy of Sciences and Arts- Branch in Novi Sad, Provincial Secretariat for Higher Education and Scientific Research.

It is our great pleasure to welcome you with us at the 7th Congress International Congress of Serbian Society of Mechanics. We would like to wish all participants of this Congress a warm welcome to our country, our Serbian Society of Mechanics and Venue Congress place at *the Karlovci Gymnasium*, Sremski Karlovci, Serbia.

Sremski Karlovci, June, 2019

*The Editors*

Mihailo Lazarević, Srboľjub Simić  
Damir Madjarević, Ivana Atanasovska  
Anđelka Hedrih, Bojan Jeremić



## Technical program

**SUNDAY, June 23, 2019**

19:30            *Welcoming Coctail*        (Hotel Prezident, Main Hall)

**MONDAY, June 24, 2019**

8:00 – 8:45        *Registration of participants* (Main Hall, The Karlovci  
Gymnasium )

*Chairs: Srboljub Simić, Mihailo Lazarević*

8:45 – 9:20 (Congress hall, The Karlovci Gymnasium )

- Radovan Kovačević, *Director of the Karlovci Gymnasium, Welcome address*
- Academician Teodor Atanacković, *Novi Sad branch of SASA, Welcome address*
- Aleksandar Stojkečić, *Historical notes - Sremski Karlovci*
- Prof.Mihailo P. Lazarević, *the President of Serbian Society of Mechanics ,Welcome address*

Plenary Lectures (Congress Hall)

Chairman: Katica R. (Stevanović) Hedrih

9:20 - 10:05        P-1    Walter Lacarbonara  
ASYMPTOTIC RESPONSE OF SYSTEMS AND  
MATERIALS WITH HYSTERESIS

10:05 - 10:50      P-2    Zdravko Terze, et al.  
LIE GROUP DYNAMICS OF MULTIBODY SYSTEM IN  
VORTICAL FLUID FLOW

10:50 - 11:15      *Coffee Break*                    (Main Hall)

11:15 - 13:00      Parallel Sessions

Session	G1	S1	M4	C1
Hall	<i>Classroom 1</i>	<i>Classroom 2</i>	<i>Classroom 24</i>	<i>Classroom 25</i>
11:15	G1a	S1a	M4a	C1a
11:35	G1b	S1b	M4b	C1b
11:55	G1c	S1c	M4c	C1c
12:15	G1d	S1d	M4d	C1d
12:35	G1e	S1e	M4e	C1e
12:55		S1f	M4f	

13:10 - 14:40 *Lunch (Restaurant Bermet)*

Plenary Lecture (*Congress hall*)

Chairman: Srboľjub Simić

14:40 - 15:25 P-3 HongGuang Sun, Yong Zhang  
ANOMALOUS DIFFUSION: MODELING AND APPLICATION

15:30 -17:30 *Social program (excursion to Monasteries at Fruska Gora)*

17:30 - 19:10 Parallel Sessions

Session	G2	S2	M4	M1	M1
Hall	<i>Classroom 1</i>	<i>Classroom 2</i>	<i>Classroom 24</i>	<i>Classroom 25</i>	
17:30	G2a	S2a	M4g	M1p*	17:30
17:50	G2b	S2b	M4h	M1a	18:00
18:10	G2c	S2c	M4i	M1b	18:20
18:30	G2d	S2d	M4j	M1c	18:40
18:50	G2e	S2e	M4k	M1d	19:00
19:10		S2f	M4l	M1e	19:20

**TUESDAY, June 25, 2019**Plenary Lectures (*Congress hall*)

Chairman: Zdravko Terze

9:00 - 9:45 P-4 Peter Van  
CONTINUUM MECHANICS AND NONEQUILIBRIUM  
THERMODYNAMICS

9:45 - 10:30 P-6 Dušan. Zorica  
HEREDITARINESS AND NON-LOCALITY IN  
WAVE PROPAGATION MODELLING

10:30 - 10:50 *Coffee Break* (Main Hall)

10:50 - 13:00 Parallel Sessions

Session	G3	M1	M2	M3	M3
Hall	<i>Classroom 1</i>	<i>Classroom 2</i>	<i>Classroom 24</i>	<i>Classroom 25</i>	
10:50	G3a	M1f	M2a	M3a	10:50
11:10	G3b	M1g	M2b	M3b	11:20
11:30	G3c	M1h	M2c	M3c	11:40
11:50		M1i	M2d	M3d	12:00
12:10		M1j	M2e	M3e	12:20
12:30		M1k	M2f		

12:50 - 14:15 *Lunch* (Restaurant Bermet)

Plenary Lecture (*Congress hall*)

Chairman: Dušan Zorica

14:15 - 15:00 P-07 N. Zorić  
INTEGRATION AND IDENTIFICATION OF ACTIVE  
VIBRATION CONTROL SYSTEM FOR SMART FLEXIBLE  
STRUCTURES

15:00 - 15:20 *Coffee Break* (Main Hall)

15:20 - 17:20 Parallel Sessions

Session	S3	M1	M2	M3
Hall	<i>Classroom 1</i>	<i>Classroom 2</i>	<i>Classroom 24</i>	<i>Classroom 25</i>
15:20	S3a	M1l	M2g	M3f
15:40	S3b	M1m	M2h	M3g
16:00	S3c	M1n	M2i	M3h
16:20	S3d	M1o	M2j	M3i
16:40	S3e	M1r	M2k	M3j
17:00	S3f			

