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.

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	**PhD** 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	**Master's degree** Advanced Mathematics	U. Franche-Comté, FR
2016	**Agrégation externe de Mathématiques** competitive exam	National, FR
2015	**Master's degree** Mathematics instruction	U. Franche-Comté, FR
2014	**CAPES de Mathématiques** competitive exam	National, FR
2013	**Bachelor's degree** Mathematics	U. Franche-Comté, FR

Publications

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

Software

2022	*FEniCSx-Error-Estimation*, a FEniCSx package for hierarchical a posteriori error estimation **R. Bulle**, J. S. Hale, git repository: github.com/jhale/fenicsx-error-estimation	LGPLv3

Conference presentations and posters

2024	*Adaptive multi-mesh FEM for the spectral fractional Laplacian* (invited by Prof. S. Harizanov) **R. Bulle**, A. Bespalov	NMSCAA 2024
2023	*An a Posteriori Error Estimator for the Spectral Fractional Power of the Laplacian* (invited by Prof. S. Harizanov) **R. Bulle**, O. Barrera, S. P. A. Bordas, F. Chouly, J. S. Hale	LSSC 2023
2021	*Local a posteriori error estimates for the spectral fractional Laplacian* **R. Bulle**, S. P. A. Bordas, F. Chouly, J. S. Hale, A. Lozinski	FEniCS conf.
2021	*Practical aspects of a hierarchical a posteriori error estimator of Bank-Weiser type* **R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski	SIAM CSE
2021	*A posteriori error estimation for the fractional Laplacian* **R. Bulle**, A. Lozinski, F. Chouly, S. P. A. Bordas, J. S. Hale, doi:10.13140/RG.2.2.10144.00006	One Nonlocal World opening event
2020	*Practical aspects of the Bank-Weiser estimator implementation and biomechanics applications* **R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski	WCCM ECCOMAS Congress

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

2024	*Estimation d'erreur a posteriori hiérarchique par reconstruction de gradients dans des milieux hétérogènes* **R. Bulle**	Séminaire Copilote Michelin-GIREF
2022	*A posteriori error estimation in the FEniCSx finite element software and application to the fractional Laplacian* **R. Bulle**, S. P. A. Bordas, F. Chouly, J. S. Hale, A. Lozinski	Café technique Michelin, Clermont-Ferrand, FR
2022	*Hierarchical a posteriori error estimation in the FEniCS finite element software and applications to fractional PDEs* **R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski	GIREF seminar, U. Laval, CA
2021	*Méthodes éléments finis et estimation d'erreur pour l'étude du ménisque* **R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski, O. Barrera	Mini-conférence PASS-SPI, U. Franche-Comté, FR
2021	*Discretization of the fractional Laplacian using finite element methods and a posteriori error estimation* **R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski	PhD seminar U. Franche-Comté, FR
2019	*Controlling error in multi-level approximations of stochastic PDEs* **R. Bulle**, F. Chouly, A. Lozinski, S.P.A. Bordas, J.S. Hale	SPOC seminar, IMB Dijon, FR

Scientific organization

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

Teaching experience

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