

MAKSIMS ABALENKOV

Alan Turing Building 2.233, School of Mathematics
The University of Manchester, Oxford Road
Manchester M13 9PL, UK
m.abalenkovs@manchester.ac.uk, +44 7 486 486 505
<http://mabalenk.gitlab.io>, Latvian (EU citizen)

Professional Motto

To grow into an outstanding researcher and inspiring educator in the area of applied mathematics by undertaking challenging projects and learning on the way.

Research Interests

Numerical Linear Algebra esp. parallelisation of common matrix factorisations and functions via task-based paradigms; Computational Electromagnetics incl. stencil-based, Finite-Difference, Boundary Element, Finite Element, Fast Multipole and Subgridding methods, Absorbing Boundary Conditions, dispersive materials modelling; Bioelectromagnetics, computational methods in medicine; optimisation with Genetic Algorithms; General-Purpose computation on Graphics Processing Units with CUDA and OpenCL; parallelisation with MPI, OpenMP, StarPU, scientific computing and parallel programming languages.

Skills Profile

- Independent thinker and self-starter abilities reinforced by (post-)doctoral experience.
- Strong communication and organisational talents resulting in leadership roles in IEEE and at the University of Manchester.
- Excellent teaching skills developed through lecturing in the BSc and MSc modules, theses and group project (co-)supervision.
- Extensive knowledge on Computational Electromagnetics and task-based programming obtained during (post-)doctoral and industrial projects.

Research & Development Work Experience

05/2015–10/2018 **Research Associate, The University of Manchester, Manchester, UK**

- Parallelised LU-factorisation algorithm for shared and distributed memory architectures using StarPU `mpi task insert` constructs (See PLASMA+StarPU distribution).
- Parallelised iterative refinement algorithms for linear systems solution in mixed precision. Routines for general and positive definite matrices were parallelised using OpenMP `task depend` and StarPU `task insert` constructs (See PLASMA 18.11.1 distribution).
- Developing *Rightsizer*—an open-source software package to detect an optimal tile size and a number of OpenMP threads for parallel common matrix factorisations. The code features {1, 2}D optimisation techniques and is capable of performing simultaneous optimisation for both parameters.
- Expanded 2D R-Matrix Propagation Codes package to apply PLASMA routines for matrix multiplication, eigenvalue decomposition, LU-factorisation and linear systems solution.
- Derived a generic algorithm for calculation of finite-difference expressions of any order n . Developing *X-Stencil*—an open-source package to validate theoretical results in a Finite-Difference Time-Domain method up to the 10th order.
- Developed a matrix casting approach to re-formulate update equations of stencil-based methods in {1, 2, 3}D and speed-up the computation.

03/2013–05/2015 **Research Engineer, Télécom Bretagne, Brest, France**

- Developing the prototype Fast Multipole Method with Fast Fourier Transform (FMM–FFT) code based on the plane wave expansion of the scalar Green’s function with spherical Bessel and Hankel functions and Legendre polynomial. The resulting method aimed at speeding-up solution of the forward problem in Electroencephalography (EEG) applications.
- Investigated the FMM–FFT, including the study and prototyping of efficient convolution $\mathcal{O}(N \log(N))$ of circulant and block Toeplitz tensors in GNU Octave and C++ with FFTW library.
- Provided computational expertise to a team developing an automotive radar simulation platform in collaboration with Renault. Major contributions to the project included development and application of beamforming and Multiple Signal Classification (MUSIC) algorithms for Angle-of-Arrival (AoA) estimation in realistic on-the-road scenarios, Graphical User Interface (GUI) functionality for the creation of Sigma–Delta, Uniform Linear Array (ULA) and Uniform Planar Array (UPA) antennae, introduction and reinforcement of Object-Oriented Programming concepts.
- Participated in the preliminary work on the development of an Integral Equation (IE) method combining single- and double-layer potentials based on Nédélec’s representation theorem and integral operators $\mathcal{D}, \mathcal{S}, \mathcal{N}$ and \mathcal{D}^* . The new method targeted solution of forward problem in EEG applications.

03/2012–08/2012 **Development Engineer, EMSS, Böblingen, Germany**

- Analysed hybrid Computational Electromagnetics methods for a possibility of efficient and convenient implementation in FEKO.
- Tested performance and precision of numerical algorithms on different CPU and GPU architectures.
- Ported various parts of the code from Fortran 77 to Fortran 2008.
- Tested newly implemented software features and resolved bugs.
- Developed an automatic code documentation by means of Doxygen.

Teaching Work Experience

09/2015–12/2018 **Teaching Assistant, The University of Manchester**

01/2009–06/2010

- Assisted in practical exercises for various mathematics and engineering modules: Calculus and Algebra, Computational Electromagnetics, Data Networking and Java Programming.
- *Thoroughness*: Edited and re-wrote parts of the laboratory notes on Computational Electromagnetics, which resulted in shorter and clearer exercise explanations.
- *Accuracy*: Marked three assignment papers for 30 students. Working quickly and accurately finished all marking within difficult time constraints.
- *Support*: Developed an informative webpage to assist students in their laboratory work, stimulating faster induction into the topic and saving lecture time.
- *Motivation*: Highlighted several real-world applications of numerical methods to the students, raising interest and general understanding of the material.

