S2501 - Acoustics and Vibrations "Tribute to Eng. Mario René Serra"

The Acoustics and Vibrations Session "Tribute to Eng. Mario René Serra" is dedicated to advancing the state of the art in the study of sound and mechanical waves in gases, liquids, and solids. It focuses on the study of their emission, propagation, reception, modeling, implications, and interactions. Both theoretical and experimental works are welcome, as long as they contribute new discoveries, innovative approaches, or valuable practical applications. Session main topics are:

- Acoustic Engineering and Noise Control
- Environmental acoustics
- Architectural acoustics
- Audiology and Sound Perception
- Digital Processing of Sound Signals and Numerical Techniques
- Structural Acoustics and Vibrations
- Underwater Acoustics and Bioacoustics
- Modal Analysis
- Acousto-Structural Interaction

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S2502 - Structural Analysis

This session aims to present and discuss investigations in structural analysis and design that employ numerical methods in their development. Session main topics are:

- Structures of different types: beams, columns, frames, arches, plates, shells
- Structures of various materials, (homogeneous and composite materials): steel, reinforced or prestressed concrete, mixed structures, composite structures
- Structures subjected to: vibrations, static and dynamic loads: wind, earthquake,impact, ...
- Procedures for structural design
- Damage assessment and structural reliability

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S2503 - Computational Fluid Mechanics

The topics of interest in this Session are related to the development of numerical or computational techniques, as well as to the application of consolidated techniques to problems in the Fluid Mechanics field. This Session is devoted to the development or study of numerical techniques based on finite elements, finite volumes, finite differences, boundary elements, particle methods, and any other that allows to obtain a numerical solution of boundary value problems, initial value problems, or mixed ones. Likewise, the areas of applications include: aeronautics, astrophysics, biology, chemistry, mechanical engineering, bio-mechanics, process engineering, environmental engineering, hydraulic, meteorology, oceanography, geology, acoustics, and combustion, among others. This variety of applications allows addressing topics such as numerical simulations of flows at high Reynolds number, involving a turbulence modelling by means of different techniques (DNS, LES, RANS, hybrid RANS/LES or other models), flows at low Reynolds number (Stokes flows), multi-phase flows, transport of species, wind, flows in porous media, or microfluidics. In all of the cases, the validation of the numerical models against analytical, semi-analytical and/or experimental results, the suitable calibration of them, and their application to real cases are also important topics in this Session.

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S2504 - Structural dynamics

The session is focused on the presentation and discussion of works concerning the analysis and design of structural systems subjected to dynamic actions, i.e., actions that vary in magnitude and/or position over time, such as wind actions, seismic loads, explosions, impacts, periodic vibrations, etc.

The works should include developments and/or applications of numerical methods and computational techniques, which may be accompanied by theoretical aspects and experimental validations. Papers related to discrete and continuous systems, linear and nonlinear behavior, deterministic and random systems are included, with applications to civil, mechanical, aeronautical, naval structures, etc.

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S2505- Multiphase Flow and Transport in Porous Media and Microscale

The session is dedicated to the presentation of works involving the resolution of fluid flow and/or transport in non-homogeneous media or systems. Generally, these non-homogeneities occur on a micrometric scale, and examples include porous media, microdroplets, microemulsions, or heterogeneities due to the accumulation of electric charges in solution, among others. Two intrinsic characteristics of the mentioned physical systems are laminar fluid flow regimes or very low Reynolds numbers, and for mass transport, the high Péclet number. Among the applications that could be part of this session, we can include:

- Paper microfluidics
- Studies of microdroplets and microemulsions
- Transport in artificial biological media
- Transport of biomolecules in micro- and nanostructured spaces
- Transport in soils and underground media
- Lubrication Flow

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S2506 - Computational Mechanics of Solids

This session focuses on the application and development of numerical methods for the computational simulation of general solid mechanics problems, including the development and implementation of innovative methods for traditional problems or the use of existing methods to solve new problems. The main topics of the session include, among others:

