

# Theo Mary | PhD

Alan Turing Building, Oxford Road – Manchester, M13 9PL, UK

☎ (+44) 161 275 5917 • ✉ [theo.mary@manchester.ac.uk](mailto:theo.mary@manchester.ac.uk)

📄 [personalpages.manchester.ac.uk/staff/theo.mary/](http://personalpages.manchester.ac.uk/staff/theo.mary/)

## Work experience

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### Research Associate

Manchester, UK

University of Manchester – School of Mathematics

Jan. 2018–ongoing

- *Supervisor:* Nicholas Higham.
  - *Description:* I am part of the [ICONIC](#) project, within which I work on analyzing numerical algorithms in finite precision arithmetic.
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### Collaboration with the [MUMPS](#) team

Toulouse, France

Toulouse INP

Oct. 2017–ongoing

In continuation of my PhD thesis work, I collaborate with the MUMPS team on the design of Block Low-Rank multifrontal solvers.

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### PhD doctorate in Computer Science and Applied Mathematics

Toulouse, France

Université de Toulouse (UPS) – IRIT laboratory

Oct. 2014–Sep. 2017

- *Title:* Block Low-Rank multifrontal solvers: complexity, performance, and scalability.
  - *Date of award:* 24 November 2017.
  - *Advisors:* Patrick Amestoy and Alfredo Buttari.
  - *Description:* I investigated the use of low-rank approximation techniques to improve the computational cost of multifrontal solvers, in terms of theoretical complexity, memory consumption, and gains in run time on shared- and distributed-memory architectures.
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### 3 month visit in Sherry Li's group

Berkeley, CA, USA

Lawrence Berkeley National Laboratory ([LBNL](#))

Feb.–Apr. 2017

Collaboration on the comparison of BLR and HSS low-rank formats in multifrontal solvers.

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### Collaboration with the [SEISCOPE](#) consortium

Nice & Grenoble, France

[Geoazur](#) institute and Université Grenoble Alpes ([UGA](#))

2014–ongoing

Application of a BLR multifrontal solver to real-life seismic modeling problems.

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### 6 month research internship in Jack Dongarra's lab

Knoxville, TN, USA

Innovative Computing Laboratory ([ICL](#)), University of Tennessee

Mar.–Aug. 2014

- *Topic:* Randomized algorithms for computing low-rank approximations of dense matrices on multicore+GPUs architectures.
- *Advisor:* Ichitaro Yamazaki.

## Education

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### UPS-IRIT

*PhD degree in Computer Science and Applied Mathematics*

**Toulouse, France**

*2014–2017*

### ENSEEIH

*French diploma of engineering, equivalent to master's degree*

Department of Computer Science and Applied Mathematics

**Toulouse, France**

*2011–2014*

### Lycée Pierre de Fermat

*Classes Préparatoires aux Grandes Ecoles*

**Toulouse, France**

*2009–2011*

### Lycée Français de Barcelone

*Baccalaureate of Science*

**Barcelona, Spain**

*2009*

## Software

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### MUMPS

**MUMPS** is a parallel, direct solver for sparse linear systems. Being designed for distributed memory computing environments, MUMPS is based on MPI and has a wide range of features that make it reliable and efficient. MUMPS is currently used in several industrial and academic applications and has thousands of users worldwide. During my PhD thesis and after that I have been working on the Block Low-Rank (BLR) feature of MUMPS, which can reduce the computational cost (time, flops and memory) of the solver.

## Professional activities

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### Paper reviews

I have reviewed papers for the following journals: ACM Trans. Math. Soft, IMAJNA, Geophysics, and Optimization Methods and Software.

### Committees

I will be a member of the program committee for the International Conference on Parallel Processing (ICPP 2019).

## Awards

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- **Gilles Kahn prize** from the SIF (Société Informatique de France) for my PhD thesis

## Teaching

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During my PhD from 2014 to 2017, I was involved in teaching activities at the Toulouse INP-**ENSEEIH** engineering school. I taught over 200 hours as teaching assistant in several courses, including Numerical Linear Algebra, Graph Theory, Parallel and Distributed Computing, and Sparse Linear Algebra. I was also involved in the creation and supervision of the student project assignments:

- Model reduction approaches for PDE problems (Numerical Linear Algebra course)
- Task scheduling on directed acyclic graphs (Graph Theory course)

Finally, in fall 2017, I co-created and co-taught with P. Amestoy and A. Buttari the course "Large-scale sparse linear algebra".

