NEMESIS
Kick-off workshop
Montpellier, 19-21 June 2024

NEMESIS

New generation
methods for numerical
simulations

The ERC NEMESIS project has been funded in the 2023 Synergy call for a duration of six years. Its goal is to lay the groundwork for a novel generation of numerical simulators by tackling key difficulties of partial differential equation problems of the 21st century:

- Incomplete differential operators in Hilbert complexes;

- The efficient solution of the discrete problems relating to the latter;

- The presence of nonlinear and hybrid-dimensional multi-physics, encountered in applications such as geological flows or magneto-hydrodynamics.

The NEMESIS project aims at overcoming the above difficulties, therefore boosting the prediction capabilities of numerical simulators in engineering and applied sciences. A key point will be the use of polytopal meshes and the higher-level point of view provided by polytopal constructions.

This kick-off workshop will gather a community of mathematicians and engineers working in the broad field of the project, with the goal of fostering exchanges and promoting long-term collaborations.

Programme

	Day 1	Day 2	Day 3
9:00	**Welcome**		
9:30	Daniele Di Pietro	Barbara Wohlmuth	Franco Dassi
10:00	Paola Antonietti	Ulrich Rüde	Ilario Mazzieri
10:30	*Coffee break*	*Coffee break*	*Coffee break*
10:45	Jérôme Droniou	Marie Rognes	Isabelle Faille
11:15	Lourenço Beirão da Veiga	Walter Boscheri	Paul Houston
11:45		Neela Nataraj	Conclusion
12:15	*Lunch break* *Poster session*	*Lunch break* *Poster session*	*Lunch break* *Poster session*
14:15	Daniel Castanon Quiroz	Jean-Luc Guermond	
14:45	Johnny Guzman	Simon Lemaire	
15:15	*Coffee break*	*Coffee break*	*Coffee break*
15:30	Lorenzo Mascotto	Marco Verani	
16:00	Alessandro Russo	Roland Masson	
16:30	Kaibo Hu	Peter Wriggers	
17:00	**End of day 1**	**End of day 2**	**End of day 3**

Keynote speakers

Antonietti Paola, Politecnico di Milano (NEMESIS PI)
Agglomeration and refinement of polytopal meshes through Machine Learning paradigms

Beirão da Veiga Lourenço, Università di Milano Bicocca (NEMESIS PI)
Convection robust elements in magneto-hydro-dynamics

Boscheri Walter, Università di Ferrara
Geometrically compatible finite volume schemes for continuum mechanics

Castanon Quiroz Daniel, IIMAS-UNAM
An introduction to HHO methods with applications to incompressible fluid flows

Dassi Franco, Università di Milano Bicocca
Divergence free Virtual Elements in fluid mechanics

Di Pietro Daniele, Université de Montpellier, IMAG (NEMESIS Corresponding PI)
Polytopal approximations of Hilbert complexes

Droniou Jérôme, CNRS, IMAG (NEMESIS PI)
Analysis approaches for polytopal schemes — The linear and nonlinear cases

Faille Isabelle, IFPEN
Some works related to general meshes in IFPEN geoscience simulators

Guermond Jean-Luc, Texas A&M
Spectral correctness of the approximation of Maxwell's equations written in first-order form

Guzman Johnny, Brown University
TBA

Houston Paul, University of Nottingham
High-Order Polytopic Discontinuous Galerkin Methods for Radiotherapy Treatment Planning

Hu Kaibo, University of Edinburgh
Towards Finite Element Tensor Calculus

Lemaire Simon, Inria Lille
Hybrid polyhedral approximation of div-curl systems

Mascotto Lorenzo, Università di Milano Bicocca
Interpolation estimates for virtual element complexes

Masson Roland, Université de Nice Côte d'Azur
Nodal fully discrete polytopal scheme for mixed-dimensional poromechanics with frictional contact at matrix fracture interfaces

Mazzieri Ilario, Politecnico di Milano
Space-time RAS for wave problems on polytopal meshes

Nataraj Neela, IIT Bombay
Lowest-order non standard FEM for Extended Fisher Kolmogorov Equations

Rognes Marie, Simula Research Laboratory
Computational mathematics for the brain's waterscape

Rüde Ulrich, Friedrich-Alexander-Universität
Hierarchical strutures are necessary for efficient solution algorithms

Russo Alessandro, Univ Bicocca
When Isoparametric met VEM (Virtual Elements for Solid Mechanics)

Verani Marco, Politecnico di Milano
Virtual Element approximation of non-Newtonian fluids

Wohlmuth Barbara, Technische Universität Münich
TBA

Wriggers Peter, Universität Hannover
Virtual elements for solids — An engineering perspective

Posters

Poster sessions will take place during lunch breaks from 12:15 to 14:15.

Bonetti Stefano, Politecnico di Milano
PolyDG methods for wave propagation phenomena in thermo-poroelastic media

Caldana Matteo, Politecnico di Milano
A Deep Learning Algorithm to Accelerate AMG Methods in Finite Element Solvers

Fumagalli Ivan, Politecnico di Milano
Discontinuous Galerkin method for fluid-poromechanics with applications to brain waste clearance

Sergio Gomez, Università di Milano Bicocca
Structure-preserving Local Discontinuous Galerkin method for nonlinear cross-diffusion systems

Laaziri Mohamed, Université de Nice-Côte d'Azur
VEM fully discrete Nitsche's discretisation of Coulomb frictional contact-mechanics for mixed-dimensional poromechanical models

Leimer Saglio Caterina, Politecnico di Milano
A high-order discontinuous Galerkin method for the numerical modeling of epileptic seizures

Perrier Vincent, Inria Bordeaux Sud-Ouest
Conservation of first order involutions in hyperbolic systems with the discontinuous Galerkin method

Ritesh, IIT Dehli
Pointwise adaptive non-conforming finite element method for the obstacle problem

Salah Marwa, Université de Montpellier
A serendipity fully discrete div-div complex on polygonal meshes

Visinoni Michele, Politecnico di MIlano
A lowest order stabilization-free mixed Virtual Element Method

Spadotto Aurelio, Université de Montpellier
Fully Discrete Approximation of an Electrostatic Problem with an Interface

Venue

The workshop will take place on the **Triolet Campus, room SC10.01** (red dot on the map of the campus). The address of the campus is

Université de Montpellier / Campus Triolet
Rue du Truel
34090 Montpellier (France)

https://maps.apple.com/?ll=43.630624,3.866397&q=Dropped%20Pin&t=h

Directions

The Triolet campus can be reached by tram.

- From the city center (*Gare Saint-Roch* or *Place de la Comédie* or *Corum* stops), take the **tram line 1** towards *Mosson* or *Occitanie*

- Get off at stop *Saint Eloi*

- Follow the map below (~10 minutes walk):
  - Walk back a few meters (the green arrow indicates the direction of the tram arriving from the city center) and **turn left** in *Avenue du Dr. Pezet*.
  - Continue until the **first street on the left** (*Rue du Truel*) and turn onto it
  - **Continue forward over the roundabout.** Shortly after you will find an **entrance to the university campus** on your right
  - IMAG building (number 9) will be just in front of you. **Walk around to the left** and you will find the conference venue (**room SC10.01**).

An interactive map of public transportations in Montpellier is available here:

https://cartographie.tam-voyages.com/?m=1&sm=ligne#12/43.6101/3.8701