MS2022

1ST INTERNATIONAL CONFERENCE ON MECHANICS OF SOLIDS

FEUP, Porto - Portugal

3-4 November 2022

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BOOK OF ABSTRACTS

U.PORTO
FEUP FACULDADE DE ENGENHARIA
UNIVERSIDADE DO PORTO

Book of abstracts of the

1st International Conference on Mechanics of Solids 2022 (MS 2022)

Porto – Portugal
3-4 November 2022

EDIÇÃO

Quântica Editora, Lda.

www.quanticaeditora.pt

ISBN

9789899101555

www.quanticaeditora.pt

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PREFACE

The conference venue is the campus of the Faculty of Engineering of the University of Porto (FEUP), which offers excellent facilities for high quality scientific interactions. FEUP is located in the town of Porto in the Northern region of Portugal. Porto is a beautiful and lively city, steeped in history and rich in great experiences. With its magnificent location by the Atlantic coast, Porto is the city of the world famous Port Wine and the River Douro.

This conference is held every 2 years. The conference is chaired by Lucas F M da Silva and António Ferreira. The focus is on the mechanics of deformable solids, dynamics of particles and rigid bodies. The conference objective is to disseminate the last developments in the field of solid mechanics in a friendly way. Papers related to basic mechanics theory as well as more applied technological aspects are welcome.

Special topics of interest are:

- automatic control theory;
- dynamics of multiple body systems;
- elasticity, viscoelasticity and plasticity;
- fracture mechanics;
- gyroscopes and navigation systems;
- heat transfer and thermal effects in solids;
- mechanical behavior of materials;
- mechanics of composite materials;
- mechanics of granular and geological materials;
- micromechanics of solids;
- nanomechanics;
- numerical techniques;
- optimum design methods;
- stability and optimization of mechanical systems;
- structure-fluid interaction;
- theory of structures and structural stability;
- tribology;
- vibration of discrete and continuous systems;
- wave propagation and impact of solids.

86 abstracts (70 oral and 16 poster) are presented in this book of abstracts, representing nearly 30 countries. Portugal and the Poland are most represented countries. The main themes treated are Mechanical behavior of materials, Fracture mechanics and Fatigue, Mechanics of composite materials, Vibration of discrete and continuous systems, Elasticity, viscoelasticity and plasticity, Thermal and electric effects in solids and Optimum design methods.

These themes will also be treated in the form of themed special issues with full papers from the conference to be published in *Theoretical and Applied Fracture Mechanics* (Elsevier), *Engineering Analysis with Boundary Elements* (Elsevier), *Wave Motion* (Elsevier), *Mechanics of Advanced Materials and Structures* (Taylor & Francis), *Mathematics and Mechanics of Solids* (Sage), *Continuum Mechanics and Thermodynamics* (Springer), *Journal of the Brazilian Society of Mechanical Sciences and Engineering* (Springer), *University of Porto Journal of Engineering* (University of Porto), *Journal of Mechanics of Solids* (University of Porto) and in a volume of the book series *Proceedings in Engineering Mechanics - Research, Technology and Education* (Springer).

The best oral presentation and the best poster presentation will be awarded with a certificate and a free registration for the 2nd International Conference on Mechanics of Solids 2024 (MS 2024).

