

## BEYOND STANDARD MESHES: THEORETICAL ADVANCES AND COMPUTATIONAL CHALLENGES OF POLYTOPAL METHODS

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### ABSTRACT

Numerical methods for Partial Differential Equations based on general polygonal and polyhedral meshes represent a highly active and evolving research field. Their success is primarily driven by their inherent flexibility in handling complex geometries, which supports seamless adaptive mesh refinement and enables the construction of discrete spaces with tailored physical or mathematical properties.

This minisymposium aims to mix rigorous mathematical foundations and high-performance computational applications. We welcome contributions on a wide range of polytopal frameworks, such as the Virtual Element Method, Hybrid High-Order methods, and Discontinuous Galerkin schemes, focusing on both their theoretical properties and their impact on complex simulations.

Key topics include advanced error analysis (a priori and a posteriori), stability, and the preservation of physical structures (e.g., divergence-free constraints or tensor symme-

try) at the discrete level. Simultaneously, the session will explore the practical challenges arising in computational mechanics, fluid dynamics, and multiphysics. Particular interest is also devoted to the design of efficient preconditioners, scalable solvers, and parallel implementations, which are essential for transitioning these modern discretizations from theoretical prototypes to robust tools for large-scale scientific computing.

### **SPEAKERS**

1. Tommaso Bevilacqua (Koeln University): “GDSW-Type Coarse Spaces for High Order Virtual Element Methods”.
2. Sabrina Pellegrino (Università degli Studi di Bari): “Asymptotic Compatible Virtual Element Method on Polygonal Mesh for Nonlocal Diffusion Problems”.
3. Albert Silgado (Universidad del Bío-Bío): “A Conservative Virtual Element Method for the Navier–Stokes–Cahn–Hilliard Equations.”.
4. Kurubel Haile (Università Milano - Bicocca): “Pressure-robust ALE space–time DG method for the Stokes equations on moving domains”.
5. Lourenco Beirão da Veiga (Università Milano - Bicocca): “A Virtual Element Method for Moving Domains”.
6. Paola Antonietti (Politecnico di Milano): “High-order structure-preserving polytopal discontinuous Galerkin discretizations of conformational conversion systems”
7. Marco Verani (Politecnico di Milano): “Towards ALE-VEM for moving geometries: the virtual element method on trimmed meshes”.
8. Lina Zhao (University Hong Kong): “Divergence-free staggered DG methods for incompressible flows”.
9. Francesca Bonnizoni (Politecnico di Milano): “Polytopal Discontinuous Galerkin methods for the Fisher-Kolmogorov equation with applications to neurodegenerative diseases”.
10. Andres Rubiano Martinez (Monash University): TBA.
11. Marco Manzini (IMATI Pavia): tentative “The Cell-based Algebraic Method (CAM): Design Principles and Unified Framework”.
12. Silvia Bertoluzza (IMATI Pavia): TBA.

13. Francesca Marcon (Politecnico di Torino): “Recent advances in virtual element methods for computational mechanics”.
14. Claudio Canuto (Politecnico di Torino): “Some applications of virtual elements to fluid-dynamics”.
15. David Mora (Universidad del Bío-Bío): “Nitsche stabilized VEM for a Brinkman problem with mixed boundary conditions”.