23-25 APRIL 2025, GRANADA, SPAIN

STAMS 2025

SEMTA-AIMETA COLLOQUIUM

Mechanics Across Realms:
Experiments to Theory (and back)

Venue:
Auditorium
School of Civil Engineering
University of Granada

More info:
https://www.ugr.es/~stams2025

Organized by:

WEDNESDAY · 23 APRIL 2025

MORNING SESSION

OPENING	9:00	
SESSION 1		Chair. Michael Ortiz
	9:30	**The limiting separation speed for mode I loading of an elastic solid with a weak interface** Alan Needleman. Texas A&M University
	10:00	**Microslip and shakedown limit in oscillating frictional contacts** Andrea Spagnoli. University of Parma
Coffee break	10:45	**Posters Session**
SESSION 2		Chair. Alejandro Martínez-Castro
	11:30	**Computational characterization of nanowire network electrodes** Angelo Simone. University of Padova
	12:00	**Fatigue-induced self-healing in cementitious material** Rena C. Yu. University of Castilla-La Mancha

LUNCH

	12:45	**Lunch** School of Civil Engineering

AFTERNOON SESSION

SESSION 3		Chair. Inas H. Faris
	14:30	**Identification of the pre-fibrotic niche in liver patients, gauging Response to therapy in breast cancer, and “seeing” the brain at work through biomechanics** Ralph Sinkus. INSERM
	15:00	**Unveiling tissue secret using vibrations** Stefan Catheline. INSERM
Coffee break	15:45	**Posters Session**
SESSION 4		Chair. Ahmed Benallal
	16:30	**Flow around elongated bluff-bodies: flow features and challenges in simulations and experiments** Maria Vittoria Salvetti. University of Pisa
	17:00	**Analyses of the cerebrospinal fluid mechanics** Carlos Martínez-Bazán. University of Granada

SOCIAL PROGRAMME

WELCOME RECEPTION	19:30	**Carmen de los Mártires** Pº de los Mártires, s/n. 18009 Granada
NIGHT VISIT TO THE ALHAMBRA	22:00	**Guided Night Tour** *Entry with reservation only

THURSDAY · 24 APRIL 2025

MORNING SESSION

SESSION 5		Chair. Fernando Ávila
	9:00	**Fracture mechanisms in largely strained solids due to self-contacting surface defects: experiments and modelling** Borja Erice. Mondragon University
	9:30	**Experiments to theory (and back) in mechanobiology: Applications to cell motility and blood clotting** Alberto Salvadori. University of Brescia
	10:00	**Synergistic integration of functionalized scaffolds and a novel bioreactor for enhanced cartilage regeneration** Daniel Martínez-Moreno. University of Granada
Coffee break	10:45	**Posters Session**
SESSION 6		Chair. Ignacio Romero
	11:30	**Crack growth in viscoelastic solids: the interplay of elasticity and dissipation** Jacopo Ciambella. University of Rome
	12:00	**An insight into mechanics of cellulose paper: statistical modelling, continuum simulation and in-situ experiments** Marco Paggi. IMT Lucca

LUNCH

	12:45	**Lunch** School of Civil Engineering

AFTERNOON SESSION

SESSION 7		Chair. Estefanía Peña
	14:30	**Multiscale nonlinear analysis of composite materials: TFA technique** Elio Sacco. University of Naples Federico II
	15:00	**Recent results in the Mechanics of biological and bio-inspired motility** Antonio de Simone. S. Anna School of Advances Studies, Pisa
Coffee break	15:45	**Posters Session**

SOCIAL PROGRAMME

TOUR TO THE HISTORIC CENTER	17:30	**Guided Tour** *Visit with reservation only
CONGRESS BANQUET	20:30	**Carmen de los Chapiteles** Cam. Fuente del Avellano, 4. 18010 Granada

STAMS 2025
SEMTA-AIMETA
COLLOQUIUM

PROGRAM
23-25 APRIL 2025
GRANADA

FRIDAY · 25 APRIL 2025

MORNING SESSION

SESSION 8		Chair. Guadalupe Vadillo
	9:00	Mechanical characterization by testing miniaturized specimens Marta Serrano. CIEMAT
	9:30	Models for effects of radiation exposure in materials and full reactor structures: fundamentals and applications Sergei Dudarev. UK Atomic Energy Authority, UK.
	10:00	A fusion-like neutron source with unprecedented experimental capabilities Moisés Weber. IFMIF-DONES, Spain
Coffee break	10:45	Posters Session
SESSION 9		Chair. Javier Segurado
	11:30	Systems mechanobiology to explore non-communicable diseases that affect load-bearing organs Jérôme Noally. University Pompeu Fabra
	12:00	Viscosity and nonlinear elastography will be the next generation biomarkers in clinical diagnosis Guillermo Rus. University of Granada

LUNCH

	12:45	Lunch School of Civil Engineering

AFTERNOON SESSION

SESSION 10		Chair. Rena C. Yu
	14:30	Oxygen inhibition of gaseous hydrogen embrittlement in steel: experiments and simulations Pilar Fernández-Pisón. MINES ParisTech
	15:00	An FFT based chemo-mechanical framework for microscopic fracture simulations Gabriel Zarzoso. IMDEA
Coffee break	15:45	Posters Session
ROUND TABLE & CLOSING	16:30	Moderators. Roberto Brighenti, Rafael Gallego Announcement of the winners of the Student Poster Competition

STUDENT POSTER AWARDS. LIST OF CANDIDATES (in alphabetical order)

1	A multiphase field framework for corrosion fatigue Yousef Navidtehrani, Covadonga Betegón Biempica, Lucas Castro Garcia, Emilio Martínez Pañeda
2	Advancing Piezoelectric Polycrystal Modeling: A Log-Euclidean Framework, Numerical Exploration and Challenges Julieta L. Buroni, Federico C. Buroni
3	Analytical formulation for the shear modulus determination and optimization of the longitudinal elasticity modulus of multiespecies glulam beam Carlos Cruz Rodríguez, Rafael Bravo Pareja, Francisco Rescalvo Fernández, Yaiza Fuentes García, Antolino Gallego Molina
4	Definition of base soil profile of geophysical properties of IFMIF-DONES site: post-processing of in-situ tests Mario Ruiz, Francisco Beltran, Jorge Maestre
5	Elastoplastic Modeling of EUROFER97 Miniature Specimens using experimental data and FEM Simulations in a Nonlocal Plasticity Framework Gonzalo Crippa, Miguel Palomino, Esther Puertas, Roberto Palma and Rafael Gallego
6	Influence of the autoclaving on healing ultra-high performance concrete with nanosilica additions Jaime D. Ruiz Martínez, Héctor Cifuentes, José D. Ríos, Miguel A. Ramos, Antonio Martínez de la Concha, Carlos Leiva
7	Mechanical characterisation based on Ultrasonic Pulse Velocity cross-sectional tomographies of rammed earth layers Álvaro Blanca-Hoyos, Ricardo A. Castro, Esther Puertas, Rafael Gallego
8	Numerical strategy for Estimating the Effective Thermal Conductivity of Liquid Sodium in the High Flux Test Module (HFTM) José Miguel Palomino Cobo, Gonzalo E. Crippa, Esther Puertas, Roberto Palma, Rafael Gallego
9	The effect of microstructural inertia on plastic localization and void growth in porous solids Navab Hosseini, Thomas Virazels, Nicolas Jacques, José Antonio Rodríguez-Martínez
10	Ultrasonic Tomography in the Evaluation of Heritage Materials: TOF Precision and Image Quality Ricardo A. Castro, Álvaro Blanca-Hoyos, Esther Puertas, Rafael Gallego