Chairmen

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PROGRAMME OF MS 2022

Author underlined → presenting author

Thursday 3 November 2022		
8:30	***MS 2022 Opening* (Room B001)**	
8:40	**Keynote lecture (Room B001)** On the modeling of periodic and quasi-periodic viscoelastic metastructures **(MS22_56)** MA Trindade (University of São Paulo, Brazil)	
	Session 1A – Elasticity, viscoelasticity and plasticity (Chair: AM Ferreira and MA Trindade)	**Session 1B – Mechanics of composite materials I** (L Feo and RD Adams)
	Room B001	***Room B002***
9:00	Modelling constitutive behaviour of electroplastic effect in dual-phase steel **(MS22_88)** J Tiwari (Indian Institute of Technology Madras, India), H Krishnaswamy, M Amirthalingam	Numerical study of seawater effect on mechanical strength in fiber-reinforced polymer composites **(MS22_104)** H Vidinha (University of Coimbra, Portugal), R Branco, MA Neto, AM Amaro, P Reis
9:20	Damage analysis in a novel hole hemming process for joining magnesium and aluminum alloy sheets **(MS22_109)** JAC Pereira, MM Kasaei (INEGI, Portugal), RJC Carbas, EAS Marques, LFM da Silva	Static analysis of FGM nano-size structures including surface effects based on stress-driven nonlocal theory of elasticity **(MS22_85)** R Penna, G Lovisi, A Lambiase, L Feo (University of Salerno, Italy)
9:40	Micro-scale modeling of theductile fracture of stainless steel foils **(MS22_110)** M Karimi Firouzjaei, H Moslemi Naeini, MM Kasaei (INEGI, Portugal), MJ Mirnia, LFM da Silva	Asymptotic homogenization approach applied to periodic laminated Cosserat media with imperfect contact conditions **(MS22_58)** V Yanes, R Rodríguez-Ramos (Universidad de La Habana, Cuba), Y Espinosa-Almeyda, CF Sánchez-Valdés, H Camacho-Montes, FJ Sabina
10:00	A systematic investigation on the role of step time increment in the implementation of physically based dislocation density model in differential form **(MS22_90)** V Balaji (Indian Institute of Technology, Madras, India), H Krishnaswamy, S Natarajan	Continuum damage mechanics framework for modeling of CFRP composites **(MS22_64)** S Rai (Indian Institute of Technology Delhi, India), BP Patel
10:20	Mechanical behavior and modelling of random strain-induced martensite formation in advanced medium-Mn automotive sheet steel **(MS22_96)** A Grajcar (Silesian University of Technology, Poland), J Kaczmarczyk, A Kozlowska, JS Cruz Banuelos	An analytical and validated sandwich theory for soft and hard cores based on Timoshenko assumptions for the single layers **(MS22_70)** J Schoeftner (Johannes Kepler University, Austria)
10:40-11:00	***COFFEE BREAK (Coffee Lounge)***	
	Session 2A – Mechanics of composite materials II (Chair: CM Mota Soares and AM Ferreira)	**Session 2B – Mechanical behaviour of materials I** (Chair: A Akhavan-Safar and RJC Carbas)
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11:20	Investigating cure shrinkage induced stress in thick composite beams by virtual manufacturing **(MS22_6)** J Vroon (Royal Netherlands Aerospace Centre (NLR), The Netherlands), N van Hoorn	Mechanical properties of ultra-high performance self-compacting mortar reinforced by recycled steel fibre **(MS22_71)** H Abdolpour (University of Science and Technology, Wroclaw, Poland), P Niewiadomski, Ł Sadowski, A Kwiecień
11:40	Solid tensegrity-inspired metamaterials with graded mechanical properties **(MS22_16)** A Al Sabouni-Zawadzka (Warsaw University of Technology, Poland), J Pełczyński, W Gilewski	Ductile fracture of metallic materials based on Rousselier damage model: implicit implementation, calibration procedure and experimental validation **(MS22_99)** VAM Rodrigues, LLD Morales, L Malcher (University of Brasília, Brazil)
12:00	A mechanical analysis of variable angle tow composite plates through variable kinematics models based on Carrera's unified formulation **(MS22_17)** DA Iannotta (Luxembourg Institute of Science and Technology, Luxembourg), G Giunta	Analysis of the mechanical performance of high-strength cementitious overlays modified with nanoparticles **(MS22_59)** J Szymanowski (Wrocław University of Science and Technology, Poland)
12:20	Nonlinear mechanical behavior of anisotropic materials cosserat continuum **(MS22_55)** F Shi (Chongqing University, China), N Fantuzzi, Y Li, P Trovalusci, Z Wei	Towards the synergistic addition of granite powder and natural fibers in epoxy resin coatings **(MS22_89)** Ł Kampa (Wroclaw University of Science and Technology, Poland), Ł Sadowski
12:40	Static and free vibrations analyses of plate-shell panels made of fibre reinforced functionally graded material **(MS22_57)** JS Moita, AL Araujo, VF Correia, CM Mota Soares (University of Lisbon, Portugal)	Changes of the mechanical properties of PA12 when using TiO2 as antimicrobial additive **(MS22_53)** P du Maire (Esslingen University of Applied Sciences, Germany), A Oechsner
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14:20	Bridge cracks in piezoelectric materials **(MS22_5)** EM Crăciun ("Ovidius" University of Constanta, Romania), GMD Ghita	A harmonic balance method based on Green's functions for the vibration of solids with non-linear interfaces **(MS22_67)** A Tsetas (Delft University of Technology, The Netherlands), A Tsouvalas, AV Metrikine
14:40	Simplified breathing crack element for spectral Timoshenko beam model **(MS22_30)** TJ Saravanan (Indian Institute of Technology Bhubaneswar, India), G Mondal, S Rajasekharan	On the buckling and vibration of noncarbon nanotubes through atomistic continuum coupled multiscale computational framework **(MS22_94)** S Singh (Indian Institute of Technology Indore, India)
15:00	Numerical investigation of the crack growth of Inconel 718 under periodic loading **(MS22_105)** M Movaffagh (Science and research Islamic Azad University, Tehran, Iran), SMR Khalili	Simulation of acoustic radiation of vibrating plates using transmission line matrix method **(MS22_42)** A Alia (University of Lille, France)

