

Booklet of Abstracts

“1st International Conference on Mathematical Modelling in Mechanics and Engineering”

**Mathematical Institute of the Serbian Academy of Sciences and Arts
Belgrade, 08.-10. September 2022.**

Editors: Ivana Atanasovska, Milan Cajić, Danilo Karličić

Organized by:

**Mathematical Institute of the Serbian
Academy of Sciences and Arts**

**Faculty of Mechanical Engineering,
University of Belgrade**

**Faculty of Mechanical and Civil
Engineering in Kraljevo,
University of Kragujevac**

**Institute for Information Technologies,
University of Kragujevac**

Supported by:

**Ministry of Education, Science and
Technological Development of
the Republic of Serbia**

METALFER STEEL MILL, Serbia

SHIMADZU, Serbia

Belgrade, 2022

Booklet of abstracts “1st International Conference on Mathematical Modelling in Mechanics and Engineering”, Belgrade, 08.-10. September 2022.

Editors: Ivana Atanasovska, Milan Cajić, Danilo Karličić

Publisher: University of Belgrade - Faculty of Mechanical Engineering, Kraljice Marije 16, Belgrade, Serbia

For publisher: Prof. dr Vladimir Popović, Dean

FME editor: Prof. dr Dragoslava Stojiljković

Approved for printing by dean's decision No. 16/2022 dated 16.08.2022.

Print: CopyPlanet, Belgrade, Serbia

Circulation: 130 copies

Belgrade, 2022

ISBN 978-86-6060-127-0



CONFERENCE COMMITTEES

International Scientific Committee

Prof. Vladan Đorđević (Academician of the Serbian Academy of Sciences and Arts; Mathematical Institute SANU, Belgrade, Serbia)

Prof. Miloš Kojić (Academician of the Serbian Academy of Sciences and Arts, Serbia; The Methoist Hospital Research Institute, Houston, USA)

Prof. Miodrag Mihaljević (Academician of the Serbian Academy of Sciences and Arts; Mathematical Institute SANU, Belgrade, Serbia)

Prof. Isak Karabegović (Academician of the Academy of Sciences and Arts of Bosnia and Herzegovina)

Prof. Livija Cvetičanin (Faculty of Technical Sciences, University of Novi Sad, Serbia; Obuda University in Budapest, Hungary)

Prof. Sondipon Adhikari (University of Glasgow, UK)

Dr Zoran Ognjanović (Mathematical Institute SANU, Belgrade, Serbia)

Prof. Chiara Bisagni (Delft University of Technology, Netherland)

Prof. Emeritus Ljiljana Kolar Anić (Faculty of Physical Chemistry, University of Belgrade, Serbia)

Prof. Christos Spitas (School of Engineering and Digital Sciences, Department of Mechanical and Aerospace Engineering, Nazarbayev University, Kazakhstan)

Prof. Vitaly Samsonov, Lomonosov Moscow State University, Russia

Prof. Aleksandar Obradović (Faculty of Mechanical Engineering, University of Belgrade, Serbia)

Prof. Wei Li (School of Mathematics and Statistic, Xidian University, China)

Dr Andrea Ianero (Bioengineering and Aerospace Engineering Department, Carlos III University of Madrid, Spain)

Prof. Mihailo Lazarević (Faculty of Mechanical Engineering, University of Belgrade, Serbia)

Prof. Jelena Andrić (Volvo Group AB, Göteborg, Sweden)

Prof. Radoš Bulatović (Faculty of Mechanical Engineering, University of Montenegro)

Prof. Mihailo Jovanović (Viterbi School of Engineering, University of Southern California, USA)

Prof. Mile Savković (Faculty of Mechanical Engineering and Civil Engineering in Kraljevo, University of Kragujevac, Serbia)

Prof. Vasilios Spitas (National Technical University of Athens, Greece)

Prof. Miroslav Živković (Faculty of Engineering, University of Kragujevac, Serbia)

Prof. Saravanan Karuppanan (Mechanical Engineering Department, Universiti Teknologi PETRONAS, Malaysia)

Prof. Nenad Filipović (Faculty of Engineering, University of Kragujevac, Serbia)

Prof. Dongmei Huang (School of Mathematics and Statistic, Xidian University, China)

Prof. Nataša Trišović (Faculty of Mechanical Engineering, University of Belgrade, Serbia)

Prof. Tomaž Vuherer (Faculty of Mechanical Engineering, University of Maribor, Slovenia)

Prof. Radoslav Tomović (Faculty of Mechanical Engineering, University of Montenegro)