POSTERS

11	A 3-D transport model of dislocation dynamics in finite solids and its line-free monopole discretization A. Cruzado, A. A. Benzerga, A. Needleman, M. Ortiz, M. P. Ariza
12	A fiber-based in silico study of articular cartilage: analysis of the microstructural alterations on its mechanical behavior Elías Núñez, José A. Sanz-Herrera, Eamonn Gaffney, Cameron Brown, Esther Reina-Romo
13	A finite element approach for morphodynamic evolution in coupled fluid-sediment systems Jorge Molina, Rafael Bravo, Pablo Ortiz
14	A multi-scale approach for the failure of fiber-reinforced cement composites Elisa Poveda, Rena C. Yu, Manuel Tarifa, Gonzalo Ruiz
15	A Multi-Scale Approach to Atherosclerosis Modeling Integrating CFD, Transport Phenomena, and Agent-Based Methods Ricardo Caballero, Miguel Ángel Martínez, Estefanía Peña
16	An inf-sup stable phase-field model for fracture in thermoresponsive hydrogels, integrating isotropic and transversely isotropic material behaviors A. Valverde-González, P. Olivares-Rodríguez, J. Reinoso, B. Dortdivanlioglu
17	Durability of adhesive composite/steel joints in harsh sea-water environments M. Ortiz, M.P. Ariza
18	Dynamic behaviour of recycled composite chopped thermoplastic material for transport industry José Alfonso Artero Guerrero, Jesús Pernas Sánchez; Juan Carlos Nieto Fuentes, Oscar Castillo Campo
19	Dynamics of sinusoidal and logarithmic spirals: application to astrodynamics Eric Guiot
20	Eco-friendly and Enhanced Performance PE Composites via Computational Modelling Francisco J. Cañamero, Federico C. Buroni, Luis Rodríguez-Tembleque
21	Effective flexural stiffness of composite columns under eccentric axial forces David Hernández Figueirido, Ana Piquer Vicent, Vicente Albero Gabarda, Marta Roig Flores
22	Finite element formulation for residual stress identification using small perturbation theory R. Palma, E. Puertas, R. Gallego
23	Flow induced in a cavity by an oscillatory channel flow separated by a flexible wall Antonio J. Bárcenas-Luque, Desirée Ruiz-Martín, Manuel Lorite-Díaz, Cándido Gutiérrez-Montes, Carlos Martínez-Bazán
24	Fracture behavior of rammed earth: the role of particle size distribution F. Ávila, A. Blanca-Hoyos, R. Gallego, R. Castro, E. Puertas
25	High-Frequency Microelastography System for Viscoelastic Characterization of Tumor Spheroids and Their Microenvironment José M Cortés Cortés, Inas H. Faris, Manuel Hurtado Estévez, Jorge Torres, Antonio Callejas Zafra, Guillermo Rus Carlborg

POSTERS

26	Interfacial Integrity and Matrix Effects on the Electromechanical Performance of KNN Piezocomposites Francisco J. Cañamero, Federico C. Buroni, Luis Rodríguez-Tembleque
27	Mechanotransduction effects of low-intensity pulsed ultrasound on melanoma cancer stem cells Manuel Hurtado, Carmen Griñán-Lisón, Gema Jiménez, Elena López, Daniel Martínez-Moreno, Antonio Callejas, Olga Roda, Francisco Artacho-Cordón, Juan A. Marchal, Juan M. Melchor, Guillermo Rus
28	Meta-modeling of maximum response envelopes in railway bridge dynamics using smart sampling of the Hilbert transform-based semi-analytic solution Enrique García-Macías, Alejandro E. Martínez-Castro
29	Modeling Calendering in Graphite Electrodes for Na-ion Batteries: A Lattice-Particle Approach to Optimizing Electrochemical Performance Ángel Valverde-González, Francisco Montero-Chacón
30	Numerical Modeling of Geysering-Induced Flow Propagation with a Non-Oscillatory Finite Element Approach Rafael Bravo Pareja, Jorge Molina Moya
31	Numerical modelling of the impact of cfrp fragments with strain rate sensitivity José Manuel Rodríguez Sereno, Jesús Pernas Sánchez, José Alfonso Artero Guerrero, Jorge López Puente
32	Physics-guided computation of nonlinear residual stress fields in growth processes José A. Sanz-Herrera, Alain Goriely
33	Potential Use of Waste Materials in Rammed Earth for Sustainable Construction Mario Solís; José D. Rodríguez-Mariscal; Jacinto Canivell; Juan J. Martín-del-Río
34	SINC-Dyn: A Julia Package for Dynamic Analysis of Railway Bridges Using Time-Discrete Sinc Interpolation Antonio Romero, Emma Moliner, María Dolores Martínez-Rodrigo, Pedro Galvín
35	Torsional waves in bioreactor design for melanoma stem cell therapy Manuel Hurtado, Carmen Griñán-Lisón, Gema Jiménez, Elena Lopez, Daniel Martínez-Moreno, Antonio Callejas, Juan A. Marchal, Juan M. Melchor, Guillermo Rus

Wednesday · 23 April 2025 · SESSION 1 · 9:30

ALAN NEEDLEMAN

Alan Needleman is a pioneering researcher in solid mechanics and computational materials modeling, particularly in the finite element method (FEM) for plastic deformation and fracture analysis. During his Ph.D. at Harvard University under John Hutchinson, he developed one of the first finite deformation elastic-plastic FEM programs, laying the foundation for its application in fracture mechanics. His career spans MIT, Brown University, the University of North Texas (UNT), and Texas A&M University, where he has made groundbreaking contributions to ductile fracture, cohesive surface modeling for crack growth, fatigue, single-crystal plasticity, and discrete dislocation plasticity. His long-standing collaboration with Viggo Tvergaard has led to influential advances in the field.

At Brown University (1975-2009), where he served as Dean of Engineering, Needleman worked with distinguished colleagues and supervised numerous students and postdocs. After retiring from Brown, he joined UNT in 2009, focusing on fracture surface roughness and crack growth resistance, inspired by Elisabeth Bouchaud's experiments. In 2015, he moved to Texas A&M University, where he continues to push the boundaries of plastic deformation modeling, integrating meso-scale modeling of amorphous solids, short-time negative dissipation effects, and Bayesian approaches for parameter identification. His impact on computational mechanics has shaped modern material behavior modeling, and his work remains fundamental in engineering and applied physics.

THE LIMITING SEPARATION SPEED FOR MODE I LOADING OF AN ELASTIC SOLID WITH A WEAK INTERFACE

A basic question in fracture mechanics is: how fast can a crack propagate? Classical elastic fracture mechanics predicts that, if the initial crack speed is less than the Rayleigh wave speed, the crack speed cannot exceed the Rayleigh wave speed, e.g. [1]. For Mode II (shear) cracks, propagation at a speed that exceeds the shear wave speed occurs by nucleation of a daughter crack that begins propagation at a supershear speed and merges with the main crack. The merged crack then propagates at a speed that is greater than the shear wave speed. This mechanism has been observed in experiments [2] and in numerical calculations [3,4]. On the other hand, Mode I (tensile) cracks are seldom observed to reach the Rayleigh wave speed because micro-crack branching and/or attempted branching lead to a limiting crack speed that is less than the Rayleigh wave speed. Nevertheless, the experiments in Ref. [5] show that if branching and/or attempted branching are suppressed, mode I cracks propagating along a weak surface in an otherwise homogeneous elastic solid can propagate at a speed exceeding the Rayleigh wave speed.

Results of experiments and calculations are presented for an elastic plate with an initial edge crack and a weak interface in an otherwise homogeneous elastic solid. subject to remote dynamic tensile loading. The results show a transition from sub-Rayleigh wave speed separation to supershear wave speed separation. However, unlike for Mode II loading, achieving a supershear separation speed does not involve nucleation of a daughter crack. The key role of a length scale associated with the separation process in determining the crack speed is revealed by both the experiments and the computations.

[1] Freund, L. B., Dynamic Fracture Mechanics, Cambridge University Press, Cambridge, UK, 1998.
[2} Xia, K., Rosakis, A.J., Kanamori, H., Science 303, 1859, 2004.
[3] Abraham, F.F., Gao, H.J., Phys. Rev. Lett. 84, 3113, 2000.
[4] Needleman, A., . J. Appl. Mech. 66, 847, 1999.
[5] Wang, M., Shi, S., Fineberg, J., Science 381,415, 2023

Thursday · 24 April 2025 · SESSION 5 · 9:30

ALBERTO SALVADORI

Alberto Salvadori (associate professor in Mechanics of Solids and Structures at the University of Brescia) was Research Assistant Professor at the University of Notre Dame, USA.

He is the author of over 60 publications in peer-reviewed international journals and over 200 conference communications. He founded the *Laboratory of Multiscale Mechanics and Multiphysics of Materials* at the University of Brescia, in which he coordinates a research group with brilliant young scientists. He directs The Mechanobiology Research Center, UNIBS.

Following a conceptual and didactic revisitation of his own discipline, he has chosen to deal with complex, multidisciplinary problems in which mechanics is a fundamental part. Among these, mechanobiology (i.e. how mechanics and biology interact in complex problems such as embryogenesis, tumor metastasis, angiogenesis), the mechanics for the green economy (mechanics in lithium and sodium ion batteries, mechanics for fuel cells, mechanics and CO_2 sequestration) and other interdisciplinary projects

EXPERIMENTS TO THEORY (AND BACK) IN MECHANOBIOLOGY: APPLICATIONS TO CELL MOTILITY AND BLOOD CLOTTING.

While the biochemistry of blood coagulation is well understood, less is known about how the mechanobiology of platelets influences clot remodeling and thus initiates tissue repair. Platelets not only release biochemical components needed to rapidly form fibrin-rich thrombi but also initiate wound site contraction. Research has shown that platelets are responsible for assembling the initial fibronectin fibers, preceding the infiltration of other cells.