- Formulation and implementation of constitutive theories
- Problems related to homogeneous or heterogeneous, linear or nonlinear solids
- Problems involving large deformations, contact and impact
- Mechanical behavior and the use of new materials
- Interfaces and bonding in composite systems
- Mechanical behavior under special actions (e.g. high temperatures)
- Prediction of failure or inestability

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S2507 - Modeling of Multibody Systems

This session aims to cover the latest advances in modeling and the development of numerical methods for multibody systems (MBS). It is dedicated to exploring theoretical and computational methods in rigid and flexible multibody systems, their applications, and the experimental procedures used to validate theoretical foundations. The goal is to present new fundamental approaches used in computer-assisted kinematic and dynamic analysis of multibody systems, as well as methods for mechanism synthesis, and to identify future research directions in the field. In the context of multibody modeling, topics of interest include, but are not limited to: new formulations and models of flexible multibody mechanics; formulations for multibody mechanics based on Lie groups, dual numbers, and screw theory; time integration methods for multibody dynamics with constraints; contact and impact mechanics; reduced-order methods in multibody dynamics; methods for kinematic synthesis of mechanisms. Also welcomed are advanced applications of multibody system modeling in areas such as wind turbines, vehicles, robotics, biomechanics, aerospace engineering, engines, and micro-electro-mechanical systems, among others.

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S2508 - Multiscale Modeling of Mechanics and Physics of Complex Materials

This session gathers contributions on recent advances in modeling material responses across multiple spatial and temporal scales. Topics of interest include developments and applications of constitutive theories that describe mechanical, physical, and coupled responses such as elastoplasticity, viscoplasticity, hyperelasticity, thermal conductivity, ferroelectricity, etc. Developments based on homogenization methods and molecular dynamics will be of particular interest. The main topics of the session are:

- Constitutive modeling
- Multiple scales
- Homogenization
- Molecular dynamics

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S2509 - Multiphysics

This session deals with algorithms, numerical techniques, and scientific or industrial applications involving multiphysics problems, i.e., problems where multiple physical fields are coupled. Typical examples are:

- Fluid-structure interaction
- Electro and Thermo mechanical interaction
- Free surface problems
- Magneto Hydro-Dynamics
- Fluid Dynamics with chemical reactions
- Hydro- and Aeroelasticity

The session particularly focuses on: (i) situations where the interaction between different physical fields is fundamental; (ii) new algorithms that address this interaction in a special way; (iii) numerical analysis and modeling techniques used in multiphysics, among others.

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S2510 - Mathematical Foundations of Numerical Methods

The papers of interest in this session are related to the development and/or analysis of numerical techniques applicable to solving boundary value, initial value, or mixed problems, including those based on finite element methods, finite volume methods, finite difference methods, boundary element methods, or others. The emphasis in these works is on the mathematical aspect and foundations of the techniques employed, without limitation to the possible application of the considered method.

More specifically, the following topics fall within the scope of this session: formulation of reduced models, element technology (e.g., enriched formulations), methods for solving linear and nonlinear systems of equations, chimera methods or related global/local schemes, stabilization schemes, and studies on the existence and uniqueness of solutions to boundary value problems, among others. Areas and topics include:

- Numerical Solution of Ordinary, Partial, and Fractional Differential Equations
- Scientific Computing and Algorithms
- Stochastic Differential Equations
- Approximation Theory
- Numerical Linear Algebra
- Numerical Solution of Integral Equations
- Error Analysis and Interval Analysis
- Difference Equations and Recurrence Relations
- Numerical Problems in Dynamical Systems
- Algebraic Differential Equations
- Numerical Methods in Fourier Analysis

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S2511 - Optimization and Control: Theory and Applications

The session will include papers on numerical methods and applications related to optimization, control, and optimal control. Applications to the transportation of people, goods, fuels, and vehicular traffic will be welcomed, as well as applications in electric power, medicine, biology, health, and the environment, among others. The main topics of the session are:

- Linear, Non-linear and Combinatorial Optimization
- Continuous, Stochastic, and Game Optimization
- Variational Inequalities, Equilibria, and Mean Field Games
- Optimal Control, Numerical Solution of HJB Equations, and Real-Time Optimal Control of Systems
- Methods adapted for solving large-scale problems
- Numerical Solutions and Computational Implementation
- Optimal design and inverse problems
- Sensitivity analysis

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S2512 - Nuclear Reactors Engineering

This session aims to bring together specialists in the calculation and numerical modeling of nuclear power reactors in the areas of solids, materials, and fluids. Specifically, it focuses on structural integrity analysis, seismic studies, deterministic and probabilistic assessments, nuclear safety, and analysis of plant behavior under design conditions and beyond design basis conditions. It also covers material aging calculation under irradiation and various plant-specific mechanisms.