Prof. Mohd. Rizwanullah (Department of Mathematics, Manipal University Jaipur, India)

Dr Dejan Momčiloivć (Institute IMS, Belgrade, Serbia)

Prof. Dharmendra Tripathi (National Institute of Technology, Uttarakhand, India)

Prof. Santosh Patil (Manipal University Jaipur, India)



Prof. Radovan Bulatović (Faculty of Mechanical Engineering and Civil Engineering in Kraljevo, University of Kragujevac, Serbia)

Prof. Slaviša Šalinić (Faculty of Mechanical Engineering and Civil Engineering in Kraljevo, University of Kragujevac, Serbia)

Dr Zoran Jelić (Aerospace Engineering, Swansea University, UK)

Prof. Bojana Rosić (Applied Mechanics & Data Analysis group, University of Twente, Netherland)

Dr Ana Pavlović (Department of Industrial Engineering, University of Bologna, Italy)

Prof. Milan Bižić (Faculty of Mechanical Engineering and Civil Engineering in Kraljevo, University of Kragujevac, Serbia)

Dr Snežana Vulović (Institute of Information Technologies, University of Kragujevac, Serbia)

Prof. Jelena Svorcan (Faculty of Mechanical Engineering, University of Belgrade, Serbia; Center for Turbulence Research through a Fulbright grant Stanford University, USA)

Prof. Đorđe Čantrak (Faculty of Mechanical Engineering, University of Belgrade, Serbia)

Dr Ivana Atanasovska (Mathematical Institute SANU, Belgrade, Serbia)

Organizing Committee

Dr Ivana Atanasovska (Chair, Mathematical Institute SANU, Belgrade, Serbia)

Dr Danilo Karličić (Vice-Chair, Mathematical Institute SANU, Belgrade, Serbia)

Dr Milan Cajić (Vice-Chair, Mathematical Institute SANU, Belgrade, Serbia)

Dr Nataša Soldat (Academy of Applied Technical Studies Belgrade, Serbia)

Dr Ana Petrović (Faculty of Mechanical Engineering, University of Belgrade, Serbia)

Stepa Paunović (Mathematical Institute SANU, Belgrade, Serbia)

Ognjen Ristić (Institute IMS, Belgrade, Serbia)

Milica Milić (Faculty of Mechanical Engineering, University of Belgrade, Serbia)

Gordana Nastić (Mathematical Institute SANU, Belgrade, Serbia)

Dragan Aćimović (Mathematical Institute SANU, Belgrade, Serbia)



PREFACE

It's our pleasure to be the chairs of the '1st International Conference on Mathematical Modelling in Mechanics and Engineering', organized by the Mathematical Institute of the Serbian Academy of Sciences and Arts, and co-organized by the Faculty of Mechanical Engineering, University of Belgrade; the Faculty of Mechanical and Civil Engineering in Kraljevo, University of Kragujevac; and Institute for Information Technologies, University of Kragujevac. The conference will be held in hybrid form at the Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, Serbia, from 8th to 10th of September, 2022.

This conference is planned as the first event in the series of conferences which will be held every two or three years and bring together leading academic scientists, researchers and research scholars to exchange and share experience and research results on various aspects of mathematical modelling in mechanics and engineering. It will bring an interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, theories, algorithms, as well as practical challenges encountered and solutions adopted in the fields of Classical Mechanics, Solid and Fluid Mechanics, Computational Mechanics, Biomechanics, Applied Mathematics and Physics, Structural Mechanics and Engineering. A considerable number of prominent scientists and professors submitted their abstracts and confirmed their attendance at the conference. The scientists and researchers from different countries in Europe and the world (Netherlands, UK, Norway, Greece, Spain, USA, Kazakhstan, Italy, Montenegro, India, Malaysia, Slovenia etc.) also have confirmed participation at the conference. We expect that the conference presentations will cover modelling with analytical/numerical and data driven solutions to study complex media, composite aerospace and periodic structures and metamaterials, and capture essential features of linear and nonlinear dynamics and wave propagation behaviour that can lead to new designs of such systems. Some presentations will include new experimental setups to study engineering materials and novel control strategies based on classical or fractional derivative models used to control the dynamics of multibody, flexible and/or electromechanical systems. Finally, we believe that the sessions' discussions will have high potential to give significant contribution to the developments of new and advanced mathematical models of real-world engineering mechanical systems.