It is now well established that cellular motility results from the polymerization of actin, the most abundant protein in eukaryotic cells, into an interconnected set of filaments. We portray this process in a continuum mechanics framework, claiming that polymerization promotes a mechanical swelling in a narrow zone around the nucleation loci, which ultimately results in cellular or bacterial motility.

To investigate the mechanobiology of these processes, state-of-the-art microscopy [1,2] has been combined with a novel theory, leading to advanced modeling and simulations. With respect to most published mixture theories, we abandoned the assumption of incompressibility of all constituents [3] and extended the classical theory of Larché-Cahn chemo-transport-mechanics [4].

The (new?) theory appears to suit well in modeling cell motility [5] and might also work well in other mechanobiological areas.

References

[1] M. Burkhardt, et al. (2016). Synergistic interactions of blood-borne immune cells, fibroblasts and extracellular matrix drive repair in an in vitro peri-implant wound healing model. Sci Rep 6, 21071.
[2] S. Lickertet. al. (2022). Platelets drive fibronectin fibrillogenesis using integrin αIIbβ3. Science Advances, 8(10), eabj8331
[3] F.J. Vernerey and M. Farsad. A constrained mixture approach to mechano-sensing and force generation in contractile cells. J MECH BEHAV BIOMED, 4(8):1683–1699, 2011.
[4] M Arricca, L Cabras, M Serpelloni, C Bonanno, R M. McMeeking, and A Salvadori. A coupled model of transport-reaction-mechanics with trapping, Part II: Large strain analysis. J MECH PHYS SOLIDS, 181:105425, 2023
[5] A. Salvadori, C. Bonanno, M. Serpelloni, R.M. McMeeking, (2024), On the generation of force required for actin-based motility., Scientific Reports, 14:18384, https://doi.org/10.1038/s41598-024-69422-3.

Wednesday · 23 April 2025 · SESSION 1 · 10:00

ANDREA SPAGNOLI

Andrea Spagnoli is Professor in Solid and Structural Mechanics at University of Parma, Italy. Andrea Spagnoli earned his PhD at Imperial College, London in 1997, discussing a thesis on the stability of shell structures. In the past two decades, his research interests have dealt with a variety of theoretical and numerical aspects related to contact mechanics, fracture mechanics and fatigue of engineering materials and structures. More recently he started working on the mechanics of soft materials, including advanced polymers and biological tissues.

MICROSLIP AND SHAKEDOWN LIMIT IN OSCILLATING FRICTIONAL CONTACTS

During their lifetime, structural components are often subjected to a combination of loads of various nature, including thermal actions and vibrations which result in time variable stresses. When components that are in mutual contact are subjected to cyclic loading, they are exposed to the detrimental effect of frictional slips, but they might also develop a favorable occurrence, where slips cease after a few cycles. Due to the similarity with an analogous phenomenon observed in the theory of plasticity, this event is commonly known as *frictional shakedown* [1]. Methods are sought to provide a reliable and efficient assessment of systems under variable loads, primarily with the aim of finding the load limit below which the shakedown is guaranteed. Employing the so-called direct methods derived from the theorems of limit analysis, we consider a specific class of linear programming problems formulated for the shakedown of elastoplastic systems with non-associated flow rule [2]. Indeed, Coulomb's frictional law does not obey the normality rule, save for the specific case when normal and tangential reactions along the contact interface are uncoupled [3].

In this work, we illustrate the linear programming algorithm which enabled us to derive the shakedown limit load from the solution of a constrained optimization problem [4-7]. Specifically, we have considered two- and three-dimensional elastic discrete systems (e.g. systems with reduced dofs – corresponding to contact displacements, obtained by FE discretization followed by a standard condensation procedure), containing a single conforming contact interface, and subjected to static and cyclic loading. The full loading history is replaced by a convex load domain, so that the solution consists in finding an optimal distribution of frictional slips which maximizes a positive multiplier of the load domain. Moreover, the three-dimensional solution is based on an approximation of the frictional law by means of a piecewise linearization of Coulomb's cone. The obtained shakedown loads compare favorably with those derived from traditional, more cumbersome, step-by-step simulations.

[1] Churchman, C.M., Hills, D.A., 2006. General results for complete contacts subject to oscillatory shear. J. Mech. Phys. Solids 54 (6).

[2] Maier, G., 1969. Shakedown theory in perfect elastoplasticity with associated and nonassociated flow-laws: a finite element, linear programming approach. Meccanica 4 (3).

[3] Klarbring, A. , Ciavarella, M. , Barber, J.R. , 2007. Shakedown in elastic contact problems with coulomb friction. Int. J. Solids Struct. 44 (25-26).

[4] jörkman, G. , Klarbring, A. , 1987. Shakedown and residual stresses in frictional systems. In: Gladwell, G.M.L., Ghonem, H., Kalousek, J. (Ed.), Contact Mechanics and Wear Rail/Wheel Systems II.

[5] larbring, A., Barber, J. R., Spagnoli, A., & Terzano, M. (2017). Shakedown of discrete systems involving plasticity and friction. European Journal of Mechanics-A/Solids, 64, 160-164.

[6] Spagnoli, A., Terzano, M., Barber, J. R., & Klarbring, A., 2017. Non-linear programming in shakedown analysis with plasticity and friction. J. Mech. Phys. Solids 104.

[7] Spagnoli, A., Beccarelli, G., Terzano, M., & Barber, J. R. (2021). A numerical study on frictional shakedown in large-scale three-dimensional conforming elastic contacts. Int. J. Solids Struct. 217, 1-14.

Wednesday · 23 April 2025 · SESSION 2 · 11:30

ANGELO SIMONE

Angelo Simone is a professor of Solid and Structural Mechanics at the University of Padova. He earned a Master's degree (Italian Laurea) in Civil Engineering, specializing in Structural Engineering, from Politecnico di Milano, and a Doctorate in Civil Engineering (Computational Mechanics) from Delft University of Technology. Before joining the University of Padova in 2017, he served as an associate professor at Delft University of Technology. His research focuses on computational mechanics, with an emphasis on the modeling of deformation and failure in materials. Applications include modeling failure processes in regularized media, exploring multiscale and multiphysics phenomena, and developing enriched approximations (XFEM/GFEM) for failure and composite material modeling.

MODELING NANOWIRE NETWORKS ACROSS SCALES

Metallic nanowire networks are a flexible and transparent alternative to brittle and costly indium tin oxide (ITO) for transparent electrodes. Their performance depends on synthesis, deposition, and welding processes, which influence network uniformity and resistance to mechanical and electrical failure. In this talk, I will illustrate our recent findings on the characterization of nanowire network electrodes, with an emphasis on a multiscale computational approach that reveals how welding conditions and nanowire arrangements influence junction properties, providing guidelines to enhance the durability and efficiency of NW-based electrodes.

Thursday · 24 April 2025 · SESSION 7 · 15:00

ANTONIO DE SIMONE

Antonio De Simone (Naples, 1962) is an Italian engineer and applied mathematician. He studied Civil Engineering at the University of Naples Federico II, graduating in 1987, and earned his PhD in Mechanics from the University of Minnesota in 1992. He was a postdoctoral researcher at Carnegie Mellon University (1993–1994), and from 1990 to 1998 he carried out research at the University of Rome Tor Vergata.
Between 1998 and 2003, he led a research group on multiscale phenomena in materials at the Max Planck Institute for Mathematics in the Sciences in Leipzig. Since 2002, he has been Professor of Structural Mechanics at the Scuola Internazionale Superiore di Studi Avanzati (SISSA) in Trieste. In 2012, he co-founded the SAMBA Lab (Sensing and Moving Bio-inspired Artifacts) at SISSA, together with neurocognitive scientist Mathew E. Diamond.
His research lies at the intersection of solid mechanics, biophysics, and smart materials, with a particular focus on microscale locomotion, morphogenesis, and multiscale modelling.
In 2006, he was awarded the Keith Medal, along with Felix Otto, Stefan Müller and Robert Kohn, in recognition of his outstanding contributions to applied mechanics.