08/2012–09/2013 **TeX Course Instructor, The University of Manchester**

- Developed, organised and delivered five pairs of lectures and exercises for a practical one day workshop “Introduction to TeX”.

03/2013–05/2015 **Teaching Assistant, Télécom Bretagne, Brest, France**

- Efficiently delivered lectures in an undergraduate course “Scientific Computing with MATLAB” in classes of 50 students and supervised practical exercise work in smaller groups of 20 people.

Education

09/2007–12/2011 **PhD in Electrical and Electronic Engineering**
The University of Manchester, UK

Thesis title: *Huygens Subgridding for the Frequency-Dependent-Finite-Difference Time-Domain Method*

- Extended classical Finite-Difference Time-Domain (FDTD) method to Frequency-Dependence (FD).
- Parallelised the FD-FDTD method with the Message Passing Interface (MPI).
- Optimised the FD-FDTD algorithm with the Huygens Subgridding (HSG) technique.
- New solver allowed efficient simulation of electromagnetic wave propagation in multi-layered media, *e.g.* human body.
- Proposed the solver application to optimise defibrillators by simulating defibrillation current in a human torso.

09/2006–09/2007 **MSc in Advanced Computer Science**
The University of Manchester, UK

Thesis title: *Large-Scale Finite-Difference Time-Domain Data Processing Using High Performance Systems*

- During an MSc project adapted the Hierarchical Data Format 5 (HDF5) for an in-house numerical simulation package. The HDF5 enabled logical data storage and efficient data processing.
- Completed a module on High Performance Computing (HPC) and parallelised the Successive Over Relaxation (SOR) method with the Red-Black algorithm.

10/2004–09/2006 **BSC in Computer Science with minor in Physics**
Heinrich-Heine-Universität Düsseldorf, Germany

Thesis title: *Extraction and Storage of Web Structures*

- For a BSC project designed a database and a *web-crawler*—a program which collected hyperlinks from websites on the Internet. This work laid the foundation for a study of connectivity strength between different websites.
- Attended two language courses and learnt German in eight months, successfully passing entry examinations for the university.

09/1989–05/2000 **Riga Secondary School No. 72, Latvia**

- Five end of school examinations: Mathematics, Computer Science, Physics, Geography and Latvian.

Scientific Contribution

Refereed Journal Publications

- [1] J. Dongarra, M. Gates, A. Haidar, J. Kurzak, P. Luszczek, P. Wu, I. Yamazaki, A. Yarkhan, M. Abalenkovs, N. Bagherpour, J. Šístek, D. Stevens, M. Zounon, and S. D. Relton, “PLASMA: Parallel linear algebra software for multicore using OpenMP,” *ACM Trans. Math. Softw.*, vol. 45, no. 2, pp. 16–35, 2019.
- [2] J. Dongarra, M. Abalenkovs, A. Abdelfattah, M. Gates, A. Haidar, J. Kurzak, P. Luszczek, S. Tomov, I. Yamazaki, and A. YarKhan, “Parallel programming models for dense linear algebra on heterogeneous systems,” *Supercomputing Frontiers And Innovations*, vol. 2, no. 4, pp. 67–86, 2016. [Online]. Available: <http://superfri.org/superfri/article/view/90>
- [3] M. Abalenkovs, F. Costen, J.-P. Bérenger, R. Himeno, H. Yokota, and M. Fujii, “Huygens subgridding for 3-D frequency-dependent Finite-Difference Time-Domain method,” *IEEE Trans. Antennas Propag.*, vol. 60, no. 9, pp. 4336–4344, Sep. 2012.

Refereed Conference Proceedings

- [4] M. Abalēnkovs, “Towards performance optimisation of the Finite-Difference Time-Domain method via matrix casting,” in *Proc. 12th European Conference on Antennas and Propagation EuCAP’18*, London, UK, Apr. 9–13, 2018.
- [5] —, “Performance optimisation of stencil-based codes for shared memory architectures,” in *Proc. 11th European Conference on Antennas and Propagation EuCAP’17*, Paris, France, Mar. 19–24 2017.
- [6] M. Abalēnkovs, F. Costen*, J.-P. Bérenger, R. Himeno, and M. Fujii, “Defibrillation optimisation via Huygens subgridding for Finite-Difference Time-Domain method,” Spokane, WA, USA, Jul. 6, 2011.
- [7] M. Abalēnkovs*, F. Costen, and J.-P. Bérenger, “Huygens subgridding for Auxiliary Differential Equation–Finite Difference Time Domain,” Charleston, SC, USA, Jun. 1–5, 2009.
- [8] M. Abalēnkovs, F. Costen*, J.-P. Bérenger, and A. K. Brown, “Application of Huygens subgridding technique to human body modelling,” San Diego, CA, USA, Jul. 5–11, 2008.
- [9] M. Abalēnkovs, F. Costen*, C. Lucas, and A. K. Brown, “Data format selection for an I/O-intensive large-scale FDTD,” San Diego, CA, USA, Jul. 5–11, 2008.
- [10] M. Abalēnkovs*, F. Costen, and A. K. Brown, “Adaptation of HDF5 for FD–FDTD data manipulation tasks,” in *Proc. IX International PhD Workshop, OWD’2007*, Oct. 20–23, 2007.