15:20	Two-scale modelling of fatigue crack initiation from macroscopic stress concentrations **(MS22_54)** D Khan (Eindhoven University of Technology, The Netherlands), J Maljaars, D Leonetti, V Kouznetsova, MGD Geers	Void detection in adhesive joints through electromechanical impedance signatures **(MS22_79)** AFG Tenreiro (INEGI, Portugal), AM Lopes, LFM da Silva
15:40	Applications of M-integral for 3D anisotropic cracks with detailed solution steps **(MS22_106)** AM Asan (Firat University, Turkey), MO Kaman, S Dag, S Erdem, K Turan	Nonlinear free vibrations analysis of porous functionally-graded nano-beams in hygrothermal environment **(MS22_84)** R Penna, G Lovisi, A Lambiase, L Feo (University of Salerno, Italy)
16:00-16:20	***COFFEE BREAK (Coffee Lounge)***	
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16:40	Mechanical properties of adhesive joints with polybutylene terephthalate reinforced with glass fiber substrates and silicone adhesive after water aging **(MS22_108)** CSP Borges (INEGI, Portugal), A Akhavan-Safar, EAS Marques, RJC Carbas, C Ueffing, P Weissgraeber, LFM da Silva	Analysis of curved beams with an edge crack using a higher-order spectral element model **(MS22_86)** SS Ahamed, TJ Saravanan (Indian Institute of Technology Bhubaneswar, India), G Mondal, S Rajasekharan
17:00	Fracture prediction of ductile epoxy resins using a modified normal stress criterion: Effects of mode mixity and strain rate **(MS22_24)** J Bidadi, A Akhavan-Safar (INEGI, Portugal), H Saeidi Googarchin, LFM da Silva	Decoupling fracture modes in non-standard test specimens: state of the art **(MS22_82)** P Tsokanas (University of Patras, Greece), A Akhavan-Safar, PS Valvo, T Loutas, LFM da Silva
17:20	Influence of waste quartz powders on the mechanical properties of epoxy coatings **(MS22_101)** A Chowaniec-Michalak (Wroctaw University of Science and Technology, Poland)	J-integral consistent phase-field approach to fracture under compressive stresses **(MS22_103)** H Jafarzadeh (Interdisciplinary Centre for Advanced Materials Simulation (ICAMS), Germany), A Patton, M Negri, A Reali
17:40	The effect of carbon nanotubes on the mechanical properties of polyurethane paint coatings for softwood protection **(MS22_102)** K Brzozowska (Wroctaw University of Science and Technology, Poland), A Chowaniec-Michalak, P Niewiadomski, Ł Sadowski	Simulation of concrete fracture under high loading rates using discrete elements **(MS22_73)** B Beckmann (Technische Universität Dresden, Germany), M Curbach
18:00	The effect of natural date palm tree fibers on the impact fatigue strength of adhesives **(MS22_26)** M Miri, A Akhavan-Safar (INEGI, Portugal), MR Ayatollahi, LFM da Silva	Energy-based meso-scale model for fracture simulation of cracked pipes under very low cycle fatigue loading **(MS22_76)** JH Hwang, YJ Kim (Korea University, Seoul, Korea), JW Kim
19:00	**Poster session and RECEPTION (Coffee Lounge)**	
Elasticity, viscoelasticity and plasticity		
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Fracture mechanics and Fatigue		
Poster 2	Determination of mode I cohesive law of structural adhesives using the direct method **(MS22_52)**	BD Simões (INEGI, Portugal), PDP Nunes, EAS Marques, RJC Carbas, LFM da Silva