Recent results in the mechanics of biological and bio-inspired motility

Thursday · 24 April 2025 · SESSION 5 · 9:00

BORJA ERICE

Dr. Erice holds a BSc in Aeronautical Engineering, and a MSc in Materials Engineering from Universidad Politécnica de Madrid (UPM), where he received a PhD in Engineering in December 2012, supported by an FPI grant from the Spanish Ministry of Science and Innovation. He has held several postdoctoral positions at École Polytechnique, ETH Zürich and the University of Oxford, and has been senior researcher at the Norwegian University of Science and Technology (NTNU). In 2019, he obtained an Ikerbasque Research Fellow contract through a competitive international call, joining Mondragon Unibertsitatea (MU–Eng) in 2020 where he develops research activities related to the experimental, theoretical and computational mechanics of materials and structural components subjected to extreme loading conditions and he lectures several undergraduate and graduate courses. His research trajectory enabled him to secure a Ramón y Cajal fellowship in 2022 and after being reviewed by an external tenure committee got promoted to Ikerbasque Research Associate Professor in 2024. He is editor of the International Journal of Impact Engineering and he serves as a member and vice–treasurer of the DYMAT Governing Board, the leading organisation in Europe in the field of dynamic behaviour of materials. Additionally, he has been acknowledged for his work in the regional context, being appointed as a member of the *Materialen Zientzia eta Teknologia Batzarra*, the organisation promoting materials science and engineering research in the Basque Country and in Basque language.

Fracture mechanisms in largely strained solids due to self-contacting surface defects: experiments and modelling

Wrinkles can be found on the surface of largely compressed areas of metallic materials. These surface instabilities can be observed in structural elements that are of interest for the automotive and offshore industries, such as bent tubes or pipes, pressure vessels or die formed sheet metal pieces. Wrinkles are understood as undulations or surface roughness that might set in due to large straining in metallic materials. Typically, they present distinct geometrical features that are periodically repeated on the surface and they are dimension-wise significantly smaller than any of the dimensions that define the rest of the solid. They fold and self-contact, creating surface defects when the structural elements are increasingly compressed, and may lead to a ductile-to-brittle transition if subsequently strained in tension. Eventually, the self-contact grows unsteadily evolving into a crease, a specific type of singularity.

To analyse such an effect, a finite element model of a half-space plane-strain material block with an imperfection was subjected to different levels of compression followed by reverse tensile straining. The existence of a critical strain, for which the self-contact defect acted as a crack during the tensile straining phase predicted by the model was confirmed by reverse compression-tension tests performed at two different strain rates. A post-mortem fractographic analysis allowed to link the ductile-to-brittle transition strain to the morphology of the fracture surfaces. This experimental analysis demonstrated that the findings from the numerical simulations using strain localisation theory were in line with the experimental results.

Wednesday · 23 April 2025 · SESSION 4 · 17:00

CARLOS MARTÍEZ-BAZÁN

Carlos Martínez-Bazán received his undergraduate degree in Mechanical Engineering at the University of Zaragoza (Spain) in 1992 and obtained his Ph.D. at the University of California, San Diego UCSD (Mechanical and Aerospace Engineering Department) in 1998. After graduating, he joined the faculty of the University Carlos III de Madrid, where he became Associate Professor in 2002. In 2005 he moved to the University of Jaen where he served as Full Professor for more than twelve years before joining the University of Granada (Department of Structural Mechanics and Hydraulic Engineering) in 2020. His research has focused on a variety of fundamental problems, such as the break up and formation of bubbles, and the stability and control of bluff bodies wakes. Combining experimental, numerical and analytical approaches, Martínez-Bazán has initiated a new line of research related to the characterization of biological flows with the aim of contributing to the understanding of the transport mechanisms of drugs in the spinal canal in the treatment of cancer and other brain diseases.

ANALYSES OF THE CEREBROSPINAL FLUID MECHANICS

Circulation of cerebrospinal fluid around the Central Nervous System transports not only fluids, but also all the solutes they carry, including nutrients, drugs, and metabolic wastes. A major characteristic of cerebrospinal fluid (CSF) flow is its oscillatory nature, driven by the cardiac cycle and respiration, with associated stoke volumes much smaller than the total CSF volume in the spinal canal. It also exhibits a slow steady flow with characteristic residence times much larger than the cardiac period, responsible for the transport of solutes. We describe here in-vitro and in-vivo MRI experimental results and modeling of CSF flow in the spinal canal, including the roles of convection and diffusion in Solute transport. We discuss the effects of the cardiac and respiratory rates, as well as the microanatomical features of the spinal canal, on the CSF motion and the associated solute transport. This work is motivated by the need for a better understanding of drug dispersion in the context of intrathecal drug delivery (ITDD), a medical procedure used for the treatment of some cancers, infections, and pain, in which the drug is injected directly into the CSF via the lumbar route. Convective transport driven by the time-averaged Lagrangian velocity (i.e., the sum of the Eulerian steady-state velocity and the Stokes drift velocity) is found to be the key dispersion mechanism.

Thursday · 24 April 2025 · SESSION 5 · 10:00

DANIEL MARTÍNEZ-MORENO

Daniel Martínez-Moreno is a biomedical engineer with extensive experience in biomedicine, translational research, and bioengineering. He holds a Bachelor's degree in Biomedical Engineering from Universidad Carlos III de Madrid, a Master's in Translational Research and Personalized Medicine, and a Ph.D. in Biomedicine with international distinction from the University of Granada. His early research involved developing 3D skin tissue models for Kindler syndrome and innovative bioreactors for cartilage regeneration in osteoarthritis treatment. Martínez-Moreno has significantly contributed to the fields of biomechanics, 3D bioprinting, and regenerative tissue engineering, evidenced by his numerous publications in prestigious journals. His professional journey includes a notable research stay at Trinity College Dublin, enhancing his expertise in advanced biomedical imaging and biochip technology.
Currently, he serves as Technical Support Staff at the University of Granada's Scientific Instrumentation Center, supervising projects such as LISTEN2FUTURE and DIGIPANCA, focused on ultrasound mechanotherapy and AI-driven anatomical modeling, respectively. He also participates in the NeuroFab project, conducting research on shear wave stimulation in bioreactors for neural tissue regeneration.

SYNERGISTIC INTEGRATION OF FUNCTIONALIZED SCAFFOLDS AND A NOVEL BIOREACTOR FOR ENHANCED CARTILAGE REGENERATION

Osteoarthritis (OA) poses significant challenges due to articular cartilage's limited regenerative ability. Tissue engineering strategies aim to create cartilage-like tissues to restore joint function. This study integrates a novel bioreactor with functionalized scaffolds to enhance chondrogenesis. Scaffolds made of 1,4-butanediol thermoplastic polyurethane (bTPUe), functionalized with pyrene butyric acid (PBA), provided optimal mechanical and biological conditions for infrapatellar fat pad mesenchymal stem cells (IPFP-MSCs). The bioreactor generated controlled viscous shear stress via perfusion flow and integrated real-time low-intensity pulsed ultrasound (LIPUS) monitoring. bTPUe scaffolds functionalized with PBA enhanced cell adhesion and proliferation. IPFP-MSCs seeded on scaffolds were cultured for 21 days under perfusion. Chondrogenic differentiation was assessed through metabolic activity, extracellular matrix (ECM) analysis, immunofluorescence, and real-time tissue evaluation using finite element modeling (FEM). PBA-functionalized scaffolds showed improved cell adhesion, proliferation, and ECM deposition compared to controls. The bioreactor stimulated chondrogenesis without pre-conditioning media, significantly increasing chondrogenic markers (Sox9, Col2a, aggrecan). Real-time LIPUS provided non-invasive tissue monitoring, correlating scaffold mechanical changes with cellular activity. FEM analysis validated ultrasound signals as cartilage maturation indicators. This study demonstrates that combining functionalized scaffolds with mechanical stimulation in a novel bioreactor significantly enhances cartilage regeneration. Real-time ultrasound monitoring integrated with scaffold-based differentiation advances OA tissue engineering, providing a scalable approach for cartilage replacement.