17:00 - 18:00 Round table: HARMONIZATION AND MODERNIZATION OF THE CURRICULUM IN ENGINEERING MECHANICS

17:00-17:15 Katica R. (Stevanović) *Hedrih, Academician LJUBOMIR KLERIĆ (June 29, 1844- January 21, 1910); Dedicated to Jubilee 175 years from birthday*

18:00 - 19:00 General Assembly Meeting of Serbian Society of Mechanics  
(*Congress Hall*)

19:00-19:30 *Wine tasting (winery "Bajilo")*

20:00 - 22:30 *Gala Dinner (Restaurant Pasent)*

### WEDNESDAY, June 26, 2019

Plenary Lecture (*Congress Hall*)

Chairman: HongGuang Sun

9:00 - 9:45 P-5 G. Karanasiou, D. Fotiadis  
IN SILICO CLINICAL TRIALS: MULTISCALE MODELS AND  
STENT INDUSTRY TRANSFORMATION

9:45 - 10:30 P-8 Bojan Medjo et al.  
MICROMECHANICAL CRITERIA OF STEEL WELDMENTS  
DUCTILE FRACTURE

10:30 - 12:10 Parallel Sessions

Session	I1	S4	M2	M5	M5
Hall	<i>Classroom 1</i>	<i>Classroom 2</i>	<i>Classroom 24</i>	<i>Classroom 25</i>	
10:30	I1a	S4a	M2l	M5a	10:30
10:50	I1b	S4b	M2m	M5b	11:00
11:10	I1c	S4c	M2n	M5c	11:20
11:30	I1d	S4d	M2o		
11:50	I1e	S4e	M2p		

12:10 - 12:35 *Coffee Break (Main Hall)*

12:35 - 12:55 B. Popkonstatinović, N. Mladenović, M. Stojićević, *Faculty of Mech. Eng.*,

*Belgrade, Presentation book ESCAPEMENT DYNAMICS AND HOROLOGICAL ERRORS, (Congress Hall)*

13:00 – 15:00 *Parallel Sessions*

Session	F1	S5	M2	M5
Hall	<i>Classroom 1</i>	<i>Classroom 2</i>	<i>Classroom 24</i>	<i>Classroom 25</i>
13:00	F1a	S5a	M2r	M5d
13:20	F1b	S5b	M2s	M5e
13:40	F1c	S5c	M2t	M5f
14:00			M2u	
14:20			M2v	
14:40			M2z	

15:00 *Closing Ceremony (Congress hall)*

## List of Contributions

### General Mechanics (G)

**G1** *Chairs: Katica R. (Stevanović) Hedrih, Sinisa Dj. Mesarović*

G1a: Katica R. (Stevanović) Hedrih  
DYNAMICS OF A ROLLING HEAVY THIN DISK ALONG ROTATE  
CURVILINEAR TRACE IN VERTICAL PLANE ABOUT VERTICAL AXIS

G1b: Sinisa Dj. Mesarović  
LATTICE CONTINUA FOR POLYCRYSTAL GRAINS

G1c: Borislav Gajić, Božidar Jovanović  
CONNECTIONS AND CHAPLYGIN REDUCING MULTIPLIER IN CLASSICAL  
MECHANICS

G1d: Damir Madjarević, Srbojub Simić  
ENTROPY GROWTH AND ENTROPY PRODUCTION RATE IN  
BINARY MIXTURE SHOCK WAVES

G1e: Andrijana A. Đurđević, Aleksandar A. Sedmak, Marko P. Rakin, Nina M.  
Anđelić, Đorđe D. Đurđević  
THERMO MECHANICAL WELDING PROCESS - FRICTION STIR WELDING

**G2** *Chairs: Borislav Gajić, Božidar Jovanović*

G2a: Borislav Gajić, Božidar Jovanović  
ON TWO INTEGRABLE NONHOLONOMIC ROLLING BALL PROBLEMS

G2b: Dragan Rakić, Miroslav Živković, Milan Bojović  
ELASTIC-PLASTIC CONSTITUTIVE MODEL FOR COHESIONLESS  
GRANULAR MATERIALS

G2c: Sreten Mastilović  
SHATTERING IMPACT FRAGMENTATION

G2d: Sreten Mastilović  
EFFECTS OF LATERAL CONFINEMENT ON PHENOMENOLOGY OF NANO-  
SCALE IMPACT FRAGMENTATION

G2e: Ivica Čamagić, Dragan Lazarević, Srđan Jović, Dragan Kalaba, Živče Šarkoćević  
ASSESSMENT OF THE SAFETY OF WELDED JOINTS FROM THE ASPECT OF THE FRACTURE MECHANICS APPLICATION

**G3** *Chairs: Milan Mićunović, Aleksandar Obradović*

G3a: B. Jeremić, R. Radulović, A. Obradović  
REALIZING BRACHISTOCHRONIC MOTION OF A VARIABLE MASS BODY BY CENTRODES

G3b: Emina Dzindo, Simon A. Sedmak, Milan Travica  
CRACK GROWTH AND FRACTURE OF WELDED STRUCTURE

G3c: Marko D. Topalović, Ljudmila T. Kudrjavceva, Milan V. Mićunović  
TEMPERATURE DEPENDENT ELASTO-VISCOPLASTIC MATERIAL MODEL FOR ASPHALT

### **Mechanics of Solid Bodies (S)**

**S1** *Chairs: Vladimir Lj. Dunić, Dragan I. Milosavljević*

S1a: Vladimir Lj. Dunić, Miroslav M. Živković, Snežana D. Vulović, Jelena M. Živković, Vladimir P. Milovanović  
PENALTY METHOD APPLIED TO STRUCTURAL STRENGTH ASSESSMENT OF THE AXIAL BALL JOINT

