

# Guillaume Delay

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## Research Interests

- Numerical Analysis (Finite Element Method on unfitted meshes)
- Scientific Computing
- Control and Stabilization of PDE's
- Fluid-Structure Interaction
- Interface problems

## Current position

09/2019–?? **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.

## Publications (available on my homepage)

- G. Delay, **Existence of strong solutions to a fluid–structure system with a structure given by a finite number of parameters**, 28 p, accepted in ESAIM:M2AN.
- G. Delay, **Local Stabilization of a fluid–structure system around a stationary state with a structure given by a finite number of parameters**, 29 p, accepted in SICON.
- G. Delay, M. Fournié, **Practical contributions on the fictitious domain method for a fluid–structure interaction problem**, 12 p, submitted to the proceedings of the BAIL conference on boundary and interior layers.
- G. Delay, S. Ervedoza, G. Haine, M. Fournié, **Numerical simulation on a fixed mesh for the feedback stabilization of a fluid–structure interaction system with a structure given by**

- a finite number of parameters**, 12 p, submitted to the proceedings of the IUTAM Symposium on Critical flow dynamics involving moving/deformable structures with design applications.
- E. Burman, M. Cicuttin, G. Delay, A. Ern, **An unfitted Hybrid High-Order method with cell agglomeration for elliptic interface problems**, 27 p, submitted.
- E. Burman, G. Delay, A. Ern, **An unfitted Hybrid High-Order method for the Stokes equations on domains with curved boundary**, in progress.

## 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.  
<https://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/>

## Teaching Activities

- 2019–2020 2<sup>nd</sup> year of Master : introduction to scientific computing (33 hours)
- 2019–2020 3<sup>rd</sup> year of Bsc : numerical analysis (24 hours)
- 2019–2020 1<sup>st</sup> year of Bsc (86 hours)
  - 2019 1<sup>st</sup> year of Bsc, Maths tutorials (~30 hours), Université Paris Est Marne-la-Vallée.
  - 2018 1<sup>st</sup> year students at ENPC, supporting a group of 25 students. Maths tutorial for the analysis course (~35 hours).
  - 2017 1<sup>st</sup> year of Maths BSc, Maths Interactive lectures using remote controllers given to the students. Supporting 120 students in lectures and 25 students in tutorials (~50 hours), Toulouse.
  - 2017 1<sup>st</sup> year of Info BSc, Numerical Analysis and programming sessions (25 students, ~30 hours), Toulouse.
  - 2016 1<sup>st</sup> year of Maths BSc, Maths tutorials (~30 hours), Toulouse.
  - 2016 1<sup>st</sup> year of Maths BSc, Linear algebra and functional analysis (courses + tutorials) (~45 hours), Toulouse.
  - 2015 1<sup>st</sup> year of Maths BSc, Maths tutorials (~15 hours), Toulouse.

## Languages

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

## Computer skills

- Software Matlab, LaTeX, Emacs, Maple, GetFEM++, git
- Programming C++, C, JAVA
- languages

## Extra-curricular activities

- Chess (club level)
- Fencing
- Guitar