

# Guillaume Delay

20-Dec-2023

Laboratoire Jacques-Louis Lions  
Sorbonne Université  
4 place Jussieu  
75252 Paris cedex 05, France  
✉ [guillaume.delay@sorbonne-universite.fr](mailto:guillaume.delay@sorbonne-universite.fr)  
🌐 [www.ljll.math.upmc.fr/delay/](http://www.ljll.math.upmc.fr/delay/)

## Research Interests

- Numerical Analysis (Finite Element Method and Hybrid High Order method, unfitted meshes)
- Control and Stabilization of PDE's
- Fluid-Structure Interaction
- Interface problems
- Data assimilation

## Current position

09/2019–now **Maître de conférences**, *Laboratoire Jacques-Louis Lions*, Sorbonne Université, Paris, France.

## Former positions

09/2018– **Postdoctoral position**, *CERMICS – ENPC and INRIA*, Paris, France.  
08/2019 Hybrid High-Order Methods on Unfitted Meshes.

## Educational Background

11/2015– **PhD Thesis**, *Institut de Mathématiques de Toulouse*, Toulouse, France.  
08/2018 Study of a fluid–structure interaction problem: Modelling, Analysis, Stabilization and Numerical Simulations, Defended on the 31<sup>st</sup> of August 2018.  
2015 **MSc in Applied Mathematics**, *Université Paul Sabatier*, Toulouse, France.  
2011–2015 **MEng in Aerospace (Supaéro)**, *Institut Supérieur de l'Aéronautique et de l'Espace*, Toulouse, France.  
Options in the last year: 'Applied Mathematics' and 'Structure'.  
One year in an Erasmus exchange with the University of Bristol, UK (2013–2014).  
2012 **BSc in Fundamental Mathematics**, *Université Paul Sabatier*, Toulouse, France.  
2009–2011 **Preparatory Classes**, *Lycée Bellevue*, Toulouse, France.  
National preparatory program for entrance into French Graduate Engineering Schools, focused on Mathematics and Physics.

## Postdoctoral research

- Title *Hybrid High-Order Methods on Unfitted Meshes*.
- Dates Sept. 2018 – Sept. 2019.
- Supervisor Alexandre Ern (ENPC and INRIA, France).
- Institutions École Nationale des Ponts et Chaussées (Champs-sur-Marne, France) and Institut National de Recherche en Informatique et Automatique (Paris, France).
- Collaborations Erik Burman (University College London, UK), CEA (Paris, France).
- Description When using fitted meshes, intricate geometries induce a lot of small elements near the boundaries or interfaces. This severely increases the computational cost of the problem. In order to use more general meshes and ease the computation, we develop a method that allows for unfitted meshes with hanging nodes and all types of polygons/polyhedra. The method has high order accuracy and is robust with respect to the cell cuts. We prove optimal a priori error estimates and run numerical simulations on elliptic and Stokes interface problems.

## PhD thesis

- Title *Study of a fluid–structure interaction problem: Modelling, Analysis, Stabilization and Numerical Simulations*.
- Defence date This PhD thesis has been defended on the 31<sup>st</sup> of August 2018.
- Supervisors Sylvain Ervedoza, Michel Fournié, Ghislain Haine.
- Institutions 'Institut de Mathématiques de Toulouse' and 'Institut Supérieur de l'Aéronautique et de l'Espace', Toulouse, France.
- Description Several aspects of a fluid–structure interaction problem have been investigated, going from modelling to stabilization and numerics. The considered system corresponds to an aeronautics setting. A feedback stabilization method is proposed for the continuous problem. Unsteady numerical simulations are led on a fixed background mesh with an unfitted Finite Element Method. The feedback stabilization is also computed by an approximation coming from the discretization of the problem. The efficiency of the discretized feedback is assessed by numerical simulations.

## PhD student

- **Daniele Corti**, Sorbonne Université, since 2020. Modeling and numerical simulation of the mitral apparatus. Co-advisors: M. Fernández, F. Vergnet and M. Vidrascu.