S1b: Marija M. Rafailović, Miroslav M. Živković, Jelena M. Živković, Milan Lj. Bojović, Vladimir P. Milovanović  
CORRECTION OF THE STRAIN FIELD OF LINEAR TETRAHEDRAL FINITE ELEMENT USING STRAIN SMOOTHING METHOD

S1c: Emilija V. Damnjanović, Miroslav S. Marjanović  
THREE-DIMENSIONAL STRESS ANALYSIS OF LAMINATED COMPOSITE PLATES USING FLWT-BASED FINITE ELEMENTS

S1d: Milena N. Rajić, Dragan B. Jovanović, Dragoljub S. Živković  
STRESS AND DEFORMATION STATE IN FURNACE TUBE, SMOKE TUBES AND TUBE PLATE OF THE HOT WATER BOILER

S1e: Dragan I. Milosavljević, Žmindać Milan, Aleksandar Radaković  
EXTENSIONAL WAVE PROPAGATION IN UNIDIRECTIONAL FIBRE REINFORCED COMPOSITE PLATE

S1f: Nevena A. Arandjelović, Buljak V. Vladimir  
FEM ANALYSIS OF CORONARY STENT DEPLOYMENT

**S2** *Chairs: Slaviša Šalinić, Vladimir Stojanović,*

S2a: Lidija Z. Rehlicki Lukešević, Marko B. Janev, Branislava B. Novaković,  
Teodor M. Atanacković  
BIFURCATION ANALYSIS FOR A BIMODAL CASE OF A BEAM ON  
WINKLER FOUNDATION

S2b: Slaviša Šalinić, Aleksandar Nikolić  
QUASI-STATIC RESPONSE OF PLANAR PARALLEL-CONNECTION  
FLEXURE HINGES MECHANISM

S2c: Nikola Despenić, Predrag Kozić  
VIBRATION OF A FREE BEAM RESTING ON AN INFINITE KERR TYPE  
FOUNDATION

S2d: Dragan B. Jovanović  
POTENTIAL STRAIN ENERGY SURFACES AT THE CRACK TIP VICINITY

S2e: Vladimir Stojanović, Dunja Milić, Marko D. Petković  
STABILIZING EFFECTS OF CURVATURES IN NON-LINEAR VIBRATIONS  
OF COUPLED STRUCTURES

S2f: Ivan Pavlović, Ratko Pavlović, Predrag Kozić, Goran Janevski, Nikola Despenić  
STOCHASTIC STABILITY OF A BEAM ON PASTERNAK VISCOELASTIC  
FOUNDATION LAYER UNDER WIDEBAND EXCITATION

**S3** *Chairs: Zoran Perović, Stanko Ćorić*

S3a: Zoran B. Perović, Dragoslav M. Šumarac, Ivan Milojević  
MODEL FOR DAMAGE IN LOW-CYCLE FATIGUE ANALYSIS OF UNIAXIAL  
STRESS STATE

S3b: Petar R. Knežević, Dragoslav M. Šumarac, Zoran B. Perović, Ćemal Dolićanin,  
Zijah Burzić  
PREISACH MODEL FOR STRUCTURAL MILD STEEL UNDER MONOTONIC  
AXIAL LOADING

S3c: Svetlana M. Kostić, Biljana Deretić-Stojanović

COMPARISON OF DIFFERENT METHODS FOR VISCOELASTIC ANALYSIS OF COMPOSITE BEAMS

S3d: Stanko Ćorić

STABILITY ANALYSIS OF MULTI-STORY STEEL FRAMES SUBJECTED TO DIFFERENT AXIAL LOAD

S3e: Marija Lazović Radovanović, Biljana Deretić-Stojanović, Jelena Nikolić, Janko Radovanović

EXPERIMENTAL TESTING OF AXIAL LOAD CAPACITY AND STABILITY OF CIRCULAR CFT COLUMNS

S3f: Marina Ćetković

FINITE ELEMENT MODEL OF IMPERFECT PLATE IN THERMAL ENVIRONMENT

**S4** Chairs: *Valentina Golubović-Bugarški, Marko Radišić*

S4a: Miloš Jočković, Gligor Radenković, Marija Nefovska-Danilović

FREE VIBRATION ANALYSIS OF CURVED SPATIAL BEROULLI-EULER BEAM WITH CIRCULAR CROSS SECTION USING ISOGEOMETRIC APPROACH

S4b: A. Borković, G. Radenković, V. Golubović-Bugarški, S. Milovanović, D. Majstorović, O. Mijatović

FREE VIBRATION ANALYSIS OF A CURVED BEAM BY THE ISOGEOMETRIC AND EXPERIMENTAL APPROACH

S4c: Marko Radišić, Emilija Damnjanović, Mira Petronijević

VIBRATIONS OF MASSLESS FLEXIBLE STRIP ON VISCO-ELASTIC HALF-SPACE

S4d: Nevena A. Arandjelović, Mihailo P. Lazarević

COMPARATIVE ANALYSIS OF THE STANDARD LINEAR SOLID MODEL

S4e: Nataša Trišović, Mirjana Misita, Wei Li, Ana Petrović, Zaga Trišović

PROBABILISTIC APPROACH IN THE DYNAMIC REANALYSIS

**S5** Chairs: *Dragan Jovanović, Srđan Jović*

S5a: Marija D. Milojević, Marija T. Nefovska-Danilović, Miroslav S. Marjanović  
FREE VIBRATION ANALYSIS OF MULTIPLE CRACKED FRAMES USING  
DYNAMIC STIFFNESS METHOD

