

# Théo Mary | PhD Candidate

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## Work experience

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**PhD doctorate in Computer Science and Applied Mathematics** **Toulouse, France**  
*Université de Toulouse (UPS) - IRIT laboratory* *2014–ongoing*

- *Title:* Block Low-Rank multifrontal solvers: complexity, performance, and scalability.
- *Expected date of award:* November 2017.
- *Advisors:* Patrick Amestoy, Alfredo Buttari, and Jean-Yves L'Excellent.
- *Description:* I am investigating 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 @ ICL** **Knoxville, TN, USA**  
*Innovative Computing Laboratory, University of Tennessee, Knoxville (UTK)* *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** **Toulouse, France**  
*PhD degree in Computer Science and Applied Mathematics* *2014–2017*

**INPT-ENSEEIHT** **Toulouse, France**  
*French diploma of engineering, equivalent to master's degree* *2011–2014*  
Department of Computer Science and Applied Mathematics

**Lycée Pierre de Fermat** **Toulouse, France**  
*Classes Préparatoires aux Grandes Ecoles* *2009–2011*

**Lycée Français de Barcelone** **Barcelona, Spain**  
*Baccalaureate of Science* *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. In the context of my PhD thesis, I am working on the Block Low-Rank (BLR) feature of MUMPS to improve the computational cost (time, flops and memory) of the solver.

## Teaching

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Since the beginning of my PhD in 2014, I have been involved in teaching activities at the INPT-**ENSEEIH** engineering school. I have taught over 200 hours as teaching assistant in the following courses:

- Numerical Linear Algebra (2014–2017, 65 hours)
- Graph Theory (2014–2017, 46 hours),
- Numerical Analysis (2015–2017, 36 hours)
- Parallel Computing (2015–2017, 24 hours)
- Distributed Computing (2015–2017, 24 hours)
- Imperative Programming (2014–2015, 12 hours)
- Sparse Linear Algebra (2017, 2 hours)

I am 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)

## Publications

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### International Journal Articles (Submitted).....

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 Transactions on Mathematical Software. Submitted (2017).

### International Journal Articles.....

P. R. AMESTOY, R. BROSSIER, A. BUTTARI, J.-Y. L'EXCELLENT, T. MARY, L. MÉTIVIER, A. MINIUSI, 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 (2016), pp. R363 – R383.

P. R. AMESTOY, A. BUTTARI, J.-Y. L'EXCELLENT, AND T. MARY, *On the Complexity of the Block Low-Rank Multifrontal Factorization*, SIAM Journal on Scientific Computing, 39 (2017), pp. A1710–A1740.

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*, Geophysical Journal International, 209 (2017), pp. 1558 – 1571.

### International Conferences and Workshops with Proceedings.....

P. R. AMESTOY, R. BROSSIER, A. BUTTARI, J.-Y. L'EXCELLENT, T. MARY, L. MÉTIVIER, A. MINIUSI, 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*, in International Conference Society of Exploration Geophysicists (SEG) Annual Meeting, New Orleans, USA, October 2015.

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*, in International Conference Society of Exploration Geophysicists (SEG) Annual Meeting, New Orleans, USA, October 2015.

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*, in SC'15 - International Conference for High Performance Computing, Networking, Storage and Analysis, Austin, USA, November 2015.

I. YAMAZAKI, T. MARY, J. KURZAK, S. TOMOV, AND J. DONGARRA, *Access-averse framework for computing low-rank matrix approximations*, in 2014 IEEE International Conference on Big Data, Washington, USA, October 2014.

#### International Conferences and Workshops without Proceedings.....

P. R. AMESTOY, J. ANTON, C. ASHCRAFT, A. BUTTARI, P. GHYSELS, J.-Y. L'EXCELLENT, X. S. LI, T. MARY, F.-H. ROUET, AND C. WEISBECKER, *A comparison of parallel rank-structured solvers*, in SIAM Conference on Parallel Processing (SIAM PP'16), Paris, France, April 2016.