Poster 3	Direct generation of cohesive zone laws of adhesives **(MS22_12)**	DS Correia, ID Costa, EAS Marques (INEGI, Portugal), RJC Carbas, LFM da Silva
Poster 4	The effect of overloading on a ductile adhesive's mode I fatigue behaviour **(MS22_20)**	FC Sousa (University of Porto, Portugal), A Akhavan-Safar, LFM da Silva
Poster 5	The interaction of mode mixity and humidity on the S-N response of an epoxy adhesive **(MS22_27)**	FVB de Castro Lopes, A Akhavan-Safar (INEGI, Portugal), RJC Carbas, EAS Marques, R Goyal, J Jennings, LFM da Silva
Mechanical behaviour of materials		
Poster 6	Numerical and experimental study of thermal residual stresses on multimaterial adherends in single-lap joints **(MS22_44)**	BD Simões (INEGI, Portugal), RJC Carbas, EAS Marques, LFM da Silva
Poster 7	Dynamic analyses of crane subjected to the wind, moving load and earthquake **(MS22_29)**	L Solazzi (University of Brescia, Italy)
Poster 8	Mode I fatigue threshold energy assessment of different adhesives: Effects of temperature **(MS22_28)**	D Santos, A Akhavan-Safar (INEGI, Portugal), EAS Marques, RJC Carbas, LFM da Silva
Poster 9	Effect of partial replacement of cement with granite powder or quarzt powder in cement mortars **(MS22_75)**	Z Woźniak (Wrocław University of Science and Technology, Poland), A Chajec, Ł Sadowski
Poster 10	Incorporation of boron nitride into alumina ceramic matrix **(MS22_91)**	PH Chibério (Universidade Federal do Rio Grande do Norte, Brazil), W Acchar, JMD Neto, HPA Alves
Poster 11	The mechanism of the adhesion and wettability of liquid and solid particles floating in the air to surfaces made of heterogeneous materials **(MS22_100)**	S Czarnecki (Wrocław University of Science and Technology, Poland), A Chowaniec-Michalak
Mechanics of composite materials		
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Poster 13	The use of tough layers in composite adherend to improve the joint strength performance **(MS22_13)**	RJC Carbas (INEGI, Portugal), S Jalali, EAS Marques, LFM da Silva
Thermal and electrical effects in solids		
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Poster 15	Phase field modeling of thermomigration at colder interface of solid state solder joints **(MS22_83)**	A Kunwar (Silesian University of Technology, Poland), U Subedi, YA Coutinho, J Hektor, S Liang, N Moelans
Vibration of discrete and continuous systems		
Poster 16	Nonlocal in time numerical model of composite beam deformation in motion **(MS22_95)**	ES Badina, RO Tsarev (Russian University of Transport, Moscow, Russia)