We're very proud to announced that the number of accepted contributions to be presented at this Conference is 106, with 7 plenary and 4 invited lecture presentations. We would like to express our gratitude to the institutions that support conference financially: The Ministry of education, science and technological development of the Republic of Serbia; METALFER STEEL MILL doo, Serbia; and SHIMADZU, Serbia. We are especially grateful to the members of the Scientific committee and participants who gave their contribution to this international scientific meeting with their advices and abstracts' reviews. We also thank to the support of the co-organizers of this Conference: The Faculty of Mechanical Engineering, University of Belgrade, Serbia; The Faculty of Mechanical and Civil Engineering in Kraljevo, University of Kragujevac, Serbia; and Institute for Information Technologies, University of Kragujevac, Serbia.

We hope that this conference will be success beginning of a recognized series of international conference events during next decades. We use the opportunity to wish to all participants a successful presentation of their scientific results.

Cordially,

Ivana Atanasovska, Conference Chair
Milan Cajić, Conference Vice-Chair
Danilo Karličić, Conference Vice-Chair



CONTENTS

PLENARY LECTURES

MODELING OF STRUCTURAL MATERIALS	
H. Altenbach	17
FURTHER RESULTS ON ADVANCED CONTROL AND STABILITY ISSUES OF FRACTIONAL-ORDER DYNAMICAL SYSTEMS	
Mihailo P. Lazarević	18
MODELLING OF COMPOSITE STRUCTURES: USING BUCKLING FOR MORE FLEXIBLE AND SUSTAINABLE AIRCRAFT	
Chiara Bisagni	20
UNCERTAINITY QUANTIFICATION IN STRUCTUREAL DYNAMICS	
Sondipon Adhikari	21
ON THE GENERALITY OF SMEARED FINITE ELEMENT APPROACH TO MODEL FIELD PROBLEMS AND MECHANICS IN BIOLOGICAL TISSUE	
Miloš Kojić	22
MATHEMATICAL MODELS OF PURELY NONLINEAR OSCILLATORS: FROM SOLUTIONS TO PHENOMENA	
Ivana Kovacic	23
FEM-BASED REAL-TIME SIMULATIONS – VIRTUAL REALITY AT ITS BEST	
Dragan Marinkovic	24

INVITED LECTURES

SERPENTINE MOTION IN ROBOTICS: WIND CAR, TRIMARAN, SNAKEBOT	
Liubov A. Klimina, Marat Z. Dosaev and Yury D. Selyutskiy	27
ALGEBRAIC MESH GENERATION IN SPUR GEAR DRIVES	
Victor Roda-Casanova, Radu Andrei-Matei, and Francisco Sanchez-Marin	28
ENERGY BALANCE FOR FRACTIONAL WAVE EQUATIONS	
Dusan Zorica and Ljubica Oparnica	29
SYNTESIS FRAMEWORK FOR NEW BREED OF ROBOTS. SOFT LOCOMOTION ROBOTS	
Andrija Milojević	30

GENERAL SESSIONS

COMPUTATIONAL FRACTURE MECHANICS	
Aleksandar S. Sedmak	33
AGING OF SOLAR CELLS UNDER OPERATING CONDITIONS	
Vesna Trifunović-Dragišić	34
OPTIMIZATION OF ENGINEERING DESIGN PROBLEMS USING HONEY BADGER ALGORITHM	
Đorđe Jovanović, Branislav Milenković	35