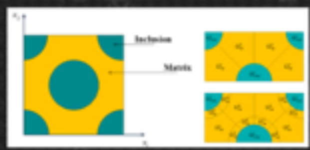
Thursday · 24 April 2025 · SESSION 7 · 14:30

ELIO SACCO

Elio Sacco (email: elio.sacco@unina.it; ResearcherID: G-5349-2017; ORCID: https://orcid.org/0000-0002-3948-4781) is retired full Professor (with tenure) of Solid and Structural Mechanics at Department of Structures for Engineering and Architecture, University of Naples "Federico II".
He had numerous abroad research experiences, e.g. in USA, France, UK. He was Member of the Evaluation Expert Group (GEV-ANVUR); Member of Evaluation Team of the University of Cassino; Chair of PhD Committee in Civil and Mechanical Engineering; Member of Academic Senate; Head of the Department. He has editorial responsibilities and is referee of many scientific journals.
The main research fields are: Material constitutive modeling of advanced materials (shape memory alloys); Micromechanics and homogenization techniques for composite materials characterized by nonlinear behavior of the constituents; Multiscale analysis of heterogeneous structures; Mechanics of masonry materials and structures; Analysis of plate and shells.
Bibliometric data (updated at October 2024):
 Scopus Documents 225 (193 from 1999)
 Citations 6496 (with no self-citations 5638)
 h-index 43 (with no self-citations 39)

MULTISCALE NONLINEAR ANALYSIS OF COMPOSITE MATERIALS: TFA TECHNIQUE

The Transformation Field Analysis (TFA) represents an effective homogenization technique for deriving the response of heterogeneous composite media that exhibit nonlinear behavior. In accordance with the TFA, the behavior of the representative volume element (RVE) is examined, taking into account the nonlinear effects through the incorporation of a uniform or nonuniform inelastic strain distribution within the nonlinear constituents of the heterogeneous material.
Over the past two decades, various formulations of the TFA have been developed, employing a range of approaches, including a uniform or nonuniform strain approach[1-3], a mixed approach [4], and a stress approach [5]. Furthermore, optimization techniques have been proposed for the optimal
discretization of the RVE into subsets.
The TFA has been successfully employed for the determination of the overall constitutive response for a diverse range of nonlinear composite materials, exhibiting characteristics such as plastic, viscoplastic, damage, fracture, and shape memory behavior. Numerical applications have been conducted.



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Friday · 25 April 2025 · SESSION 10 · 15:00

GABRIEL ZARZOSO BUENO

Research engineer at IMDEA Materials Institute in the Multiscale Materials Modelling group. Bachelor's degree in Aerospace Engineering by Polytechnical University of Madrid (UPM) and Master in Applied Mathematics at UPM. Since 2022, PhD student at the UPM. Expertise in Reduce Order Modelling, multiphysics, Phase-Field Fracture and FFT-Homogenization

AN FFT BASED CHEMO-MECHANICAL FRAMEWORK FOR MICROSCOPIC FRACTURE SIMULATIONS

In this work, an FFT based method is proposed to simulate chemo-mechanical problems at the microscale including fracture. The methodology involves the full coupling of three fields: concentration, deformation gradient, and damage. The simulations rely on an staggered approach in which the three coupled problems are solved sequentially until convergence is achieved.
The mechanical problem is solved using Fourier Galerkin for non-linear problems. The damage is modeled through the Phase Field Fracture approach using a stress-driven force in Fourier space and solved via a conjugate gradient solver with an ad-hoc preconditioner. The chemical problem is modeled by the second Fick's law and physically based chemical potentials, is integrated in time using the backward Euler method, and is solved through Newton-Raphson iteration combined with a conjugate gradient solver. Additionally, buffer layers are introduced when necessary to break the periodicity and emulate Neumann boundary conditions for incoming mass flux.
The proposed methodology is first applied to simulate chemo-mechanical damage in the active particles of ion-lithium batteries. In these particles, the intercalation and deintercalation cycles in the electrode particles induce crack initiation and propagation which degrades their behavior. Second, the framework is employed to model hydrogen embrittlement fracture, where the hydrogen population is subdivided into two classes: trapped hydrogen and (mobile) lattice hydrogen. The method solves large problems at a reduced computational cost while accurately reproducing the crack patterns observed in experiments.

Friday · 25 April 2025 · SESSION 9 · 12:00

GUILLERMO RUS CARLBORG

Over the past ten years, the central objective of my research has focused on ultrasonic tissue mechanics, following my Fulbright postdoc at MIT (US, 2002), both in fundamentally understand the interaction between ultrasound and tissue (theory and experimentation, from propagation of linear and non-linear viscoelastic waves, to their multiscale and multiphysics histological and biochemical interactions relevant in clinical processes), as well as in its application for individualized diagnostic and therapeutic ultrasound (conception and design of new types of waves and sensors, to prototyping clinical devices).

Being a Tenured Professor of UGR since 2009, during the past ten years, I have complemented my research career with postdoc stays in different countries, including Germany (Technische Universität Hamburg - Airbus, 2012), USA (Prognosis Center of Excellence of the NASA Ames Research Center, 2012), and Sweden (Karolinska Institutet, Division of Functional Imaging & Technology, 2016). Since 2018 I am currently Professor at the UGR (Universidad de Granada, Spain), where I coordinate the Ultrasonics Lab (TEP-959) and warrant the Excellence Research Unit Modelling Nature (MNat), which integrates biology, physics, biomedicine, engineering and mathematics to address fundamental and applied problems in the context of biomechanics, tumour dynamics, and physics of new materials. I also head the Biomechanics Group (IBS-TEC12) of the Biosanitary Research Institute.

My active role in promoting young research careers has produced 10 doctoral thesis and 6 postdocs, all currently hired in internationally renowned centers. My transfer is evident by having filed 9 patents and being the co-founder of three spin-offs: www.oritiayboreas.com (5 awards, turnover 640k€/year), www.regemat3d.com (2 awards, turnover 200k€/year) and www.innitius.com (2 awards, valued 8.2M€).

Viscosity And Nonlinear Elastography Will Be The Next Generation Biomarkers In Clinical Diagnosis

Elastic changes in a tissue are associated with a broad spectrum of pathologies, which stems from the tissue microstructure, histology and biochemistry. This presentation aims to elucidate the potential of viscous and nonlinear elastic parameters as conceivable diagnostic mechanical biomarkers. First, by providing an insight into the role of soft tissue microstructure in linear elasticity; second, by understanding how viscosity and nonlinearity could enhance the current diagnosis in elastography; and finally, by compounding preliminary investigations of those elastography parameters within different technologies.

Ultrasonic elastography characterization and understanding of soft tissue is recently being developed as a clinical diagnostic tool. New elastography sensor technologies, from hardware to algorithms, are bound to endow a new class of biomarkers that quantify the mechanical functionality and abnormalities in the structural architecture of soft tissues are intimately linked to a broad range of pathologies including tumors, atherosclerosis, ageing, liver fibrosis or osteoarticular syndromes, to name a few. These higher order mechanical parameters may become key discriminating biomarkers since: (1) the physics of wave propagation is explaining how dispersion is a compound expression of the rheological, poroelastic, and microstructural scattering and (2) the extreme hyperelasticity that soft tissue exhibits clearly manifests as quantifiable harmonic generation.

Thursday · 24 April 2025 · SESSION 6 · 11:30

JACOPO CIAMBELLA

Jacopo Ciambella is an Associate Professor in Solid and Structural Mechanics with academic and research background in the field of mechanics of materials. He holds a degree in Electronic Engineering and a PhD in Structural Engineering from Sapienza University of Rome. His academic career includes a tenure as a Lecturer in Composite Materials Engineering at the University of Bristol, where he also contributed to the PhD School in Advanced Composites at the Bristol Composites Institute (formerly ACCIS). Additionally, he has served as a Visiting Researcher at the Department of Aerospace Engineering at the University of Bristol.
His research interests encompass the linear and nonlinear theories of elasticity and viscoelasticity, with applications to polymers, composite and nano-composite materials, and fiber-reinforced systems. He is also engaged in the field of structural identification and monitoring.
He was awarded the Sapienza Prize for the Best PhD Dissertation in Engineering in 2012. He is also the author of the monograph "An Introduction to Nonlinear Viscoelasticity of Filled-Rubber," published by Sapienza Editrice.

CRACK GROWTH IN VISCOELASTIC SOLIDS: THE INTERPLAY OF ELASTICITY AND DISSIPATION

The fracture of viscoelastic materials presents a complex interplay between elasticity, viscoelasticity, and crack propagation, posing significant challenges in accurately predicting failure behavior. These materials, which encompass a wide spectrum of applications—from industrial elastomers to biological tissues—exhibit time-dependent mechanical responses that influence their fracture toughness and energy dissipation mechanisms. Understanding how elastic and viscoelastic contributions interact during crack initiation and propagation is essential for designing resilient materials and optimizing their performance in real-world applications such as aerospace, biomedical devices, and soft robotics.
In this work, we propose a comprehensive phase-field fracture model that captures the intricate relationship between elastic and viscoelastic effects in the fracture of soft materials. The model incorporates a thermodynamically consistent formulation that distinguishes between equilibrium and non-equilibrium elastic energies, accounting for rate-dependent dissipation mechanisms and irreversible damage processes. A novel aspect of the model is the introduction of two characteristic time scales, which separately govern the long-term viscoelastic relaxation of the bulk material and the short-term damage evolution near the crack tip. This dual-timescale approach enables a deeper understanding of how stored energy and dissipation influence crack propagation dynamics.
Through extensive numerical simulations, the model's predictive capabilities are evaluated against experimental observations, on filled rubber demonstrating its ability to reproduce key fracture phenomena, including crack speed transitions and energy dissipation patterns. The findings highlight the model's potential to inform the design of advanced viscoelastic materials with enhanced fracture resistance and tailored mechanical properties.