## Publications (available on my homepage)

### Preprints

none

### Articles

- D. Corti, G. Delay, M. A. Fernández, F. Vergnet, M. Vidrascu: **Low-order fictitious domain method with enhanced mass conservation for an interface Stokes problem**, to appear in ESAIM Math. Model. Numer. Anal.

- E. Burman, G. Delay, A. Ern, L. Oksanen: **A stability estimate for data assimilation subject to the heat equation with initial datum**, *Comptes Rendus Math.* 361 (2023), 1521–1530.
- E. Burman, G. Delay, A. Ern: **The unique continuation problem for the heat equation discretized with a high-order space-time nonconforming method**, *SIAM J. Numer. Anal.* 61(2023), no.5, 2534–2557.
- E. Burman, G. Delay, A. Ern: **An unfitted hybrid high-order method for the Stokes interface problem**, *IMA J. Numer. Anal.* 41 (2021), no. 4, 2362–2387.
- E. Burman, G. Delay, A. Ern: **A hybridized high-order method for unique continuation subject to the Helmholtz equation**, *SIAM J. Numer. Anal.* 59 (2021), no. 5, 2368–2392.
- J. Dabaghi, G. Delay: **A unified framework for high-order numerical discretizations of variational inequalities**, *Comput. Math. Appl.* 92 (2021), 62–75.
- E. Burman, M. Cicuttin, G. Delay, A. Ern: **An unfitted Hybrid High-Order method with cell agglomeration for elliptic interface problems**, *SIAM J. Sci. Comput.* 43 (2021), no. 2, A859–A882.
- G. Delay: **Existence of strong solutions to a fluid-structure system with a structure given by a finite number of parameters**, *ESAIM Math. Model. Numer. Anal.* 54 (2020), no. 1, 301–333.
- G. Delay: **Local stabilization of a fluid-structure system around a stationary state with a structure given by a finite number of parameters**, *SIAM J. Control Optim.* 57 (2019), no. 6, 4063–4098.

### Proceedings

- E. Burman, G. Delay, A. Ern: **The unfitted HHO method for the Stokes problem on curved domains**, *Numerical mathematics and advanced applications—ENUMATH 2019*, 389–397, *Lect. Notes Comput. Sci. Eng.*, 139, Springer, Cham, 2021.
- G. Delay, M. Fournié: **Practical contributions on the fictitious domain method for a fluid-structure interaction problem**, *Boundary and interior layers, computational and asymptotic methods—BAIL 2018*, 45–58, *Lect. Notes Comput. Sci. Eng.*, 135, Springer, Cham, 2020.

### Conferences and Seminars

- 12/2015 **Workshop on Infinite dimensional systems in fluid mechanics and biology**, Université des Antilles, Pointe-à-Pitre, France.  
<http://idsfmb.iecl.univ-lorraine.fr/>
- 01/2016 **Couches limites et Interactions Fluide/Structure**, Bordeaux, France.  
<https://blfsi.sciencesconf.org/>
- 10/2016 **Institut Supérieur de l’Aéronautique et de l’Espace**, *Applied maths seminar*, Toulouse, France.