P. R. AMESTOY, C. ASHCRAFT, A. BUTTARI, P. GHYSELS, J.-Y. L'EXCELLENT, X. S. LI, T. MARY, F.-H. ROUET, AND C. WEISBECKER, *A comparison of different low-rank approximation techniques*, in SIAM Conference on Applied Linear Algebra (SIAM LA'15), Atlanta, USA, October 2015.

P. R. AMESTOY, A. BUTTARI, P. GHYSELS, J.-Y. L'EXCELLENT, X. S. LI, T. MARY, AND F.-H. ROUET, *Comparison of BLR and HSS low-rank formats in multifrontal solvers: theory and practice*, in SIAM Conference on Computational Science and Engineering (SIAM CSE'17), Atlanta, USA, February 2017.

P. R. AMESTOY, A. BUTTARI, J.-Y. L'EXCELLENT, AND T. MARY, *Complexity and performance of Block Low-Rank multifrontal factorization and its variants*, in SIAM Conference on Parallel Processing (SIAM PP'16), Paris, France, April 2016.

———, *On the complexity of the Block Low-Rank multifrontal factorization*, in Sparse Days, Toulouse, France, June 2016.

———, *Performance and scalability of the Block Low-Rank multifrontal factorization*, in Parallel Matrix Algorithms and Applications (PMAA'16), Bordeaux, France, July 2016.

———, *Sparse direct solvers towards seismic imaging of large 3D domains*, in 78th EAGE Conference, workshop methods and challenges of seismic wave modelling for seismic imaging, Vienna, Austria, June 2016.

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*,

in SIAM Conference on Computational Science and Engineering (SIAM CSE'15), Salt Lake City, USA, March 2015.

THE MUMPS TEAM, *Improving multifrontal solvers by means of Block Low-Rank approximations*, in CIMI HPC semester: workshop on fast solvers, Toulouse, France, June 2015.

I. YAMAZAKI, T. MARY, J. KURZAK, S. TOMOV, AND J. DONGARRA, *Performance of Computing Low-Rank Approximation on Hybrid CPU/GPU Architectures*, in SIAM Conference on Computational Science and Engineering (SIAM CSE'15), Salt Lake City, USA, March 2015.

### Seminars.....

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*, in PhD Days IRIT-APO, Toulouse, France, November 2015.

P. R. AMESTOY, A. BUTTARI, P. GHYSELS, J.-Y. L'EXCELLENT, X. S. LI, T. MARY, AND F.-H. ROUET, *On the comparison of sparse multifrontal hierarchical and Block Low-Rank solvers*, in MUMPS User Days, Montbonnot Saint-Martin, France, June 2017.

P. R. AMESTOY, A. BUTTARI, J.-Y. L'EXCELLENT, AND T. MARY, *Multicore performance of the Block Low-Rank multifrontal factorization*, in Journé Lyon Calcul, Lyon, France, December 2016.

——, *Performance and scalability of the Block Low-Rank multifrontal factorization*, in PhD Days IRIT-APO, Toulouse, France, September 2016.

T. MARY, *Complexity and performance of Block Low-Rank multifrontal factorization and its variants*, in Journé des doctorants, Université Paul Sabatier, Toulouse, France, January 2017.

T. MARY, I. YAMAZAKI, J. KURZAK, P. LUSZCZEK, S. TOMOV, AND J. DONGARRA, *Performance of Random Sampling for Low-rank Approximation on GPUs*, in PhD Days IRIT-APO, Toulouse, France, October 2014.

THE MUMPS TEAM, *3D frequency-domain seismic modeling with a Parallel BLR multifrontal direct solver*, in SEISCOPE Annual Meeting, Grenoble, France, May 2015.

——, *Improving multifrontal solvers by means of Block Low-Rank approximations*, in Livermore Software Technology Corporation (LSTC) workshop, Livermore, USA, March 2015.