EXTREMAL THRUST FOR BRACHISTOCHRONE PROBLEM O. Cherkasov, E.Malykh.....	37
COMPUTATIONAL MODELING OF AIR FLOW IN THE COOLING TOWER E. Berberović, S. Bikić	38
INHIBITORY POTENCY OF USNIC ACID TOWARD PHOSPHODIESTERASE TYPE 5 Jelena R. Đorović Jovanović, Svetlana R. Jeremić and Zoran S. Marković.....	39
TOWARDS NOVEL COMPUTATIONAL ROBUST GEAR TCA SOLUTION WITH PARAMETRIC STUDY OF MISALIGNMENTS AND PROFILE MODIFICATION Maksat Temirkhan, Hamza Bin Tariq, Konstantinos Kaloudis, Christos Kalligeros, Vasileios Spitas and Christos Spitas	40
DELAY DIFFERENTIAL EQUATIONS GOVERNING DYNAMICS OF A LANDSLIDE MECHANICAL MODEL Srđan D. Kostić, Nebojša T. Vasović	42
PARALLEL COMPUTATIONS IN FLUID DYNAMICS USING MULTICORE/MANYCORE PROCESSORS Ivan D. Tomanović, Srđan V. Belošević, Nenad Đ. Crnomarković, Aleksandar R. Milićević and Andrijana D. Stojanović	43
FRAMEWORK FOR MODELLING GENUINE GROUND REACTION FORCES DUE TO WALKING Vitomir Racić	45
SIMULATING FLOW IN SILICON Y-BIFURCATED MICROCHANNELS Jelena M. Svorcan, Milče M. Smiljanić and Miloš D. Vorkapić.....	46
FREE VIBRATIONS OF FGM PLATES WITH IMPERFECTIONS USING LAYERWISE FINITE ELEMENT Marina V. Cetkovic.....	47
A SIMULATION-INFORMED MODELING OF DEPTH OF PENETRATION OF RIGID RODS INTO QUASIBRITTLE SOLIDS Sreten Mastilovic	49
LES OF FLOW AROUND NACA 4412 AIRFOIL AT HIGH ANGLE-OF-ATTACK Jelena M. Svorcan and Kevin Patrick Griffin	50
PERFORMANCES OF REPAIRED HONEYCOMB SANDWICH PANEL Younes Djemaoune, Branimir Krstić.....	51
INHIBITION POTENCY OF 1,2,4-TRIHIDROXYANTHRAQUINONE AND 1,2,4- TRIHIDROXYXANTHONE TOWARD PENICILLIN-BINDING PROTEIN 1A Svetlana R. Jeremić, Jelena R. Đorović Jovanović and Zoran S. Marković.....	53
MODAL PARAMETERS IDENTIFICATION AND DYNAMIC PERFORMANCE OF A STEEL FOOTBRIDGE WITH A SIGNIFICANT 3D BEHAVIOUR Victor Roda-Casanova, David Hernandez, Joaquin L. Sancho-Bru and Maria D. Martinez-Rodrigo	54



GENERATIVE ADVERSARIAL NETWORKS FOR THE ESTIMATION OF 3D TURBULENT FIELDS WITH WALL-MEASUREMENTS Antonio Cuellar Martin, Alejandro Guemes, Andrea Ianiro, Oscar Flores, Ricardo Vinuesa, and Stefano Discetti	55
FEATURES OF BODY BALANCE ON HINGED AND MOVABLE SUPPORTS Marat Z. Dosaev, Vitaly A. Samsonov	58
ROTATION IN HORIZONTAL PLANE OF THE FRICTION-POWERED ROBOT WITH UNBALANCED ROTOR AND FLYWHEEL Marat Z. Dosaev, Vitaly A. Samsonov, Mikhail A. Garbuz.....	59
GALLOPING-BASED WIND POWER HARVESTER WITH SEVERAL MOVING MASSES Yury D. Selyutskiy, Andrei P. Holub, and Boris Ya. Lokshin	60
LIGHT-WEIGHT DESIGN OF AN OVERHEAD CRANE'S GIRDER WITH A NON- SYMMETRIC BOX CROSS-SECTION Goran V. Pavlović, Mile M. Savković, Radovan R. Bulatović, Nebojša B. Zdravković and Goran Đ. Marković	61
MATHEMATICAL MODELING OF THE CHAOTIC DYNAMICS OF POROUS NANOBEAMS INCLUDING GEOMETRIC NONLINEARITY AND ELASTIC-PLASTIC DEFORMATIONS Irina V. Papkova, Anton V. Krysko and Vadim A. Krysko	62
OPTIMIZATION OF ADHESIVE JOINTS BY TOPOLOGICAL OPTIMIZATION METHODS Pavel V. Dunchenkin, Anton V. Krysko, Maxim V. Zhigalov, Vadim A. Krysko	63
WRINKLING OF THIN ELASTIC FILMS ON COMPLIANT VISCOELASTIC SUBSTRATES UNDER COMPRESSIVE LOADS Jan Zavodnik and Miha Brojan.....	64
EQUILIBRIUM OPTIMIZER FOR OPTIMIZATION OF TRUSS STRUCTURE WITH DISCRETE DESIGN VARIABLES Hammoudi Abderazek and Ivana Atanasovska	65
OPTIMIZATION OF TURNING PROCESS PARAMETERS USING A HYBRIDE VOLUTIONARY ALGORITHM Hammoudi Abderazek, Aissa Laouissi, Mourad Nouioua, and Ivana Atanasovska	66
INVESTIGATION OF EEG SIGNALS OF PATIENTS WITH ALCOHOL DEPENDENCE BY METHODS OF NONLINEAR DYNAMICS Tatiana V. Yakovleva, Stanislav A. Galkin, Andrey Teryaev and Vadim A. Krysko	67
EFFECTS OF DYNAMIC ABSORPTION CAUSED TO CURVATURES IN GEOMETRY OF COUPLED NANO-STRUCTURES Marija Stamenković Atanasov, Ivan R. Pavlović	68
COMPLEMENTARY TOPOLOGICAL METHODS FOR THE ANALYSIS OF NONLINEAR TIME SERIES Miroslav Andjelkovic and Slobodan Maletic.....	69
WAVE PROPAGATION CHARECTERISTICS OF CURVED HEXAGONAL LATTICE S. Mukherjee, M. Cajić and S. Adhikari	70