Friday · 25 April 2025 · SESSION 9 · 11:30

JÉRÔME NOAILLY

Jérôme Noailly holds degrees in physical chemistry, material science, and acoustics. He began a PhD in spine computational biomechanics at Universitat Politècnica de Catalunya (UPC) in 2002, focusing on finite element modelling. In 2006, he received a Marie Skłodowska-Curie fellowship to work on computational mechanobiology for cartilage tissue engineering at the AO Foundation (Switzerland) and Eindhoven University of Technology (Netherlands). Returning to Barcelona in 2009 with a Marie Skłodowska-Curie reintegration grant, he resumed spine modelling at the Institute for Bioengineering of Catalonia (IBEC). In 2012, he became PI of the European project My Spine, and of the Biomechanics and Mechanobioogy group, at IBEC, expanding his research to computational systems biology.
In 2015, Jérôme joined Universitat Pompeu Fabra (UPF) as PI of the Multiscale and Computational Biomechanics and Mechanobiology (MBIOMM) group, integrating medical image analysis and machine learning into his research. He consolidated multiscale computational systems biology approaches, received a Ramon y Cajal fellowship in 2016, and became Full Professor in 2023. Currently co-director of the SIMBIOSys group, he leads the Biomechanics and Mechanobiology Area at the Barcelona Centre for New Medical Technologies. He coordinates the European Doctoral Metwork Disc4All and the ERC Consoldator O-Health projects, along with other national and regional projects, in both research and transfer of technology.
Jérôme has supervised 15 PhD theses, authored 52+ journal articles, and contributed to 160+ conferences. He has held leadership roles in the European Society of Biomechanics (ESB), serving as Treasurer, Vice-President, and as past president of its Spanish Chapter. He also chairs the Student Committee of the Virtual Physiological Human Institute.

SYSTEMS MECHANOBIOLOGY TO EXPLORE NON-COMMUNICABLE DISEASES THAT AFFECT LOAD-BEARING ORGANS

While the burden of infectious diseases has decreased over the last decades globally, the one of Non-Communicable Disease and Disorders (NCD) continues increasing, in terms of premature loss of life quality and years of life. As such, NCD represent 70% of the top-10 disabling and lifethreatening diseases and disorders worldwide. Remarkably, more than half of these NCD affects mechanical load-bearing organs and tissues, and the identification of modifiable risk factors and of therapeutic targets is a major challenge. On the one hand, NCD can evolve subclinically over decades. On the other hand, the mechano-regulation of the cells that populate and regulate load-bearing tissues and organs makes pathophysiological processes be hugely multifactorial, driven by intricate physical, biophysical and biological phenomena. Computer models and simulations able to mechanistically represent key regulation phenomena over the scales are becoming increasingly valuable, to identify different pathophysiological mechanisms and stratify risk factors, for example in musculoskeletal joint degeneration. Yet, a large spectrum of the computer models and simulations must be employed, combining physics-based, biology-based, systems-based, and knowledge- and data-driven modelling. An overview of the development, analysis and achievements of such heterogeneous modelling approach, in rheumatology, will be given.

Thursday · 24 April 2025 · SESSION 6 · 12:00

MARCO PAGGI

Prof. Paggi is Full Professor of Structural Mechanics at the IMT School for Advanced Studies Lucca from 2017, where he founded the research unit MUSAM on multi-scale analysis of materials in 2013 and he currently serves as Deputy Rector. Graduated in Civil Engineering with honors from Politecnico di Torino in 2002, he earned the PhD in Structural Engineering in 2005 from the same university and was appointed Assistant Professor from 2007 to 2013. In 2010 he was recipient of the Alexander von Humboldt fellowship at the Leibniz University of Hannover. He has been principal investigator of several Italian and EU projects, including an ERC Starting Grant in 2012 and an ERC Proof of Concept Grant in 2016. He is honorary assistant at the University of Seville and has been appointed visiting professor at University of Girona, IIT Delhi, and University of Paris-Est.

AN INSIGHT INTO MECHANICS OF CELLULOSE PAPER: STATISTICAL MODELLING, CONTINUUM SIMULATION AND IN-SITU EXPERIMENTS

Mechanics of paper materials is challenging due to the underlying network of cellulose fibres. We propose a statistical mechanics model to predict the anisotropic response of paper just as a result of the statistical distribution of fibers' orientation. Key microstructural phenomena -such as fibers' recruitment, debonding and progressive tensile failure- are experimentally assessed through in-situ tensile tests. Finally, we show how to incorporate model results into an equivalent nonlinear elastic continuum framework for finite element computations.

Wednesday · 23 April 2025 · SESSION 4 · 16:30

MARIA VITTORIA SALVETTI

Maria Vittoria Salvetti is a Full Professor of Fluid Dynamics at the Department of Civil and Industrial Engineering, University of Pisa.
She serves as the Chair of the Scientific Programme Committee of the European Research Community on Flow, Turbulence and Combustion (ERCOFTAC) and is a member of the EUROMECH Council.
She is the Editor-in-Chief of Flow, Turbulence and Combustion, Associate Editor of Computers and Fluids, editor of the ERCOFTAC Book Series (Springer), and a member of the advisory board of Acta Mechanica. She has been, and continues to be, a member of the organizing and scientific committees of numerous international conferences (e.g., DLES, ETMM, FRONTUQ, TI series).
Her main research interests include simulation and modeling, with a focus on Large-Eddy Simulation of turbulent flows (e.g., bluff-body flows, particle-laden flows, wind turbines), reduced-order models for fluid dynamics, flow control, drag reduction, uncertainty quantification and stochastic sensitivity analysis in CFD, microfluidics, and cardiovascular flows.
She is the author of approximately 190 scientific publications indexed in Scopus.

Flow around elongated bluff-bodies: flow features and challenges in simulations and experiments

The flow around elongated bluff bodies is of significant interest in engineering, as they serve as simplified models for structures like high-rise buildings or bridge sections. A key phenomenon is the separation of shear layers, which become unstable and generate vortical structures. These vortices are convected downstream, interacting with each other and the solid surface. The resulting mean flow features a recirculation region that ends with mean flow reattachment on the body surface. This scenario is further complicated by turbulence transition and turbulence itself.

This talk reviews experimental and numerical studies to shed light on the dynamics of separating and reattaching flows and their influence on overall flow characteristics. Challenges and implications for experiments, numerical simulations and modeling are also discussed.

Friday · 25 April 2025 · SESSION 8 · 9:00

MARTA SERRANO

MSc on Mechanical Engineering in 1991 by ICAI in Madrid and PhD on Engineering by Politecnical University of Madrid in 2007

30 years of experience At CIEMAT (Spain) on the study of degradation mechanism of structural materials operating under extreme environments, in particular on the determination of mechanical properties by small specimens.

Head of the Division of Materials of Energy Interest at the Department of Technology since 2016. She has very active participation on EURATOM funded projects since the last 20 years. She is currently the coordinator of the H2020-ENTENTE project, leader of the WP on additive manufacturing of the EASI-SMR project and coordinator of the Materials R&D subgroup of the European Industrial Alliance on SMRs. She is very active in international forums as IAEA, OCDE/NEA and member of ISO and ASTM standardization committees. At national level, she is the principal investigator of a national-funded project on sustainable AM techniques, and she coordinates the Materials Group on the Spanish Nuclear Fission Energy Technology Platform and of the Materials for Energy group of the Advanced Materials and Nanomaterials Spanish Technological Platform.

Mechanical characterization by testing miniaturized specimens

Friday · 25 April 2025 · SESSION 8 · 10:00

MOISÉS WEBER

Moisés Weber is the Deputy Director of the IFMIF-DONES España consortium and Executive Office Leader of the DONES On-Site Joint Team. He holds a PhD in Industrial Engineering, an Executive MBA, and a PMP certification in Project Management. Active since 1999, he has been working in the field of fusion energy and has contributed to the IFMIF-DONES project since its inception in 2005.

A FUSION-LIKE NEUTRON SOURCE WITH UNPRECEDENTED EXPERIMENTAL CAPABILITIES

IFMIF-DONES (International Fusion Materials Irradiation Facility – Demo Oriented Neutron Source) is a cutting-edge facility that generates a high-intensity, fusion-relevant neutron flux to test and qualify radiation-resistant materials and tritium breeding blanket technologies under extreme irradiation conditions, replicating those expected in future fusion reactors.
Beyond being a key milestone on the path to commercial fusion energy, IFMIF-DONES offers unique capabilities that will also support research in industrial applications, fundamental physics, aerospace, and medical sciences, making it a strategic asset for the global scientific community. This has led to the growth of the DONES Users Community, which is actively exploring new applications to expand its impact.