Friday 4 November 2022	
	Session 5 – Optimum design methods (Chair: AL Araujo and AM Lopes)
	Room B001
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9:20	Lamb waves propagation in SLJs with multiple levels of weak adhesion **(MS22_80)** GMF Ramalho (University of Porto, Portugal), AM Lopes, LFM da Silva
9:40	Topology optimization of origami structures using smooth folds **(MS22_22)** A Habibian, A Sohouli, A Suleman (University of Victoria, Canada)
10:00	Topology optimization of plane 2D structures with adaptive finite elements **(MS22_41)** DMF Paraíso (University of Lisbon, Portugal), JM Guedes, HC Rodrigues
10:20	Investigation of geometries for increasing the energy density in electromechanical battery flywheels **(MS22_43)** D Coppedé, C Frajuca (IFSP, São Paulo, Brazil), FS Bortoli, MA de Souza
10:40-11:00	***COFFEE BREAK (Coffee Lounge)***
	Session 6 – Mechanical behaviour of materials III (Chair: L Solazzi and CSP Borges)
	Room B001
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11:20	An investigation of environmental effects on the mechanical performance of hyperelastic adhesives joints **(MS22_11)** PHE Fernandes (Fraunhofer IFAM, Germany), VC Beber, A Wulf, C Nagel
11:40	Experimental and numerical investigation into the hybrid joint performance considering microstructural roughness **(MS22_32)** K Pang (Lancaster University, UK), XN Hou, XE Wang, JQ Ye
12:00	Comparative analyses of selected machine learning algorithms for prediction of green cementitious composites subsurface tensile strength **(MS22_33)** S Czarnecki (Wroclaw University of Science and Technology, Poland), M Moj
12:20	Free-surface proximity induced mechanical bistability in precipitation systems **(MS22_97)** RM Raghavendra (Indian Institute of Technology Kanpur, India), G Iyer, A Subramaniam
12:40	Dynamic buckling of sandwich panels **(MS22_38)** AS Afonso, RB Santos, AL Araujo (University of Lisbon, Portugal)
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	Session 7 – Thermal and electrical effects in solids (Chair: XF Yao and EAS Marques)
	Room B001
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14:20	Thermodynamically extended symplectic numerical simulation of viscoelastic, thermal expansion and heat conduction phenomena in solids **(MS22_37)** T Fülöp, R Kovács, Á Pozsár, M Szücs, DM Takács (Budapest Univ of Techn and Econ, Hungary)
14:40	The use of Bragg fiber gratings for monitoring of thermal strain in additively manufactured continuous carbon fiber reinforced PLA **(MS22_69)** A Orlowska-Galezia (Polish Academy of Sciences, Poland), C Graczykowski, P Pawlowski, M Mieloszyk, K Majewska, A Andrearczyk, R Rimasauskiene, M Rimasauskas

15:00	Investigation of flexoelectric effect on the functionally graded micro/nano plates by Moving Finite Element Method **(MS22_50)** L Sator (Slovak Academy of Sciences, Slovakia), V Sladek, J Sladek
15:20	Thermal-mechanical coupling dynamic analysis and optimization of drilling in composite repair **(MS22_51)** XF Yao (Tsinghua University, PR China), LB Zhang, Y Kan, X Fan, SY Xuan
15:40	A nonlinear fractional BEM model for magneto-thermo-visco-elastic problems in temperature-dependent FGA anisotropic rotating granular structures **(MS22_92)** MA Fahmy (Umm Al-Qura University, Saudi Arabia)
16:00-16:20	***COFFEE BREAK (Coffee Lounge)***
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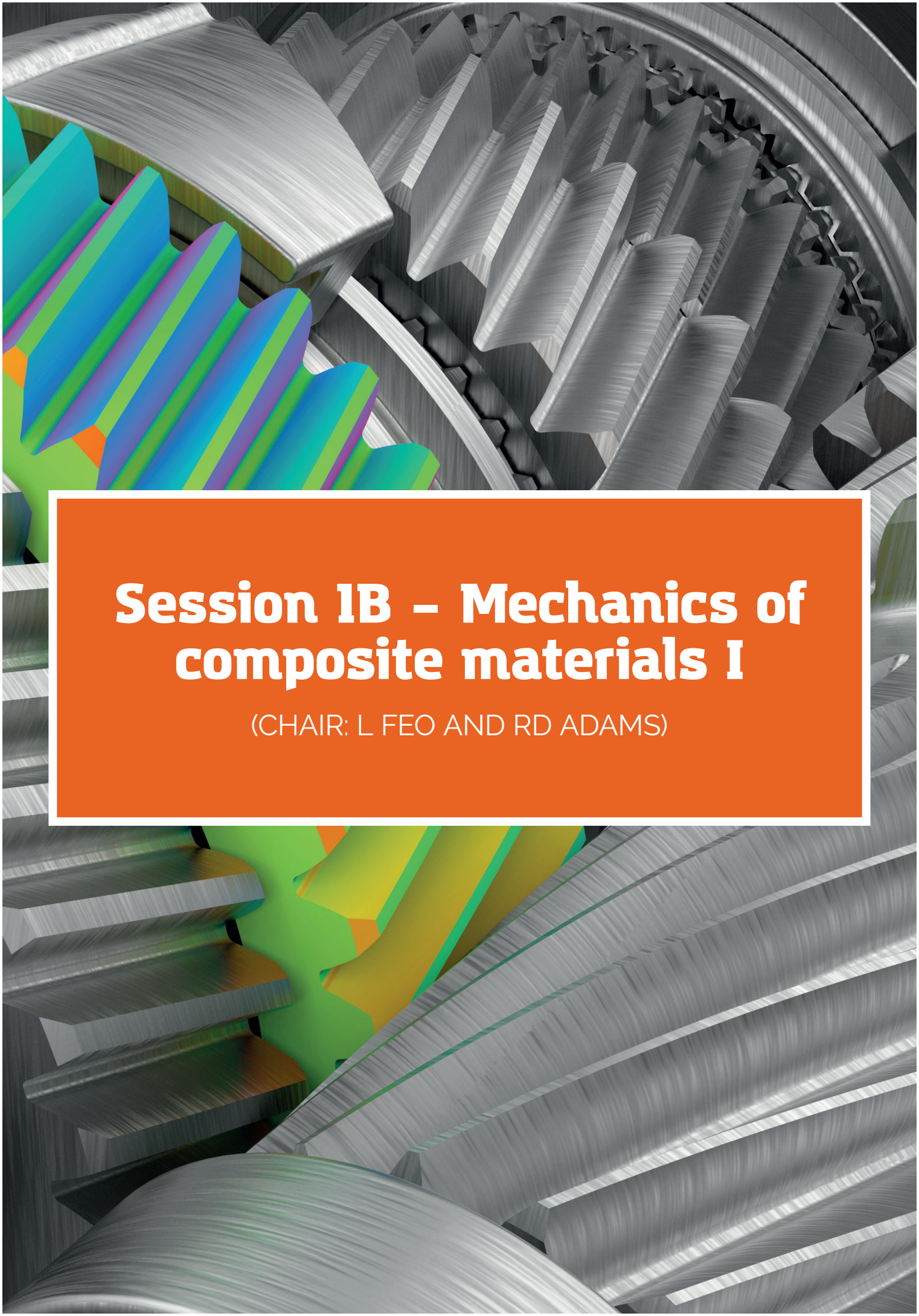
16:40	Sensitivity method for structural model update and identification in finite elements using vibration measurements **(MS22_19)** LF Barazzutti (Federal University of Rio Grande do Sul, Brazil), HM Gomes, LRC Drehmer
17:00	Vibration characteristics of porous functionally graded material sandwich plates resting on the elastic foundation with geometric discontinuities **(MS22_35)** D Singh, A Gupta (Shiv Nadar University, India)
17:20	The mechanics of a tuning fork (**MS22_107)** RD Adams (University of Bristol, UK)
17:40	Variational formulation for double-walled carbon nanotubes undergoing nonlinear vibrations due to nonlinear van der Waals forces **(MS22_49)** S Adali (University of KwaZulu-Natal, South Africa)
20:00	***MS 2022 BANQUET (Porto Caves Calém)***



