

# Raphaël Bulle

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Currently **post-doctoral fellow** at GIREF (Laval University, QC, CA), I am working on non-intrusive gradient reconstructions for multimaterial finite element simulations in collaboration with Michelin.

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## Research interests

**Major:** Finite element methods • Error estimation • Adaptive methods • Fractional PDEs

**Minor:** FEniCS software • Linear poroelasticity • Stochastic PDEs • Multi-level Monte Carlo methods

## Education

2022	<b>PhD</b> in Engineering sciences and Mathematics Thesis supervised by S. P. A. Bordas, F. Chouly, J. S. Hale, A. Lozinski	U. Luxembourg & U. Franche-Comté, FR
2017	<b>Master's degree</b> Advanced Mathematics	U. Franche-Comté, FR
2016	<b>Agrégation externe de Mathématiques</b> competitive exam	National, FR
2015	<b>Master's degree</b> Mathematics instruction	U. Franche-Comté, FR
2014	<b>CAPES de Mathématiques</b> competitive exam	National, FR
2013	<b>Bachelor's degree</b> Mathematics	U. Franche-Comté, FR

## Publications

Ongoing	<i>A multi-mesh finite element discretization of spectral fractional Laplacian equations</i> A. Bespalov, <b>R. Bulle</b>	
	<i>An a posteriori error estimator for the spectral fractional power of the Laplacian</i>	
2023	<b>R. Bulle</b> , O. Barrera, S.P.A. Bordas, F. Chouly, J.S. Hale, <i>Computer Methods in Applied Mechanics and Engineering</i> , doi.org/10.1016/j.cma.2023.115943	
	<i>Hierarchical a posteriori error estimation of Bank-Weiser type in the FEniCS project</i>	
2023	<b>R. Bulle</b> , J.S. Hale, A. Lozinski, S.P.A. Bordas, F. Chouly, <i>Computers &amp; Mathematics with Applications</i> , doi.org/10.1016/j.camwa.2022.11.009	
	<i>The human meniscus behaves as a functionally graded fractional porous medium</i>	
2021	<b>R. Bulle</b> , G. Alotta, G. Marchiori, M. Berni, N. F. Lopomo, S. Zaffagnini, S. P. A. Bordas, O. Barrera, <i>Applied Sciences</i> , doi:10.3390/app11209405	
	<i>Removing the saturation assumption in Bank-Weiser error estimator analysis in dimension three</i>	
2020	<b>R. Bulle</b> , F. Chouly, J. S. Hale, A. Lozinski, <i>Applied Mathematics Letters</i> , doi:10.1016/j.aml.2020.106429	

## Software

2022	<i>FEniCSx-Error-Estimation</i> , a FEniCSx package for hierarchical a posteriori error estimation <b>R. Bulle</b> , J. S. Hale, git repository: github.com/jhale/fenicsx-error-estimation	LGPLv3
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## Conference presentations and posters

- 2023 *An a Posteriori Error Estimator for the Spectral Fractional Power of the Laplacian* (invited by Prof. S. Harizanov) LSSC 2023  
**R. Bulle**, O. Barrera, S. P. A. Bordas, F. Chouly, J. S. Hale
- 2021 *Local a posteriori error estimates for the spectral fractional Laplacian* FEniCS conf.  
**R. Bulle**, S. P. A. Bordas, F. Chouly, J. S. Hale, A. Lozinski
- 2021 *Practical aspects of a hierarchical a posteriori error estimator of Bank-Weiser type* SIAM CSE  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski
- 2021 *A posteriori error estimation for the fractional Laplacian* One Nonlocal World opening event  
**R. Bulle**, A. Lozinski, F. Chouly, S. P. A. Bordas, J. S. Hale, doi:10.13140/RG.2.2.10144.00006
- 2020 *Practical aspects of the Bank-Weiser estimator implementation and biomechanics applications* WCCM ECCOMAS Congress  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski

## Visiting researcher

- Sep. 2023 Invited by Dr. Alex Bespalov to work on a multi-mesh discretization of the spectral fractional Laplacian. U. of Birmigham, UK

## Invited seminars

- 2022 *A posteriori error estimation in the FEniCSx finite element software and application to the fractional Laplacian* Café technique Michelin, Clermont-Ferrand, FR  
**R. Bulle**, S. P. A. Bordas, F. Chouly, J. S. Hale, A. Lozinski
- 2022 *Hierarchical a posteriori error estimation in the FEniCS finite element software and applications to fractional PDEs* GIREF seminar, U. Laval, CA  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski
- 2021 *Méthodes éléments finis et estimation d'erreur pour l'étude du ménisque* Mini-conférence PASS-SPI, U. Franche-Comté, FR  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski, O. Barrera
- 2021 *Discretization of the fractional Laplacian using finite element methods and a posteriori error estimation* PhD seminar U. Franche-Comté, FR  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski
- 2019 *Controlling error in multi-level approximations of stochastic PDEs* SPOC seminar, IMB Dijon, FR  
**R. Bulle**, F. Chouly, A. Lozinski, S.P.A. Bordas, J.S. Hale

## Scientific organization

- 2021 **Minisymposium chairman** Advanced adaptive discretization methods SIAM CSE

## Teaching experience

2024	<b>Lecture: Numerical analysis for engineers</b> 1st year of Engineering bachelor, winter semester	U. Laval, CA
2018	<b>Exercises: Mathematics for engineers</b> 1st year of Engineering bachelor, autumn semester	U. Luxembourg
2015	<b>Lecture &amp; exercises: Linear ODEs</b> 1st year of Biology bachelor, half of autumn semester	U. Franche-Comté, FR
2014	<b>Exercises: Linear ODEs</b> 1st year of Biology bachelor, half of autumn semester	U. Franche-Comté, FR

## Technical skills

Python • C++ • LaTeX • bash • matlab • Git • Docker • Podman • FEniCS • FreeFEM++