## Publications

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### Journal articles.....

- [1] N. J. Higham and T. Mary. [A New Preconditioner that Exploits Low-Rank Approximations to Factorization Error](#). *SIAM J. Sci. Comput.* 41.1 (2019), A59–A82.
- [2] P. R. Amestoy, A. Buttari, J.-Y. L'Excellent, and T. Mary. [Performance and Scalability of the Block Low-Rank Multifrontal Factorization on Multicore Architectures](#). *ACM Trans. Math. Software* (2018). To appear.
- [3] D. V. Shantsev, P. Jaysaval, S. de la Kethulle de Ryhove, P. R. Amestoy, A. Buttari, J.-Y. L'Excellent, and T. Mary. [Large-scale 3D EM modeling with a Block Low-Rank multifrontal direct solver](#). *Geophys. J. Int.* 209.3 (2017), 1558–1571.
- [4] P. R. Amestoy, A. Buttari, J.-Y. L'Excellent, and T. Mary. [On the Complexity of the Block Low-Rank Multifrontal Factorization](#). *SIAM J. Sci. Comput.* 39.4 (2017), A1710–A1740.
- [5] P. R. Amestoy, R. Brossier, A. Buttari, J.-Y. L'Excellent, T. Mary, L. Métivier, A. Miniussi, and S. Operto. [Fast 3D frequency-domain full waveform inversion with a parallel Block Low-Rank multifrontal direct solver: application to OBC data from the North Sea](#). *Geophysics* 81.6 (2016), R363–R383.

### Conference proceedings.....

- [1] P. R. Amestoy, R. Brossier, A. Buttari, J.-Y. L'Excellent, T. Mary, L. Métivier, A. Miniussi, S. Operto, J. Virieux, and C. Weisbecker. [3D frequency-domain seismic modeling with a Parallel BLR multifrontal direct solver](#). *International Conference Society of Exploration Geophysicists (SEG) Annual Meeting*. New Orleans, USA, Oct. 2015.
- [2] P. R. Amestoy, R. Brossier, A. Buttari, J.-Y. L'Excellent, T. Mary, L. Métivier, A. Miniussi, S. Operto, A. Ribodetti, J. Virieux, and C. Weisbecker. [Efficient 3D frequency-domain full-waveform inversion of ocean-bottom cable data with sparse block low-rank direct solver: a real data case study from the North Sea](#). *International Conference Society of Exploration Geophysicists (SEG) Annual Meeting*. New Orleans, USA, Oct. 2015.
- [3] T. Mary, I. Yamazaki, J. Kurzak, P. Luszczek, S. Tomov, and J. Dongarra. [Performance of Random Sampling for Computing Low-rank Approximations of a Dense Matrix on GPUs](#). *SC'15 - International Conference for High Performance Computing, Networking, Storage and Analysis*. Austin, USA, Nov. 2015.
- [4] I. Yamazaki, T. Mary, J. Kurzak, S. Tomov, and J. Dongarra. [Access-averse framework for computing low-rank matrix approximations](#). *2014 IEEE International Conference on Big Data*. Washington, USA, Oct. 2014.

### Journal articles (submitted).....

- [1] N. J. Higham and T. Mary. [A New Approach to Probabilistic Rounding Error Analysis](#). *SIAM J. Sci. Comput.* (2018).
- [2] C. Gorman, G. Chavez, P. Ghysels, T. Mary, F.-H. Rouet, and X. S. Li. [Matrix-free Construction of HSS Representation Using Adaptive Randomized Sampling](#). *SIAM J. Sci. Comput.* (2018).
- [3] P. R. Amestoy, A. Buttari, J.-Y. L'Excellent, and T. Mary. [Bridging the gap between flat and hierarchical low-rank matrix formats: the multilevel BLR format](#). *SIAM J. Sci. Comput.* (2018).

PhD thesis.....

[1] T. Mary. [Block Low-Rank multifrontal solvers: complexity, performance, and scalability](#). PhD Thesis. Université de Toulouse, Nov. 2017.