S5b: Srđan Jović, Živče Šarkoćević, Dragan Lazarević, Branko Pejović, Jasmina  
Dedić  
ANALYSIS OF THE EFFECT TEMPERATURE CHANGES HAVE ON  
BUCKLING OF SLENDER BEAMS UNDER STATIONARY CONDITIONS

S5c: Nikola Nešić, Dragan Jovanović, Goran Janevski, Dušan Stojiljković, Srđan  
Jović  
TRANSVERSAL VIBRATION OF THIN CRACKED BEAMS: EXPERIMENTS,  
THEORY AND NUMERICS

**Fluid Mechanics (F)**

**F1** Chairs: *Ivan Kostić, Kristina Kostadinović Vranešević*

F1a: Iva I. Guranov, Snežana S. Milićev, Nevena D. Stevanović  
PRESSURE DISTRIBUTION IN MICROTUBES WITH VARIABLE CROSS  
SECTION

F1b: Kristina Kostadinović Vranešević, Anina Glumac, Ulf Winkelmann  
PRESSURE FIELD ANALYSES OF A LOW-RISE BUILDING MODEL  
SURROUNDED BY NEIGHBOURING BUILDINGS IN URBAN AREAS

F1c: J. Sobot, I. Kostić, O. Kostić  
CFD EVALUATION OF TRANSONIC FLOW ANALYSIS AROUND JET  
TRAINER AIRCRAFT

**Control and Robotics (C)**

**C1** Chairs: *Sreten Stojanović, Jelena Vidaković*

C1.a: Sreten B. Stojanović, Milos M. Stevanović, Milan S. Stojanović, Dragutin LJ.  
Debeljković  
FINITE-TIME STABILITY OF CONTINUOUS-TIME SYSTEMS WITH  
INTERVAL TIME-VARYING DELAY

C1b: Miloš M. Živanović

CONTINUOUSLY DIFFERENTIABLE VELOCITY CONTROL OF A MECHANICAL SYSTEM BASED ON SECOND-ORDER DECOMPOSITION PRINCIPLE

C1c: Petar D. Mandić, Mihailo P. Lazarević, Tomislav B. Šekara, Marko Č. Bošković, Guido Maione

ROBUST CONTROL OF ROBOT MANIPULATORS USING FRACTIONAL ORDER LAG COMPENSATOR

C1d: Petar D. Mandić, Mihailo P. Lazarević

FRACTIONAL ORDER VISCOUS FRICTION MODEL IN ROBOTIC JOINTS

C1e: Jelena Z. Vidaković, Vladimir M. Kvrđić, Mihailo P. Lazarević, Zoran Z. Dimić

DEVELOPMENT OF THE ALGORITHMS FOR SMOOTHING OF TRAJECTORIES OF A ROLL AND A PITCH AXIS OF A CENTRIFUGE MOTION SIMULATOR

## **Interdisciplinary Areas (I)**

**I1** *Chairs: Miodrag Zigić, Predrag Elek*

I1a: Miodrag Zigić, Nenad Grahovac, Lothar Heinrich

FOUR COMPARTMENT PHARMACOKINETIC MODEL FOR TRANSDERMAL DRUG TRANSPORT

I1b: Milica M. Glavšić, Predrag M. Elek

NUMERICAL ANALYSIS OF MINE BLAST ACTION ON A VEHICLE

I1c: J. Sobot, M. Jovanović

ANALYSIS OF THE IMPACT OF AILERON DEFLECTION ON AIRCRAFT SPIN

I1d: O. Ristić, D. Ristić

NUMERICAL CALCULATION OF GRID FINS IN SUBSONIC FLIGHT REGIME

I1e: Nemanja D. Zorić, Radoslav D. Radulović, Vladimir M. Jazarević

DEVELOPMENT OF SMALL ELECTRIC FIXED-WING vtol uav

**M1 Minisymposium – Nonlinear dynamics**

**Organizers:** *Katica R. (Stevanović) Hedrih, Ivana Atanasovska  
Mathematical Institute SASA, Belgrade*

**M1\_1** *Chairs: Katica R. (Stevanović) Hedrih, Ivana Atanasovska*

M1p\*: Alexander N. Prokopenya (*Invited lecture*)

DYNAMICS OF A BLOCK ON A HORIZONTAL ROUGH PLANE WITH  
VARIABLE COEFFICIENT OF FRICTION

M1a: Katica R. (Stevanović) Hedrih

DYNAMICS OF A ROLLING HEAVY BALL ALONG CURVILINEAR TRACE  
IN VERTICAL PLANE

M1b: Georgios Vasileiou

CAN A MODIFIED MATHIEU - DUFFING OSCILLATOR SIMULATE THE  
DYNAMIC TRANSMISSION ERROR OF A GEAR PAIR?

M1c: M. Minglibayev, A. Prokopenya, O. Baisbayeva

EVOLUTION EQUATIONS OF TRANSLATIONAL-ROTATIONAL MOTION  
OF A TRIAXIAL BODY WITH CONSTANT DYNAMICAL SHAPE AND  
VARIABLE SIZE IN A NON-STATIONARY CENTRAL GRAVITATIONAL  
FIELD

M1d: Ljubinko B. Kevac, Mirjana M. Filipović, Živko D. Stikić

CONSTRUCTIVE STABILITY (INSTABILITY) OF THE SYSTEM

M1e: Marina Trajković-Milenković, Otto T. Bruhns

LOGARITHMIC RATE IMPLEMENTATION IN NUMERICAL ANALYSIS OF  
FINITE MONOTONIC AND SMALL CYCLIC ELASTOPLASTIC  
DEFORMATIONS