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S2513 - Industrial Applications

The objective of the session is to showcase case studies of numerical methods applied to solving engineering problems derived from industrial and governmental activities. The aim is to create a discussion forum where working groups related to this topic can present their progress and discuss difficulties, outstanding issues, and proposed solutions, aiming to provide increasingly comprehensive and precise answers to the problems posed by the industrial sector. The main topics of the session are:

- Industrial installations: process industry, petrochemicals, metallurgy, etc.
- Machinery: mechanical stresses, external and internal flow in components
- Structures: support systems, transportation systems, static and dynamic loads, vibrations, etc.
- Vehicles: dynamic behavior, structural stresses, external aerodynamics, interior flow in cabins, internal combustion engines
- Pressure vessels and reactors: verification of equipment subjected to pressure and temperature
- Manufacturing processes: simulation of metal parts manufacturing, composite materials, etc.
- Modeling of physical and chemical processes for industrial application: processes involving mass and energy transfer, multiphase and multicomponent systems
- Failure analysis and forensic engineering: expertise, failure studies
- FEA and CFD for device design and optimization

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S2514 - Surfaces and interfaces modeling

The objective of this session is to bring together researchers to share their latest scientific advances in the field of computational modeling of solid surfaces and interfaces. Topics of interest include theoretical computational studies and applications (simulations based on DFT, ab initio, semi-empirical methods) that describe mechanical, physical, and/or chemical properties of the systems under study. The works may be accompanied by experimental validations.

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S2515 - High Performance Computing

The objective of this session is to develop an interdisciplinary dialogue to explore how the latest trends in HPC can transform scientific and engineering problem-solving, promoting collaboration between academia, industry, and software developers.

Description: Advances in computational resources and capabilities, driven by the convergence of heterogeneous architectures and artificial intelligence, are redefining paradigms for efficiently leveraging technological resources. Over the last decade, parallelism has been the cornerstone of increasing processing speed, evolving from instruction and data levels to complex models of threads, nodes, and specialized accelerators (GPUs, TPUs, FPGAs). However, the increasing complexity of today's systems—which integrate multiple layers of parallelism, hierarchical memory, and ultra-low-latency networks—requires innovative programming and optimization strategies. These must maximize, not only performance and scalability, but also energy efficiency and sustainability, critical aspects in the era of massive data centers and cloud computing.

This session seeks to bring together researchers and practitioners addressing challenges in computational mechanics, multiphysics, and related fields by designing advanced algorithms, adaptive data structures, and optimization techniques for emerging architectures.

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S2516 - Teaching of Numerical Methods

The intensive use of numerical methods for the simulation and analysis of complex problems is now a well-established reality in the various branches of Exact Sciences and Engineering. In this context, the teaching of numerical methods has been incorporated into various undergraduate and graduate programs in different curricular areas, both specifically and transversally, with a wide range of teaching approaches, reflecting a diverse interest in their basic and applied nature.

Recently, the popularization of applications related to "artificial intelligence" (AI) has become a new challenge for the development of new teaching-learning dynamics. On the one hand, tools such as Artificial Neural Networks (ANN) allow for new approaches to the study of fundamental equations of physics, applying deep learning algorithms that complement traditional numerical methods (data-driven methods). On the other hand, large language models (LLMs) pose new opportunities and challenges at the pedagogical and didactic levels.

In this context, this session aims to create a space for discussion and reflection on how to approach, from a pedagogical and curricular perspective, both the use and deep understanding of classical numerical methods in interaction with these new computational tools. Are invited papers that include:

- Innovative teaching experiences using numerical methods as pedagogical tools.
- Innovative proposals for the curriculum design of subjects related to numerical methods.
- Case studies related to the integration of AI in traditional numerical methods courses.