Session 1B – Mechanics of composite materials I

(CHAIR: L FEO AND RD ADAMS)

Asymptotic homogenization approach applied to periodic laminated Cosserat media with imperfect contact conditions

V Yanes[1], R Rodríguez-Ramos[2], Y Espinosa-Almeyda[3], CF Sánchez-Valdés[3], H Camacho-Montes[3], FJ Sabina[4]

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[3]Universidad Autónoma de Ciudad Juárez, Av. Del Charro 450 Norte Cd. Juárez, Chihuahua, CP 32310, México.

[4]Universidad Nacional Autónoma de México, Apartado Postal 20-126, Alcaldía Álvaro Obregón, 01000 CDMX, México.

In this work, the two-scale asymptotic homogenization method (AHM) is applied to find the effective properties of periodic laminated Cosserat media with centro-symmetric constituents and non-uniform imperfect interface contact conditions, i.e., tractions and coupled stress are continuous but displacements and microrotations are discontinuous across the imperfect interface. The jumps in the displacement and microrotation components are proportional to their respective interface traction and coupled stress components in terms of a partition of different spring-factor-type interface parameters. Series expansions are proposed as a function of a local (microscopic) variable and a global (macroscopic) variable for the displacement and microrotation fields. The local problems are solved; the effective properties are given as a function of the material properties of the constituents, the volume fractions of the phases and the imperfection parameters. Numerical results are reported and discussed for a bi-laminated Cosserat composite assuming multiple interface imperfection partitions and different ranges for the imperfection parameter values. The effect of imperfections on the effective properties is illustrated.

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