**M1\_2** *Chairs: Alexander Prokopenya, Mirjana Filipović*

M1f: Stevan R. Maćešić, Željko D. Čupić, Milorad M. Anđelković, Ana D.  
Stanojević, Vladimir M. Marković, Ljiljana Z. Kolar-Anić

REACTION PATHWAYS IN A MODEL WITH TWO SOURCES OF THE  
REACTANT

M1g: Ana Ivanović-Šašić, Željko Čupić, Stevan Maćešić, Ljiljana Kolar-Anić

POSSIBLE DYNAMIC STATES OF THE ACID SOLUTION OF IODIDE AND HYDROGEN PEROXIDE

M1h: Sreten Stojanović, Milos M. Stevanovic, Milan S. Stojanovic, Dragutin LJ. Debeljkovic

FINITE-TIME STABILITY OF DISCRETE-TIME SYSTEMS WITH INTERVAL TIME-VARYING DELAY

M1i: R. Radulović, B. Jeremić, A. Obradović

REALIZATION OF THE BRACHISTOCHRONIC MOTION OF A NONHOLONOMIC VARIABLE MASS MECHANICAL SYSTEM BY IDEAL HOLONOMIC CONSTRAINT

M1j: Mirjana M. Filipović

MATHEMATICAL MODEL OF VIBRATORY CONVEYORS MECHANISM FOR GRANULAR MATERIAL

M1k: Jelena M. Djoković, Ružica R. Nikolić, Saša M. Kalinović, ANALYSIS OF BEHAVIOR OF THE INTERFACE CRACK THAT IS APPROACHING THE THREE-MATERIAL JOINT

**M1\_3** *Chairs: Ivana Atanasovska, Jelena Đoković*

M1l: Ivana D. Atanasovska, Dejan B. Momcilovic, Snezana D. Vulović

THE INFLUENCE OF GROOVES ON THE BEHAVIOR OF STEEL TUBE SHOCK ABSORBERS

M1m: Danilo Karličić, Milan Cajić, Sondipon Adhikari

BIFURCATION ANALYSIS OF BASE EXCITED HARMONIC OSCILATOR WITH NONLINEAR ENERGY SINK

M1n: Branislav Milenković

MULTIFACTOR ANALYSIS OF DYNAMICS OF THE SLIDER-CRANK MECHANISM

M1o: Đorđe Jovanović

SCIENTIFIC CALCULATION: EXAMPLE OF GRAPHIC REPRESENTATION FOR MAIN FRACTIONAL ORDER MODES OF FRACTIONAL TYPE FORCED VIBRATIONS USING CONVOLUTIONAL INTEGRAL – *student work*

M1r: Stepa M. Paunović

HOLOGRAPHY IN PHOTOELASTICITY – AN OVERVIEW AND A BRIEF REVIEW OF PROF. VLATKO BRČIĆ'S CONTRIBUTION TO THIS FIELD

## **M2 Minisymposium - Bionengineering**

**Organizer:** *Nenad Filipović, Faculty of Eng.,  
Univer. of Kragujevac, BioIRC, Kragujevac*

**M2\_1** *Chairs: Nenad Filipović, Gordana Jovičić*

M2a: Aleksandar Milovanović, Igor Saveljić, Nenad Filipović, Slobodan Savić  
3D RECONSTRUCTION AND NUMERICAL CALCULATION OF  
FRACTIONAL FLOW RESERVE IN ATHEROSCLEROTIC CORONARY  
ARTERIES

M2b: Igor Saveljić, Dalibor Nikolić, Tijana Djukić, Nenad Filipović  
NUMERICAL MODEL OF THE BIO MOLECULAR PARAMETERS TRANSFER  
THROUGH THE CORONARY ARTERY WALL

M2c: Gordana Jovičić, Smiljana Djorović, Arso Vukicević, Nenad Djordjević,  
Nenad Filipović  
INTEGRITY ASSESSMENT OF HUMAN MANDIBLE BY USING FAILURE  
CRITERIA

M2d: Dejan A. Milenković, Ana D. Amić, Zoran S. Marković, Žiko B. Milanović  
STRUCTURE AND REACTIVITY OF FOLIC ACID

M2e: Dejan Milenković, Dušan S. Dimić, Jasmina M. Dimitrić-Marković, Zoran S.  
Marković  
THE MECHANISTIC STUDY OF THE HYDROGEN ATOM ABSTRACTION  
BETWEEN OCTOPAMINE/NOREPINEPHRINE AND DPPH

M2f: Dalibor Nikolić, Igor Saveljić, Nenad Filipović  
COMBINING NUMERICAL METHODS AND PARAMETRIC OPTIMIZATION  
OF STENT DESIGN

**M2\_2** *Chairs: Miljan Milošević, Jelena Đorović*

M2g: Jelena R. Đorović, Svetlana R. Jeremić, Zoran S. Marković, Dušan Dimić,  
Marijana Stanojević-Pirković  
ASSESSMENT THE POTENTIAL OF 1,2,4-TRIHYDROXYXANTHONE TO  
INHIBIT P-GLYCOPROTEIN

M2h: Jelena R. Đorović, Dejan A. Milenković, Ljubinka G. Joksović, Milan D.  
Joksović, Zoran S. Marković

PROTEIN-LIGAND INTERACTIONS BETWEEN SELECTED TRIAZOLE COMPOUND AND FAD-LINKED SULFHYDRYL OXIDASE ALR

M2i: Bogdan Milićević, Raffaella Santagiuliana, Miljan Milošević, Vladimir Simić, Bernhard Schrefler, Miloš Kojić