Moreover, a ROUNDTABLE DISCUSSION will be organized within this session to address issues related to the pedagogical use of language models, such as chatGPT.

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S2517 - Hydrodynamics and Transport in Hydraulic Engineering

The session aims to bring together specialists in the application of numerical methods for the representation of flows in the field of water resources, hydrology, hydraulics, and environmental engineering. It encompasses both the study of dynamics and scalar transport in water bodies of natural systems (underground, fluvial, lacustrine, and maritime) as well as in hydraulic structures (spillways, effluent treatment and water potabilization).

Recent advances in methods will be analyzed, and implementation cases will be discussed related to the characterization of flow dynamic, turbulence parameters, mixing and transport processes, spectral information, influence of domain roughness, bed adaptation processes, geometric designs of structure, travel times, among other relevant aspects. The main topics are:

- Implementation of numerical schemes for the representation of hydrodynamics in natural systems and hydraulic structures
- Modeling of scalar transport
- Computational representation of erosion/deposition processes in natural systems
- Information requirements and methodologies for the calibration of numerical models
- Design criteria and geometric optimization in hydraulic structures

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S2518 – Europe-Argentina Cooperation

This Session is aimed at creating a space for bringing together authors who participate or have participated in Interaction and Cooperation Projects involving Argentina and European countries. There are many existing links, and this space hopes to foster their strengthening and growth in the field of Computational Mechanics. Papers that are part of a Cooperation Project and focus on the following topics (not exclusive) are welcome:

- Methodologies for energy and structural optimization of construction solutions
- Energy efficiency
- Life Cycle Assessment (LCA)
- Sustainability
- Application of AI to engineering problems

Organizers:
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S2519 - Computational Modeling in Bioengineering, Biomechanics, and Biomedical Systems

The aim of this session is to bring together researchers to share their latest scientific achievements in the field of computational modeling and numerical simulation of bioengineering, biomechanics, and biomedical systems. Contributions are welcome in theoretical, numerical, and practical areas in the following areas and topics:

- Anatomical modeling from medical images
- Structural and dynamic design of prostheses
- Modeling and simulation of tissue growth and remodeling
- Multiscale biomechanical modeling of living tissues
- Physiological modeling of organs and systems
- Microfluidics modeling
- Virtual and augmented reality tools for simulation and surgery
- Dynamic exoskeleton models controlled by neural, electroencephalographic, and electromyographic signals
- Disease prediction and diagnostic models
- Application of models in medical practice

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S2520 - Uncertainty Quantification and Stochastic Modeling

The rational treatment of uncertainties and their effects in computational mechanics has received increasing attention, particularly in recent years. In many cases and circumstances, loading conditions, material properties, and/or geometry exhibit variabilities of significant importance. Observations and measurements of physical processes, as well as parameters, display random characteristics. Consequently, statistical techniques and probabilistic procedures provide a very useful framework with a rational basis for the analysis of these uncertainties. In addition to uncertainty in model parameters, uncertainty in the models as a whole also plays a very important role in contemporary computational mechanics. In summary, neither a true model nor the parameters of the model are actually known deterministically. It is because of the presence of these uncertainties that the assumption that finer discretizations lead to greater accuracy becomes mythical. In this context, aspects of model validation and verification are also addressed. In this session, computational and conceptual aspects of uncertainty processing will be discussed, being the main topics:

- Uncertainty quantification
- Stochastic modeling
- Probabilistic methods in mechanics
- Dynamics of mechanical systems

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S2521 - Heat and Mass Transfer

The aim of the session is to disseminate new developments in numerical and computational modeling of heat and mass transport phenomena present in heat conduction, diffusion of chemical species, forced, natural, or combined convection, evaporation, boiling and condensation, thermal radiation, transport in porous media, design and calculation of heat exchangers, thermal insulation systems, cooling of electronic components, thermophysical properties of materials and fluids as well as their application to analyze various industrial processes related to Mechanical Engineering, Chemistry, Aerospace Engineering, Food Technology, Agricultural Engineering, Environment, among others.

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