DESIGN AND ANALYSIS OF BONE TISSUE SCAFFOLDS: A TWO-WAY FLUID STRUCTURE INTERACTION MODEL Rakesh Kumar, Harsha Pandey and Santosh Patil.....	71
ENSTROPHY IN TURBULENT SWIRLING FLOW IN PIPE Đorđe S. Čantrak, Novica Z. Janković and Dejan B. Ilić.....	72
ON SOME FEATURES OF THE LOSS OF STABILITY OF FLEXIBLE CYLINDRICAL NANOPANELS ON A RECTANGULAR PLAN Vadim A. Krysko-jr, Leonid A. Kalutsky, Svetlana A. Mitskievich and Tatiana V. Yakovleva.....	73
INFLUENCE OF STING PLUNGING OSCILLATIONS ON MEASUREMENT OF PITCH- DAMPING DERIVATIVES M. Samardžić.....	74
APPLICATION OF MARINE PREDATORS ALGORITHM IN DESIGN OF RAILWAY VEHICLES SUSPENSION MADE OF COIL SPRINGS Milan B. Bižić, Radovan R. Bulatović, Dragan Z. Petrović.....	75
ON EULERIAN-BASED APPROACH TO EVALUATE BLOOD MIXEDNESS IN THE PATIENT-SPECIFIC FONTAN CIRCULATION D. H. K. Gaillard, R. E. Bolt, F. M. Rijnberg, J. J. M. Westenberg, H. J. Lamb, M. G. Hazekamp, M. R. M. Jongbloed, A. A. W. Roest, J. J. Wentzel, and S. Kenjeres.....	77
ESTIMATION OF EXTREME LOADS ON A WIND TURBINE BLADE AT LARGE ANGLE-OF-ATTACK AND HIGH VELOCITY Dragoljub Tanović, Marija Baltić and Miloš Vorkapić.....	79
OPTIMIZATION OF SUPPLIER SELECTION USING ANALYTICAL HIERARCHY PROCESS IN FUZZY ENVIRONMENT Dr. Mohammad Rizwanullah, Dr. K.K. Kaanodiya.....	80
EFFECT OF MEASUREMENT NOISE ON MPC FOR DRAG REDUCTION L. Marra, A. Meilan-Vila, and S. Discetti.....	82
ON USING LMP LIMITERS IN SIMULATION OF GAS FLOW IN CONVERGING-DIVERGING NOZZLE BY RKDG METHOD Victoria N. Korchagova.....	85
CFD ANALYSIS OF PRESSURE DROP FROM THE AIR SIDE IN AUTOMOTIVE HEAT EXCHANGER USING POROUSMEDIA APPROACH Marija V. Milivojevic, Aleksandar S. Čočić, and Matej M. Tomic.....	86
CONCEPTUAL DESIGN OF SOLAR-POWERED HIGH-ALTITUDE LONG ENDURANCE AIRCRAFT Mohammad Sakib Hasan, Jelena Svorcan.....	87
PROSPECTS OF DRAFT GEAR MODELLING FOR TRAINS IN EUROPE Marija N. Vukšić Popović.....	88
LAYERED MODEL OF RED BLOOD CELL MEMBRANES AS VISCOELASTIC SHELLS Liliya Batyuk, Natalya Kizilova.....	89
EFFICIENT FLOW-FIELD DESIGN FOR PROTON EXCHANGE MEMBRANE FUEL CELLS	