COMPUTATIONAL PROCEDURE FOR COUPLING OF TUMOR GROWTH AND DRUG DISTRIBUTION MODEL

M2j: Miljan Milošević, Dusica Stojanović, Vladimir Simić, Bogdan Milićević, Andjela Radisavljević, Petar Uskoković, Miloš Kojić

NUMERICAL MODELS FOR DRUG RELEASE FROM DRUG-LOADED NANOFIBERS

M2k: Miloš Radović, Arso Vukićević, Alen Zabotti, Vera Milić, Salvatore De Vita, Nenad Filipović

DEEP LEARNING BASED APPROACH FOR THE ASSESSMENT OF PRIMARY SJÖGREN'S SYNDROME FROM SALIVARY GLAND ULTRASONOGRAPHY IMAGES

**M2\_3** *Chairs: Tijana Djukić, Miljan Milošević*

M2l: Smiljana M. Djorović, Igor B. Saveljić, Nenad D. Filipović,

COMPUTATIONAL MODELLING OF CAROTID ARTERY AND SIMULATION OF PLAQUE PROGRESSION

M2m: Tijana Djukić, Miloš Radović, Danijela Cvetković, Nenad Filipović

NUMERICAL SIMULATION OF THE INFLUENCE OF THE ELECTROMAGNETIC FIELD ON CANCER CELL LINES

M2n: Vladimir Simić, Miljan Milošević, Bogdan Milićević, Miloš Kojić

APPLICATION OF THE CSFE FINITE ELEMENT IN LIVER MODEL WITH TUMORS

M2o: Žiko B. Milanović, Edina H. Avdović, Srećko R. Trifunović, Svetlana R. Jeremić, Zoran S. Marković

INVESTIGATION INTERACTION BETWEEN A PALLADIUM (II) COMPLEXES WITH A COUMARIN LIGANDS AND SUBSTANCE P-RECEPTOR

M2p: Žiko B. Milanović, Edina H. Avdović, Srećko R. Trifunović, Zoran S. Marković

MOLECULAR DOCKING AND MOLECULAR DYNAMIC INVESTIGATION OF INTERACTIONS BETWEEN THYROID HORMONE RECEPTOR ALPHA (TR-ALPHA) AND NEW COUMARINE DERIVATIVES

**M2\_4** *Chairs: Žarko Milošević, Nenad Filipović*

M2r: Ana Vulović, Milašinović Danko, Dragan Sekulić, Aleksandar Tomić, Nenad Filipović

NUMERICAL ANALYSIS OF BLOOD FLOW IN FEMORAL ARTERIES - PATIENT SPECIFIC CASE

M2s: Vladimir Geroski, Milos Kojić, Miljan Milošević, Vladimír Simić, Bogdan Milićević, Nenad Filipović

COUPLED ELECTROPHYSIOLOGICAL AND MECHANICAL FINITE ELEMENT MODEL OF THE HEART WALL

M2t: Žarko Milošević, Dalibor Nikolić, Ana Vulović, Nenad Filipović

HOLOGRAM AND AUGMENTED REALITY BIOMECHANICAL MODELS OF A VIRTUAL BALANCE PHYSIOTHERAPIST

M2u: Aleksandra Vulović, Nenad Filipović

EFFECT OF THE FEMORAL BONE MATERIAL PROPERTIES ON THE NUMERICAL SIMULATION RESULTS

M2v: Tijana Šušteršič, Gorkem Muttalip Simsek, Nihal Engin Vrana, Nenad Filipović

COMPUTATIONAL MODELLING OF CORROSION PROCESS IN MEDICAL IMPLANT SURFACES

M2z: Marko N. Živanović, Dalibor D. Nikolić, Nenad D. Filipović

USE OF POLYETHYLENE GLYCOL AND POLYCAPROLACTONE IN 3D-BIOPRINT SCAFFOLD PRODUCTION

**M3 Minisymposium – Turbulence**

*Organizer: Đorđe Čantrak, University of Belgrade, Faculty of Mech. Eng.*

**M3\_1** *Chairs: Aleksandar Čočić, Dejan Cvetinović*

M3a: Andrea Ianiro, (*Invited lecture*)

SOME THOUGHTS ON THE MEANINGFULNESS OF INSTANTANEOUS HEAT TRANSFER MAPS IN TURBULENT FLOWS

M3b: Đorđe M. Novković, Jela M. Burazer, Aleksandar S. Čočić, Milan R. Lečić,  
IMPLEMENTATION OF HAMB  $k$ - $\varepsilon$  TURBULENCE MODEL IN OPENFOAM  
SOFTWARE

M3c: Milan M. Raković, Aleksandar S. Čočić, Milan R. Lečić,  
NUMERICAL STUDY ON AERODYNAMIC DRAG REDUCTION OF A  
TRACTOR-TRAILER MODEL

M3d: Jelena Svorcan, Marija Baltić, Toni Ivanov, Ognjen Peković, Milica Milić,  
NUMERICAL EVALUATION OF AERODYNAMIC LOADS AND  
PERFORMANCES OF VERTICAL-AXIS WIND TURBINE ROTOR

M3e: Dejan B. Ilić, Djordje S. Čantrak, Novica Z. Janković, Milan Pajić,  
EXPERIMENTAL INVESTIGATIONS OF THE FLOW UNIFORMITY AND JET  
DEVELOPMENT ON THE FREE JET CALIBRATION WIND TUNNEL

**M3\_2** Chairs: *Jelena Svorcan, Dejan Ilić*

M3f: Dejan Cvetinović, Rastko Jovanović, Jiří Vejražka, Jaroslav Tihon, Kazuyoshi  
Nakabe, Kazuya Tatsumi,  
MATHEMATICAL MODELLING OF VORTEX STRUCTURES OF THE  
TURBULENT AXISYMMETRIC AIR JET MODIFIED BY LOW-AMPLITUDE  
OSCILLATIONS