Friday · 25 April 2025 · SESSION 10 · 14:30

PILAR FERNÁNDEZ PISÓN

Dr. Pilar Fernández-Pisón is a research engineer specialized in Mechanics of Materials, with expertise in experimental mechanics and materials modeling. She completed her Ph.D. in Mechanical Engineering at Universidad Carlos III de Madrid, Spain, in September 2023 and is currently a postdoctoral researcher at the Centre des Matériaux, Mines Paris PSL in France. Dr. Fernández-Pisón has conducted research at CERN, Switzerland, and contributed to the ITER nuclear fusion project. Her work focuses on understanding material behavior under extreme conditions, such as at cryogenic temperatures and in high-pressure hydrogen environments.

OXYGEN INHIBITION OF GASEOUS HYDROGEN EMBRITTLEMENT IN STEEL: EXPERIMENTS AND SIMULATIONS

This work investigates the potential of using oxygen as a gas-phase inhibitor of hydrogen embrittlement in steel pipelines designed for gaseous hydrogen transport. The results of tensile tests conducted under a gaseous hydrogen-oxygen mixture are presented, analyzing the influence of oxygen concentration, total pressure, and strain rate. Additionally, a numerical simulation model is introduced, which is based on a nonlocal Gurson–Tvergaard–Needleman (GTN) model coupled with hydrogen diffusion and incorporating an "oxide-layer" boundary condition. The results of this ongoing investigation suggest that small additions of oxygen to the transported hydrogen could enhance pipeline durability.

Wednesday · 23 April 2025 · SESSION 3 · 14:30

RALPH SINKUS

Being a physicist with a background in high energy physics, nuclear physics and MRI, I am working with my research team in Paris in a scientific and yet clinical environment strongly oriented towards translational research (University Paris Cite Cité, Hôpital Bichat/Beaujon, Paris, France).

I spent half of my scientific career in industry and half in academia. During my PhD in high energy physics (DESY, Deutsches Elektronen Synchrotron, Hamburg, Germany) I workd on quantum electrodynamics and chromodynamics. After my PhD (1997) I took a position at Philips Medical Systems Research Laboratories in Hamburg, Germany. My main focus of research was in the domain of MRI and in particular in the field of MR-elastography (MRE).

In 2004 I decided to leave the industrial research in order to further develop my academic career. I followed a call to the "Laboratoire Ondes et Acoustique", ESPCI, Paris, France and was offered a 3 years position as research director (CNRS) in order to establish a MRI group. My academic research activities were accompanied by collaboration with a newly founded ultrasound company (Supersonic Imaging, France). In 2007 I obtained a permanent position as research director at CNRS. This inspired me to move towards a new scientific environment offering me the possibilities to have access to three spatial scales: molecular and cellular level, small animal scale, and access to patients. Hence, I was able to develop more freely and comprehensively my own research program.

In 2013 I followed a call to King's College London as Chair in Biomedical Engineering. Together with exciting collaborators in computational modelling (David Nordsletten) and clinicians working on breast cancer (Arnie Purushotham) we obtained a EU-funded Horizon 2020 project aiming to quantify non-invasively the pressure a tumour exerts on its surroundings, which is a keymarker for response/resistance to chemotherapy.

In 2018 decided to return to France. I have right now a split lab in Paris and London working on the quantification of tissue biomechanics in various domains, ranging from fibrosis & inflammation in the domain of diffuse liver diseases, gauging response to therapy in the domains of breast & liver cancer, cardiovascular biomechanics, over to neuronal application where we observe neuronal activities at 10ms temporal resolution through biomechanics. We are also investigating the biomechanics of tissue organoids at scales as small as 20mm. One key aspect we are currently investigating is the ability of waves to inform not only about the constitutive hence intrinsic integrity of tissue, but also about the vascular organization due to multiple scattering effects.

IDENTIFICATION OF THE PRE-FIBROTIC NICHE IN LIVER PATIENTS, GAUGING RESPONSE TO THERAPY IN BREAST CANCER, AND "SEEING" THE BRAIN AT WORK THROUGH BIOMECHANICS

The non-invasive quantification of biomechanics through imaging is a recent and exciting field of translational research, as its not only allows to quantify fundamental biological processes regarding their modulation in stiffness, but to also impact patient pathway through advanced diagnosis. Here we will focus on MR-Elastography, i.e. the imaging of mono-frequent mechanical waves via MRI in 3D enabling an unbiased spatial reconstruction of the complex-valued shear modulus, i.e., dynamic and loss modulus. Multi-frequency MRE allows subsequently to explore the dispersive properties, which - as recently understood [1] - allow to infer through multiple scattering processes the spatial architecture of the tissue vasculature due to its strong contrast in stiffness. Thereby, MRE turns into a tool that allows to quantify constitutive properties characterizing the intrinsic integrity of tissue, as well as its vascular organization which is crucial for tumour characterization as well as gauging response to therapy.
We will discuss the following "hot" topics in future precision medicine: 1. Can we identify patients with a liver that has been damaged due to inflammatory processes before fibrotic processes turn it into an irreversible state [2]? 2. Is biomechanics capable to aid the identification of responders/non-responders in neo-adjuvant chemotherapy for breast cancer[3], and 3. do neuronal processes modulate mechanics at the timescale of the switching of a neuron, i.e. as fast as 10ms[4]?

1. Annio, G., et al., *Making sense of scattering: Seeing microstructure through shear waves.* Sci Adv, 2024. **10**(31): p. eadp3363.
2. Koch, V., et al., *Biomechanical Assessment of Liver Integrity: Prospective Evaluation of Mechanical Versus Acoustic MR Elastography.* J Magn Reson Imaging, 2024.
3. Tumor Biomechanics Quantified Using MR Elastography to Predict Response to Neoadjuvant Chemotherapy in Individuals with Breast Cancer. RYCAN-24-0138.R2
4. Patz, S., et al., *Imaging localized neuronal activity at fast time scales through biomechanics.* Sci Adv, 2019. **5**(4): p. eaav3816.

Wednesday · 23 April 2025 · SESSION 2 · 12:00

RENA C. YU

Dr Yu received a BS degree in Aeronautics from the Beijing University of Aeronautics and Astronautics (BUAA), Beijing, China, in 1994, and MS and Ph.D. degrees in Aeronautics from the California Institute of Technology, Pasadena, USA in 1997 and 2001, respectively. She moved to the University of Castilla- La Mancha, Spain in 2001 through a postdoc grant. From 2003-2007, she held a researcher position funded by the Spanish Program Ramón y Cajal. She secured the tenured position in 2009 and was appointed as a full professor of Continuum Mechanics in 2019.
Dr. Yu's research primarily focuses on the computational analysis of fracture and fatigue damage in quasi-brittle materials, employing both finite element and meshfree methodologies. Currently, she serves as the Vice-President of SEMTA and has been an active member of the General Council for the International Association for Computational Mechanics since 2022. She is also a part of the Congress Committee for the International Union of Theoretical and Applied Mechanics for the term 2024-2028 and acts on the National Evaluation Committee for Professor Accreditations in Mechanics for the term 2024-2026.

FATIGUE-INDUCED SELF-HEALING IN CEMENTITIOUS MATERIALS

We analyze the fatigue behavior in connection with the crucial role of fiber reinforcement, focusing on its impact on post-cracking toughness, crack propagation mechanisms, and fatigue endurance. Autogenous self-healing in steel-fibre reinforced cementitious materials is observed where fatigue-induced microcracks prompt the release of occluded water, leading to the rehydration of cementitious particles and the precipitation of calcium carbonate, enhancing residual strength. The interaction between size effect, fiber content, and self-healing is discussed, providing insights into how these factors can improve the material's long-term durability under cyclic loading. The practical implications are significant for the design of SFRC structures, particularly for elements subjected to compressive fatigue, such as wind turbine towers and railway slabs.

Friday · 25 April 2025 · SESSION 8 · 9:30

SERGEI L. DUDAREV

Sergei L. Dudarev was born in Belarus, grew up in Tbilisi, Georgia, and studied mathematical physics at the Moscow Engineering Technical University. In 1989 he was awarded a Moscow Komsomol Prize for outstanding scientific achievements and in 1991 a Royal Society Research Fellowship. He moved to Oxford, UK in 1992, becoming a Fellow of Linacre College, Oxford in 1995. From 2005 S.L. Dudarev leads computational materials science research at UK Atomic Energy Authority, and European programmes in modelling and simulation of radiation effects in fusion materials. He held visiting professorships at the Hong Kong Polytechnic University and the University of Hong Kong, and a distinguished visiting lectureship at the Los Alamos National Laboratory. He is an author of a treatise on Electron Diffraction and Microscopy published by the Oxford University Press in 2004, and over 270 papers on subjects spanning the theory of electron diffraction and imaging, methods of electronic structure calculations, and mathematical models for fusion reactor materials. He is a Fellow of the Institute of Physics, and a member of editorial boards of Frontiers in Nuclear Engineering, Physical Review Materials, Journal of Nuclear Materials, and Nuclear Fusion.