Abdelhakim Merdjani, Natalya Kizilova.....	90
OPTIMIZATION OF COMPACT FRACTAL-TYPE HEATERS/COOLERS FOR AEROSPACE ENGINEERING	
Saiyadhasan Naqvi, Natalya Kizilova.....	91
WATER-DRIVEN POLUTIONS TRANSFER AND ACCUMULATION AT THE FLUID- SOLID INTERFACES	
Natalya Ruchak, Natalya Kizilova.....	92
INVESTIGATION OF SHAPE MEMORY ALLOYS CONSTITUTIVE MODELING	
Vladimir Lj. Dunić.....	93
PHYSIOLOGICAL LOADING AND ITS EFFECT ON STREAMING POTENTIAL GENERATED BY INTERSTITIAL FLUID FLOW INDISORDERED BONE'S CANALICULI	
Nikhil V. Shrivas, Abhishek K. Tiwari, Santosh Patil and Dharmendra Tripathi.....	94
NUMERICAL SIMULATION OF COLUMN BASE PLATE BEHAVIOR	
M.A Aichouche, A. Abidelah, Dj.D Kerdal and V. Dunić.....	96
NUMERICAL INVESTIGATION OF THE INFLUENCE OF GEOMETRY ON THE THERMAL PROPERTIES OF A HEAT PIPE	
Milica M. Ivanović, Toni D. Ivanov and Aleksandar M. Kovačević.....	97
AN OVERVIEW OF FORWARD DYNAMICS ALGORITHMS AND THEIR USE IN OPEN-SOURCE DYNAMICS ENGINES	
Nikola LJ. Zivkovic, Jelena Z. Vidakovic and Mihailo P. Lazarevic.....	98
STATICS OF THE FLEXIBLE MESHED CYLINDRICAL NANOSHELL IN THE TEMPERATURE FIELD	
E. Krylova.....	100
ANALYTICAL MODELING OF HARDNESS IN THE HEAT AFFECTED ZONE DURING WELDING A PLATES MADE OF STEEL P355GH BY GMAW PROCESS	
M. Rasinac, M. Bjelić, M. Miodragović, J. Perić.....	101
A REVIEW ON GROUND SOURCE HEAT PUMP	
Harsh Surana, Gourav Moonka, S P Akash, Dhananjay Singh Parmar and Dr. Hemant Raj Singh.....	102
ROUV HEADING BY A FRACTIONAL-ORDER PI CONTROLLER	
N. Svishchev, P. Lino, G. Maione, A. Rybakov, M.P. Lazarević.....	103
APPLICATION OF BIOLOGICAIHY INSPIRED ALGORITHMS FOR OPTIMIZATION IN MACHINING PROCESS	
Aleksandra V. Petrović, Stefan M. Pajović, Mladen S. Rasinac, Vladan R. Grković.....	104
NUMERICAL AND ANALYTICAL STUDY OF A BAR DAMPER DEVICE	
Andrija Zorić, Marina Trajković-Milenković.....	105
STABILITY OF PRESTRETCHED CIRCULAR COMPOSITE PLATES	
Miha Brojan, Jan Zavodnik.....	106
CAM PROFILE OPTIMIZATION FOR MINIMAL JERK	
Marko Todorović, Radovan Bulatović, Goran Marković, Marina Bošković, and Mile Savković.....	107
COMPUTED TORQUE CONTROL SIMULATION FOR 6DOF	