M3g: Suzana Lj. Linić, Bojana M. Radojković, Marko D. Ristić, Ivana V. Vasović,  
ONE METHOD FOR ORDERING TURBULENCE MEASURING PLACES  
APPLIED TO FREE-CONVECTION FLOW AROUND THERMAL PLANT  
COAL MILL

M3h: Mohammad Sakib Hasan, Jelena Svorcan, Aleksandar Simonović, David  
Daou, Bojan Perić,  
CFD ANALYSIS OF A HIGH ALTITUDE LONG ENDURANCE UAV WING

M3i: Bojan Perić, Aleksandar Simonović, Aleksandar Kovačević, Dragoljub  
Tanović, Miloš Vorkapić,  
NUMERICAL ANALYSIS OF AERODYNAMIC PERFORMANCE OF  
OFFSHORE WIND TURBINE

M3j: Jelena T. Ilić, Novica Z. Janković, Slavica S. Ristić, Đorđe S. Čantrak,  
UNCERTAINTY ANALYSIS OF 3D LDA SYSTEM

**M4: Mini-symposium- Waves and diffusion in complex media**

Organizers: *Milan Cajić, Danilo Karličić, MI SASA, Belgrade*

*Zhuojia Fu, College of Mech. and Materials, Hohai University, Nanjing, China*

**M4\_1** *Chairs: Trifce Sandev, Zhuojia Fu*

M4a: Zhuojia Fu, Liwen Yang, Qiang Xi

SELF-REGULARIZATION SINGULAR BOUNDARY METHOD FOR WAVE PROPAGATION ANALYSIS UNDER HOMOGENEOUS SOLID CONTAINING MULTIPLE INCLUSIONS

M4b: Ji Lin, Yongxing Hong, Alexander H.-D. Cheng,

A LOCALIZED MESHLESS SCHEME COMBINED WITH A SELF-CORRECTING PREDICTION MODEL TO SIMULATE THERMAL FIELD IN PIPE COOLING CONCRETE STRUCTURE

M4c: Aleksandar Tomović, Slaviša Šalinić, Aleksandar Obradović, Mihailo Lazarević, Zoran Mitrović,

THE EXACT NATURAL FREQUENCY SOLUTION OF A FREE AXIAL-BENDING VIBRATION PROBLEM

M4d: Qiang Xi, Zhuojia Fu, Nikola Spasojević, Dušan Zorica,

FRACTIONAL HEAT CONDUCTION EQUATION ON BOUNDED TWO-DIMENSIONAL DOMAIN

M4e: Milan Cajić, Stepa Paunović, Danilo Karličić, Sondipon Adhikari,

BAND STRUCTURE OF FRACTIONALLY DAMPED PHONONIC CRYSTALS

M4f: Marija Stamenković Atanasov, Vladimir Stojanović,

FORCED VIBRATION OF THE UNDAMPED ROTATING NANOBEAM

**M4\_2** *Chairs: Ji Lin, Milan Cajić*

M4g: Trifce Sandev, Alexander Lomin, Ljupco Kocarev,

DIFFUSION AND RANDOM SEARCHES ON COMB STRUCTURES

M4h: Qiang Xi, Zhuojia Fu,

INVERSE CAUCHY PROBLEMS OF STEADY HEAT CONDUCTION IN 3D FUNCTIONALLY GRADED MATERIALS BY A SEMI-ANALYTICAL BOUNDARY COLLOCATION SOLVER

M4i: Dongbao Zhou, Yong Zhang, Hongguang Sun,  
APPLICATION OF TIME FRACTIONAL MOBILE-IMMOBILE MODEL IN SIMULATING NON-FICKIAN TRANSPORT IN SELF-AFFINE FRACTURES OF A NON-UNIFORM AFG CANTILEVER BEAM WITH A TIP BODY

M4j: Danilo Karličić, Milan Cajić, Stepa Paunović, Sondipon Adhikari,  
DYNAMICS OF NONLINEAR VISCO-ELASTIC METASURFACE WITH BOUC-WEN HYSTERESIS

M4k: Stepa Paunović, Milan Cajić, Danilo Karličić,  
INFLUENCE OF THE ATTACHED MASSES ON THE DYNAMIC RESPONSE OF A CANTILEVER BEAM UNDER AN IMPULSE SUPPORT MOVEMENT

M4l: Nikola Nešić, Milan Cajić, Danilo Karličić,  
FRACTIONALLY DAMPED NONLINEAR PARAMETRIC VIBRATION OF A FUNCTIONALLY GRADED NONLOCAL BEAM

## **M5 Biomechanics and Mathematical Biology**

(Organizers: *Andjelka Hedrih, MI SASA, Belgrade,*  
*Ricardo Ruiz Baier, MI, Oxford University, UK*)

**M5\_1** Chairs: *Ljiljana Z. Kolar-Anić, Ricardo Ruiz Baier*

M5a: Ricardo Ruiz Baier, Alessio Gizzi, Alessandro Loppini  
MODELLING CARDIAC BIOMECHANICS USING STRESS-ASSISTED DIFFUSION AND THERMO-ELECTRIC EFFECTS

M5b: Jochen Mau,  
THEORY OF FUNCTIONAL AGING IN HIERARCHICAL DYNAMICS

M5c: Ivana D. Atanasovska, Dušan Šarac, Nenad Mitrović  
THE FINITE ELEMENT ANALYSIS OF DENTAL IMPLANT INFLUENCE ON STRAIN STATE IN JAWBONE

