Master internship and PhD proposal in numerical analysis

Title	Design and analysis of compatible polytopal methods for nonlinear PDEs.
Supervisor	Jérôme Droniou (jerome.droniou@cnrs.fr)
Period	Master internship: Spring 2026. PhD studies: starting in the fall of 2026.
Project/funder	ERC Synergy NEMESIS
Location	IMAG UMR CNRS 5149, Montpellier.

The Montpellier node of the ERC Synergy NEMESIS welcomes applications for a Master internship and/or PhD studies, starting in 2026.

NEMESIS is a 6-year project led by four principal investigators (Daniele Di Pietro and Jérome Droniou in Montpellier, Paola Antonietti and Lourenço Beirão da Veiga in Milano), funded by the European Union, and whose goal is to develop the next-generation numerical methods for complex partial differential equations. The focus of the project is on methods that can be applied on generic polytopal meshes (polygonal in 2D, polyhedral in 3D).

We are looking at recruiting a Master student for an internship in the Spring of 2026, which could be followed — pending evaluation of the internship — with a PhD starting in the fall of 2026. Alternatively, we also welcome direct PhD applications for the fall of 2026.

The topic of the research is the design, rigorous analysis and implementation of arbitrary-order polytopal methods for nonlinear PDEs. The design will be inspired by the Hybrid High-Order and/or Discrete De Rham methods [1,2], and the analysis will draw on recent results from the NEMESIS group as well as classical discrete compactness approaches [3]. Implementation will be carried out in C++, using the library developed by the Montpellier team of the project. The precise topic will be discussed by the selected applicant.

Applicants should have a strong mathematical background, having completed or being enrolled in a Master of pure or applied mathematics. They should have a good knowledge (theoretical and practical) of finite element methods based, e.g., on Lagrange, Nédélec or Raviart-Thomas elements, and have some experience in implementing mathematical algorithms (preferably in a compiled language like C++, otherwise in interpreted languages like Matlab or Python).
Applications should be sent by email to the supervisor, together with a brief resume, a transcript of the Master degree, and a letter of motivation.

References:

[1] The Hybrid High-Order Method for Polytopal Meshes: Design, Analysis, and Applications. D. A. Di Pietro and J. Droniou. Modeling, Simulation and Applications, vol 19, Springer, 2020. doi: 10.1007/978-3-030-37203-3.

https://hal.archives-ouvertes.fr/hal-02151813.

[2] An arbitrary-order discrete de Rham complex on polyhedral meshes: Exactness, Poincar´e inequalities, and consistency. D. A. Di Pietro and J. Droniou. Found. Comput. Math. 23, pp. 85–164, 2023. doi: 10.1007/s10208-021-09542-8.
https://arxiv.org/abs/2101.04940.

[3] The gradient discretisation method. J. Droniou, R. Eymard, T. Gallouët, C. Guichard, and R. Herbin. Mathematics & Applications, vol. 82. Springer, 2018, 511p. doi: 10.1007/978-3-319-79042-8.
https://hal.archives-ouvertes.fr/hal-01382358.