INDUSTRIAL ROBOT Jelena Z. Vidakovic, Mihailo P. Lazarevic, Nikola Lj. Zivkovic, Pavle Lj. Stepanic, and Stefan M. Mitrovic.....	109
MODELING, SIMULATION AND CONTROL OF PROPELLER DRIVEN SEESAW SYSTEM WITH ASYMMETRIC GEOMETRY USING PID CONTROLLER Aleksandar M. Kovačević, Jelena M. Svorcan and Toni D. Ivanov	111
UNMANNED AERIAL VEHICLE TRAJECTORY VISUALIZATION AND RECONSTRUCTION USING THE CHANGES IN SIGNIFICANT VARIABLES OVER TIME Milica P. Milic, Jelena Svorcan	112
WAVE ATTRACTORS IN LARGE ASPECT RATIO DOMAINS Stepan Elistratov, Ilias Sibgatullin, and Xu Xiulin.....	113
FEM ANALYSIS OF CONTINUOUS TRACKS Snežana D. Vulović, Miroslav M. Živković, Marko D. Topalović, Rodoljub S. Vujanac and Ana Pavlović	114
DEVELOPMENT OF INTERFACE FOR IMPLEMENTATION AND APPLICATION OF USER CONSTITUTIVE MODELS IN FEM SOFTWARE PAK Ljubica M. Milanović, Vladimir Lj. Dunić.....	115
APPLICATION OF ITERATIVE LEARNING CONTROL FOR PATH FOLLOWING OF 3DOFS ROBOT ARM Petar D. Mandić, Mihailo P. Lazarević, Tomislav B. Šekara, Guido Maione and Paolo Lino	116
CAN FULLY CERAMIC GEARS PROVIDE A FEASIBLE ALTERNATIVE TO THEIR STEEL COUNTERPARTS IN INDUSTRIAL APPLICATIONS G. Vasileiou, N. Rogkas, A. Markopoulos and V. Spitas.....	118
NUMERICAL COMPUTATIONS OF ELASTIC TORSION USING THE FINITE-VOLUME METHOD Aleksandar S. Čoćić.....	120
ANALYSIS OF CONTACT STIFFNESS IN ROLLING BALL BEARINGS WITH OUTER RING DAMAGE Nataša D. Soldat, Ivana D. Atanasovska	121
ANALYSIS AND OPTIMIZATION OF REGULAR T-SHAPED FRACTAL SYSTEM Abdulmuttalib A. MUHSEN	122
RAPID AND ACCURATE OPTIMISATION OF THE PARTICLE-IN-CELL MODELLING OF GRIDDED ION ENGINES Joseff I. Parke Sturrock, Zoran D. Jelic and Ben. J. Evans	123
ANALYSIS OF CROSSING AND VEERING PHENOMENA IN PLANAR FRAME STRUCTURES Marko A. Veg, Aleksandar M. Tomović and Aleksandar M. Obradović.....	124
NON-RECIPROCAL WAVE PROPAGATION IN PERIODICALLY STRUCTURED TIMOSHENKO BEAMS Nevena Rosić, Danilo Karličić, Milan Cajić and Mihailo Lazarević	125



NONLINEAR PERIODIC CHAINS WITH FRACTIONAL DAMPING Milan Čajić, Danilo Karličić, Stepa Paunović and Sondipon Adhikari.....	126
IMPROVING THE PERFORMANCE OF PIEZOELECTRIC FRACTIONALLY DAMPED DYNAMIC ABSORBERS FOR BRIDGES S. Paunović, M. Čajić and D. Karličić	127
COMPARATIVE STUDY OF FLUID TRANSPORTATION PROPERTIES OF REGULAR AND IRREGULAR FRACTAL-TYPE PIPELINES-A REVIEW Abdulmuttalib A. MUHSEN	128
EFFECT OF CENTRAL POINT ON THE ACCURACY OF A FRACTIONAL-ORDER MODEL IDENTIFICATION METHOD BASED ON THE PROCESS REACTION CURVE Juan J. Gude and Pablo García Bringas	129
NONLINEAR VIBRATIONS OF A CYLINDRICAL PIPE EMBEDDED IN A FRACTIONAL DERIVATIVE MEDIUM Marina V. Shitikova, Vladimir V. Kandu.....	131
NUMERICAL SIMULATION OF THE FRAME STRUCTURE DYNAMIC BEHAVIOR BY THE APPLICATION OF THE NONLOCAL IN TIME DAMPING MODEL Vladimir N. Sidorov, Elena S. Badina, Elena P. Detina, Marina V. Shitikova	132
SPECIAL SESSION 1	
FRACTIONAL ORDER PID CONTROL ON STRUCTURAL RELIABILITY OF STOCHASTIC DYNAMICAL SYSTEMS Wei Li, Lincong Chen, Junfeng Zhao and Natasa Trisovic.....	137
FLIGHT DYNAMICS MODELLING AND FLIGHT SIMULATION Petar Dimitrov.....	138
NON-LINEAR DYNAMICS OF A DAMAGED STIFFENED COMPOSITE LAMINATED PANEL Beatriz Henriques, Pedro Ribeiro and Marcelo F.S.F. de Moura	139
BIO-INSPIRED SHAPE OPTIMIZATION FOR STRUCTURAL RESISTANCE Renata Troian and Chunmei Liu.....	140
STOCHASTIC DYNAMICS OF A SNAP-THROUGH TRUSS OSCILLATOR Aasifa Rounak, Rohit Chawla and Vikram Pakrashi.....	142
THEORETICAL SOLUTIONS OF THE MULTI-STABLE ENERGY HARVESTERS Dongmei Huang, Shengxi Zhou	143
DYNAMIC ANALYSIS OF A THREE-DEGREE-OF-FREEDOM VIBRATION-IMPACT SYSTEM WITH RANDOM PARAMETERS Guidong Yang, Zicheng Lin, Xiaocheng Liu	144
DESIGN FOR INSPECTION AND SAFETY – NOVEL CONCEPT OF CABLING MACHINE Maja Čavić, Milan Kostić, Miodrag Zlokolica	145