**M5\_2** Chairs: *Jochen Mau, Ivana Atanasovska*

M5d: Željko D. Čupić, Ljiljana Z. Kolar-Anić, Stevan R. Maćešić, Johannes W. Dietrich  
ANALYSIS OF COMPLEX STOICHIOMETRIC NETWORKS – hpt AXIS

M5e: Ljiljana Z. Kolar-Anić, Željko D. Čupić, Ana Stanojević, Johannes W. Dietrich  
ON THE MODELLING OF COMPLEX NONLINEAR PROCESS: THYROID  
HORMONE SYNTHESIS

M5f: Andjelka N. Hedrih, Katica (Stevanović) Hedrih,  
FRACTIONAL ORDER FORCED OSCILLATORY MODES OF ELEMENTS OF  
THE MITOTIC SPINDLE

M2t Zarko Milosevic<sup>1,2</sup>, Dalibor Nikolic<sup>1,2</sup>, Ana Vulovic<sup>1,2</sup> and Nenad Filipovic<sup>1,2</sup>  
 HOLOGRAM AND AUGMENTED REALITY BIOMECHANICAL MODELS OF  
 A VIRTUAL BALANCE PHYSIOTHERAPIST

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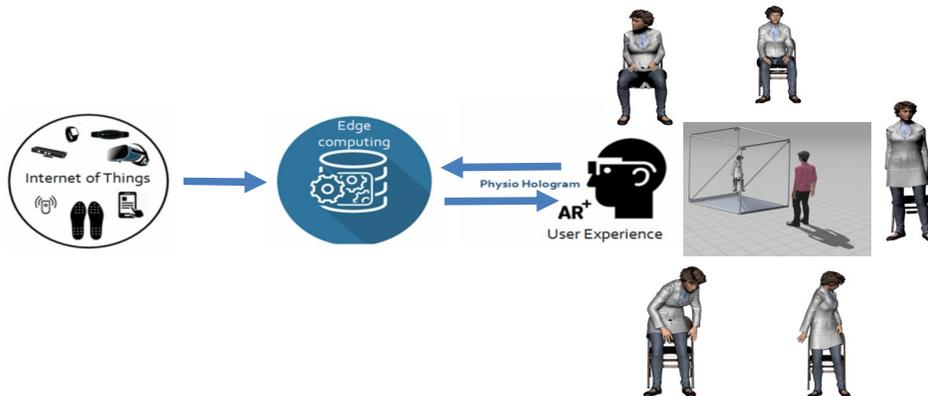
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**Abstract:**

Human balance is multifactorial and relies on the complex integration of visual, somatosensory, vestibular information and musculoskeletal function. Currently there is a lack of personal coaching options in population with balance disorders. Due to the delicate nature of the disorder personal coaching in the patients it is necessary to help recover balance and increase activity. Personal coaching allows them to engage into motion exercises, decreasing their fear of physical activity, motion and giving them motivation to become more active. The overall objective is to develop and validate a new personalized hologram coach platform for virtual training exercises. Platform that consists from a hologram based surrogate, augmented reality cognitive game followed by auditory exercises and physical activity planner. First demo represent virtual coach with mocked edge server presenting the sitting exercise (Fig. 1). When the session begins, the hologram physio sits in front of the patient, provides the instructions and shows the exercise. Then the hologram sits close to the patient, at his left, and the patient can see it when he looks at the direction where the hologram physio is. At the end, and without interruptions during the exercise, the hologram verbally asks the patient about his symptoms and provides a reward.

First prototype architecture demonstrate capability of proposed approach to establish communication between virtual coach and edge computer responsible to estimate patient condition based on which virtual coach will make interruptions and promote accessible interaction. It was applied to mobile phone with headset equipment. With this augmented reality technology we expect to help patient at their home for physiotherapy session.



**Fig. 1.** Overview of 3D hologram and augmented reality solution for virtual balance physiotherapist

**Keywords:** Augmented reality, Balance disorder, Cognitive training, physiotherapy

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M2u: **Aleksandra Vulović<sup>1,2,3</sup>**, **Nenad Filipović<sup>1,2,3</sup>**

### **EFFECT OF THE FEMORAL BONE MATERIAL PROPERTIES ON THE NUMERICAL SIMULATION RESULTS**

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### **Abstract:**

Application of the appropriate material properties is one of the major issues for any numerical simulation. This is especially noticeable in the numerical analyses that deal with bone models. The femoral bone consists of cortical and cancellous bone. Both types have complex material properties. Although it is known that realistic material properties lead to obtaining more realistic numerical results, these properties are usually simplified. Most commonly, both types are considered to be linear elastic, isotropic and homogeneous. Our aim was to analyze the mechanical behavior of the femoral bone and hip implant, using two types of material properties (isotropic and orthotropic cancellous bone material properties) during standing. For the evaluation of the effect that the material properties have on the results of the numerical simulation, the finite element method was used.

**Key words:** femoral bone, material properties, finite element analysis

### **1. Introduction**

Finite element model of the hip implant and the femoral bone provides opportunity to improve the design of the implant as well as its performance. The biggest challenge with the analysis of biological models is defining the appropriate material properties that can predict the behavior of the models. Femoral bone consists of cortical and cancellous bone that have different degree of porosity, strength and stiffness. Although, both types are known to be anisotropic, due to the complexity of the problem they are commonly considered to be homogeneous, linear elastic and isotropic. The goal was to analyze the effect that cancellous bone material properties have on the von Mises stress distribution in the femoral bone and the femoral implant during the standing.

### **2. Materials & Methods**