- 08/2017 **VII Partial differential equations, optimal design and numerics**, Benasque, Spain, <http://www.benasque.org/2017pde/>.
- 10/2017 **Analysis and Control of Fluid-Structure Interaction Systems**, Bordeaux, France, <https://indico.math.cnrs.fr/event/1367/session/5/contribution/47>.
- 05/2018 **Congrès d'Analyse NUMérique (CANUM)**, Cap d'Agde, France.  
<http://smai.emath.fr/canum2018/resumesPDF/gdelay/Abstract.pdf>
- 06/2018 **International Conference on Boundary and Interior Layers (BAIL)**, Glasgow, UK, <https://bail.org.uk/speakers>.
- 10/2018 **CERMICS – École Nationale des Ponts et Chaussées, Applied maths seminar**, Champs-sur-Marne, France.  
[https://cermics-lab.enpc.fr/wp-content/uploads/2017/03/slides\\_delay-1.pdf](https://cermics-lab.enpc.fr/wp-content/uploads/2017/03/slides_delay-1.pdf)
- 01/2019 **University College London, Computational Methods for Interface Problems Workshop**, London, UK.  
<https://www.ucl.ac.uk/math/events/2019/jan/computational-methods-interface-problems-workshop>
- 02/2019 **SIAM CSE**, Spokane, USA.  
[http://meetings.siam.org/sess/dsp\\_programsess.cfm?SESSIONCODE=65734](http://meetings.siam.org/sess/dsp_programsess.cfm?SESSIONCODE=65734)
- 04/2019 **FEF 2019**, Chicago, USA.  
<http://www.fef2019.org/>
- 05/2019 **HOFEIM 2019**, Pavia, Italy.  
<https://hofeim2019.org/>
- 06/2019 **MAFELAP 2019**, Brunel University London, UK.  
<http://people.brunel.ac.uk/~icsrsss/bicom/mafelap/>
- 06/2019 **Laboratoire de mathématiques de Besançon, Numerical analysis and scientific computing seminar**, Besançon, France.  
<http://lmb.univ-fcomte.fr/Archives-2017-2019-2064>
- 06/2019 **INRIA, Commedia team seminar**, Paris, France.
- 09/2019 **Sorbonne Université, LJLL seminar**, Paris, France.  
<https://www.ljll.math.upmc.fr/contenu/article/seminaire-du-ljll-27-09-2019-14h00-g-delay>
- 01/2021 **WCCM 2020**, online presentation.
- 01/2021 **Oberwolfach Workshop**, online presentation.
- 09/2021 **European Finite Element Fair 2020**, Paris, France.
- 01/2022 **Laboratoire de mathématiques de Versailles, PDE seminary**, Versailles, France.
- 06/2022 **Congrès National d'Analyse Numérique**, Evian-les-Bains, France.
- 11/2022 **Workshop, Numerical methods for fluid, structure and interactions problems**, Toulouse, France.  
<https://indico.math.cnrs.fr/event/7591/>
- 01/2023 **Institut Montpellierain Alexander Grothendieck, Séminaire ACSIOM**, Montpellier, France.
- 05/2023 **HOFEIM 2023**, Larnaca, Cyprus.
- 11/2023 **Workshop, Simulation of data assimilation under a PDE constraint**, Paris, France.

## Others

- 2022–...: Co-organizer of the **INRIA-LJLL seminar** of Scientific Computing, Numerical Analysis and Modeling  
<https://project.inria.fr/rencontresljll/fr/>
- 11/2023: Organized the workshop **Simulation of data assimilation under a PDE constraint**  
[https://www.ljll.math.upmc.fr/delay/workshop\\_data\\_assimilation.html](https://www.ljll.math.upmc.fr/delay/workshop_data_assimilation.html)

## Teaching Activities (in french)

### Current:

- 2021–... Responsable de l'organisation de la préparation à l'épreuve de modélisation pour l'agrégation externe de mathématiques (option B) (organisation des cours et environ 40h d'enseignements/an)
- 2021–... Enseignements à Polytech Sorbonne (environ 50h/an)
- 2020–... cours de C++ dans le master Ingénierie Mathématiques (45h/an)
- 2019–... TD d'analyse numérique en L3 (28h/an)

### Past:

- 2022–2023 Responsable du cours d'analyse numérique de L3
- 2019–2021 Préparation à l'agrégation externe : cours d'EDP (~20h/an)
- 2019–2021 Ateliers de Recherche Encadrés (30h/an)
- 2019–2020 TD en L1 (26h)
- 2019–2020 Orientation et Insertion Professionnelle (30h)
- 2018–2019 TD d'analyse à l'École des Ponts (~35h)
- 2018–2019 TD en licence à l'Université Paris Est Marne-la-Vallée (~30h)
- 2015–2018 Moniteur à l'Université Paul Sabatier de Toulouse (environ 64h/an)

## Languages

- French Native speaker
- English Professional level (B2)
- German Basics

## Computer skills

- Software Matlab/Scilab, LaTeX, Emacs, git
- Programming languages C/C++, Python

## Extra-curricular activities

- Chess (club level)
- Fencing
- Guitar
- Ballroom dancing