Théo Mary | PhD

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Work experience

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.
- *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 @ 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

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

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. 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

During my PhD from 2014 to 2017, I was involved in teaching activities at the INPT-**ENSEEIHT** engineering school. I 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 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)

Publications

PhD Thesis ....

T. MARY, *Block Low-Rank multifrontal solvers: complexity, performance, and scalability*, PhD thesis, Université de Toulouse, November 2017.

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. 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 (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. 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*, in International Conference Society of Exploration Geophysicits (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 Geophysicits (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.

———, *Block Low-Rank multifrontal solvers: complexity, performance, and scalability*, in Sparse Days, Toulouse, France, September 2017.

———, *Block Low-Rank multifrontal sparse direct solvers*, in Mathias 2017, Paris, France, October 2017.

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 Journée 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 Journée 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.