MODELLING OPTIMIZATION FOR A COMPOSITE WING COMPONENT Ivana D. Atanasovska, Milica P. Milic and Nataša Trišović	147
--	-----

SPECIAL SESSION 2

EXAMINATION OF THE PHYSICAL-CHEMICAL AND MECHANICAL PROPERTIES OF HELICAL CYLINDRICAL COMPRESSION SPRINGS PRESERVED IN THE LEGACY IN THE NIKOLA TESLA MUSEUM Bratislav N. Stojiljković, Dejan B. Momčilović.....	153
NEURAL NETWORK MODEL FOR THE CONDITION ASSESSMENT OF HYDRO TURBINES Dragoljub Ilić, Dragan Milošević and Dejan B. Momčilović.....	154
OPTIMIZATION OF ALUMINOTHERMIC RAIL WELDING BY MODELING AND SIMULATION OF BASIC PARAMETERS OF THERMITE STEEL CASTING Milorad Gavrilovski, Alen Delić and Vaso Manojlović	155
FAILURE ANALYSIS OF BEAM OF UNMANNED AERIAL VEHICLE Milica Milić, Ivana Atanasovska, Ognjen Ristić and Dejan B. Momčilović	156
EXPERIMENTAL MECHANICS – VISION OF EXCELLENCE IN SCIENCE BY SHIMADZU Aleksandar Žurkić.....	157
SPONSORS	158

DEVELOPMENT OF INTERFACE FOR IMPLEMENTATION AND APPLICATION OF USER CONSTITUTIVE MODELS IN FEM SOFTWARE PAK

Ljubica M. Milanović¹, Vladimir Lj. Dunić¹

¹University of Kragujevac, Faculty of Engineering, 34000 Kragujevac, Serbia

Keywords: user model, FEM software, interface.

ABSTRACT

Researchers and engineers often have problems developing and implementing constitutive models for the simulation of the various materials into a Finite Element Method (FEM) based software. The reasons are complicated procedures and difficulties related to the features of the FEM software. This paper aims to describe the development of an interface for implementing and applying user constitutive models in FEM software PAK [1] for the structural analysis (Figure 1). First, this paper presents an overview of the possibilities of implementing user models in various FEM software [2] and the procedure of implementing constitutive models in 3D finite elements in PAK software. After that, the possibility of creating an interface for easy use of user subroutines for constitutive models intended for other FEM software was analyzed, and guidelines for developing one such interface in PAK software were given. Finally, the developed and implemented interface was tested for the selected constitutive model, and the implementation functionality was verified [3].

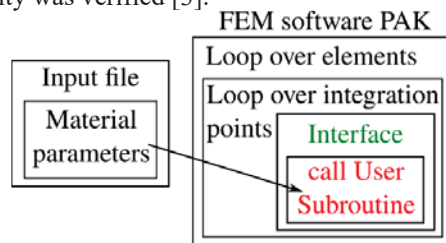


Figure 4 Scheme of the interface implementation into the FEM software PAK

REFERENCES

- [1] Kojić, M., Slavković, R., Živković, M., Grujović, N. (1999), “PAK-S, Program for FE structural analysis”, Programmers Manual Kragujevac, Serbia.
- [2] Abaqus 6.9-2 User Subroutines Reference Manual
- [3] Dunić, V., Slavković, R. (2020) “Implicit stress integration procedure for large strains of the reformulated Shape Memory Alloys material model”, *Continuum Mechanics and Thermodynamics*, 32, 5, 1287-1309

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

531/534(048)

51-7(048)

62(048)

INTERNATIONAL Conference on Mathematical Modelling in Mechanics and Engineering (1 ; 2022 ; Beograd)

Booklet of Abstracts / "1st International Conference on Mathematical Modelling in Mechanics and Engineering", Belgrade, 08.-10. September 2022. ; organized by Mathematical Institute of the Serbian Academy of Science and Arts ... [et al.] ; editors Ivana Atanasovska, Milan Cajić, Danilo Karličić. - Belgrade : University, Faculty of Mechanical Engineering, 2022 (Belgrade). - 157 str. : ilustr. ; 24 cm

Тираж 130. - Библиографија уз већину апстараката.

ISBN 978-86-6060-127-0

а) Механика -- Апстракти б) Примењена математика -- Апстракти в) Инжењерство -- Апстракти

COBISS.SR-ID 72444681