MODELS FOR EFFECTS OF RADIATION EXPOSURE IN MATERIALS AND FULL REACTOR STRUCTURES: FUNDAMENTALS AND APPLICATIONS

Effects of neutron exposure on materials, components, and entire reactor structures are a major source of uncertainty associated with nuclear fission and fusion reactor design. Exposure of materials to energetic neutrons and gamma-quanta gives rise to swelling and dimensional changes, leading to the deformation of reactor components; it alters the mechanical response to applied loads, electrical and thermal conductivities, optical properties, as well as the corrosion resistance of materials.

The fact that the environment, in which materials operate in a fission or fusion power plant, is fundamentally different to that typically encountered in civil engineering, is well recognised. There are now major research programmes aiming at creating reactor environments in experimental tests and assessing the effect of irradiation on specific properties of materials. However, the selection of radiation environments is often driven by qualitative judgement, emphasizing either high radiation exposure, or high temperature effects, or the rates of corrosion under the otherwise not fully representative radiation conditions.

Recently, our effort has been focused on the development of a holistic model for a full tokamak power plant that is expected to self-consistently define the local operating environments for materials, closing the loop involving the models for radiation effects and the corresponding experimental tests.

Wednesday · 23 April 2025 · SESSION 3 · 15:00

STEFAN CATHELINE

Stefan Catheline received his PhD degree in physics (1998) from University of Paris VII (Denis Diderot) for his work on transient elastography. His research conducted him from University of Paris to University of Lyon, France, via University of California, San Diego, USA, and University of Montevideo, Uruguay. Travelling was the occasion to learn about medical ultrasounds, underwater acoustics, wave physics, and seismology among other things. He holds 12 patents in the field of ultrasounds and seismology and wrote more than 100 research articles. He has been co-founder of two companies: Sensitive Object in the field of acoustic interactivity and SEISME in the field of elastography. He is now director of research in the LabTAU, INSERM, University of Lyon.

UNVEILING TISSUE SECRET USING VIBRATIONS

The first part is devoted to human soft tissues. Elastography, sometimes referred as seismology of the human body, is an imaging modality now implemented on medical ultrasound systems, on MRI and recently in optical coherence tomography devices. It allows to measure shear wave speeds within soft tissues and gives a tomography reconstruction of the shear elasticity. The shear elasticity being the elasticity felt by fingers during palpation, elastography is thus a palpation tomography. In the first part of this presentation, a passive elastography method is described. Inspired by noise correlation seismology and time reversal, it allows to extract from natural shear waves produced in the human body by heart beatings, muscles activities, arterial pulsations, a shear wave speed estimation. Therefore, an elasticity palpation mapping with no shear wave source is conducted. Latest developments in micro-elastography of a single cell will be described.

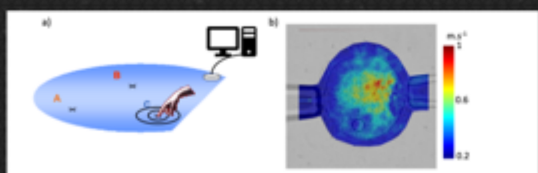


Figure : a) Experimental measurement of elasticity table, b) elasticity palpation of a single cell (oocyte).

SOCIAL PROGRAMME

WELCOME RECEPTION

Wednesday 23 April, 19:30

Carmen de los Mártires (Pº de los Mártires, s/n)

The Carmen de los Mártires is a historic complex located on the Mauror hill, near the Alhambra. It combines a 19th-century manor house with gardens designed in French, English, and Hispano-Muslim styles. The site offers panoramic views over the city of Granada and its natural surroundings. The welcome reception of the STAMS2025 Colloquium will be held at this venue, providing a suitable setting for the initial gathering of participants.

NIGHT VISIT TO THE ALHAMBRA

Wednesday 23 April, 22:00

Palacios Nazaríes (Alhambra)

The night visit to the Nasrid Palaces of the Alhambra is one of the cultural activities scheduled as part of the STAMS2025 Colloquium. This guided tour takes place in the evening hours and offers access to the main areas of the palace complex, with very limited capacity. Access to the monument is strictly by personalized ticket and therefore restricted to participants who have reserved a place in advance during registration.

SOCIAL PROGRAMME

TOUR TO THE HISTORIC CENTER

Thursday 24 April, 17:30

Meeting point: near the Cathedral

The walking tour through Granada's historic city centre is open exclusively to participants who have preregistered for this activity and are not attending the SEMTA Assembly. The guided tour includes key urban and architectural landmarks such as the Cathedral, the Alcaicería and the lower Albaicín. This activity is intended to complement the academic programme of the colloquium by offering a perspective on the city's built heritage from both structural and historical viewpoints.

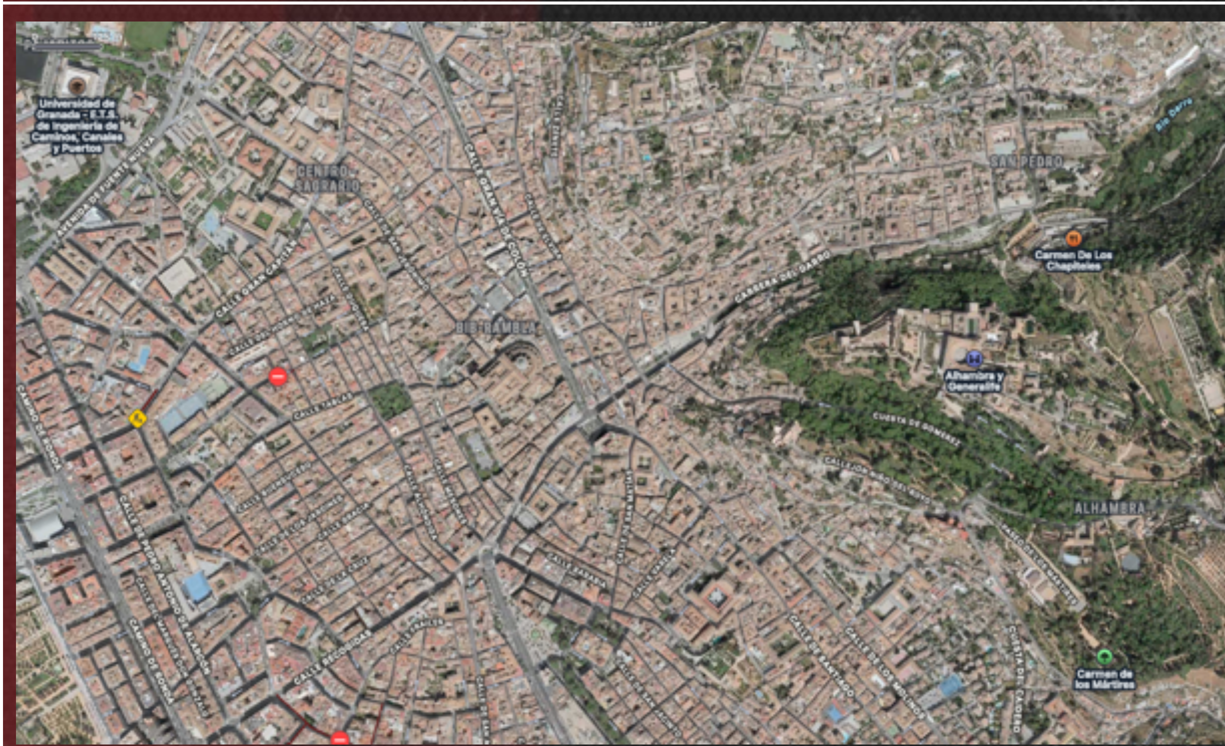
CONGRESS BANQUET

Thursday 24 April, 20:30

Carmen de los Chapiteles (Cam. Fuente del Avellano, 4)

The Carmen de los Chapiteles is a building of Andalusí origin located on the slopes of the Alhambra, currently adapted for cultural and institutional events. Its location provides exceptional views over the Albaicín and the city of Granada. The STAMS2025 congress dinner will be held at this venue, offering an informal setting that encourages interaction among participants within a site emblematic of Granada's cultural landscape.

VENUE MAP. SCHOOL OF CIVIL ENGINEERING & SOCIAL EVENTS



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This map shows the main colloquium venue and the location of social events, including Carmen de los Mártires and Carmen de los Chapiteles.

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