Technical Reports

- [11] M. Abalēnkovs, N. Bagherpour, J. Dongarra, M. Gates, A. Haidar, J. Kurzak, P. Luszczek, S. Relton, J. Šístek, D. Stevens, P. Wu, I. Yamazaki, A. YarKhan, , and M. Zounon, “PLASMA 17.1 functionality report,” The University of Manchester, UK and The University of Tennessee, US, Tech. Rep., 2017. [Online]. Available: <http://www.netlib.org/lapack/lawnspdf/lawn293.pdf>
- [12] M. Abalēnkovs, N. Bagherpour, J. Dongarra, M. Gates, A. Haidar, J. Kurzak, P. Luszczek, S. Relton, J. Šístek, D. Stevens, P. Wu, I. Yamazaki, A. YarKhan, and M. Zounon, “PLASMA 17 performance report,” The University of Tennessee, US and The University of Manchester, UK, Tech. Rep., 2017. [Online]. Available: <http://www.netlib.org/lapack/lawnspdf/lawn292.pdf>
- [13] M. Abalēnkovs, “Note on Toeplitz tensor–random tensor convolutions by means of Fast Fourier Transform (FFT),” Microwave Department, Télécom Bretagne, Institut Mines-Telecom, Technopôle Brest-Iroise, CS 83818, 29238 Brest, CEDEX 3, France, Tech. Rep., Jul. 29, 2014, internal report.
- [14] M. Abalēnkovs, A. Peden, and P. Pajusco, “Plate-forme de simulation d’un système radar ACC embarqué sur véhicule : IHM de la plate-forme de simulation radar,” Microwave Department, Télécom Bretagne, Institut Mines-Telecom, Technopôle Brest-Iroise, CS 83818, 29238 Brest, CEDEX 3, France, Tech. Rep., Sep. 30, 2014, progress report.
- [15] —, “Plate-forme de simulation d’un système radar ACC embarqué sur véhicule : IHM de la plate-forme de simulation radar,” Microwave Department, Télécom Bretagne, Institut Mines-Telecom, Technopôle Brest-Iroise, CS 83818, 29238 Brest, CEDEX 3, France, Tech. Rep., Apr. 30, 2014, progress report.

Symbol “*” indicates the presenter.

- [16] A. Peden, P. Pajusco, and M. Abalēnkovs, “Plate-forme de simulation d’un système radar ACC embarqué sur véhicule : IHM de la plate-forme de simulation radar,” Microwave Department, Télécom Bretagne, Institut Mines-Telecom, Technopôle Brest-Iroise, CS 83818, 29238 Brest, CEDEX 3, France, Tech. Rep., Jan. 31, 2014, progress report.
- [17] Y. D. Zhang, M. Abalēnkovs, C. Argyropoulos, F. Costen, and A. K. Brown, “Design study annual report,” Microwave and Communication Systems Group, The University of Manchester, UK, Tech. Rep. EU DS4-T6, Sep. 5, 2007, SKADS progress report.

Seminar Presentations

- [18] M. Abalēnkovs*, F. Costen, and J.-P. Bérenger, “Subgridding for Finite-Difference Time-Domain methods,” in *Departmental Seminar*, Télécom-Bretagne, Brest, France, Jun. 13, 2013.
- [19] —, “Huygens subgridding for frequency-dependent Finite-Difference Time-Domain method,” in *Numerical Analysis Seminar*, The University of Manchester, UK, Nov. 11, 2011.
- [20] —, “Huygens subgridding for frequency-dependent Finite-Difference Time-Domain method,” in *Computational Electromagnetics Meeting*, The University of Manchester, UK, Jul. 1, 2010.
- [21] M. Abalēnkovs*, L. Cebamanos, and F. Costen, “Simulation of electromagnetic wave propagation from an antenna element,” in *Manchester SKADS Meeting*, Jan. 25, 2008.

Poster Presentations

- [22] M. Abalēnkovs, D. Stevens, A. Sunderland, and S. Scott, “Towards parallel 2D R-Matrix Propagation Codes for multicore architectures,” The University of Manchester, UK, May 29–30, 2019, poster presentation.
- [23] M. Abalēnkovs*, F. Costen, J.-P. Bérenger, R. Himeno, and M. Fujii, “Application of Huygens subgridding to study defibrillation in human body,” The University of Manchester, UK, Nov. 24, 2010, poster presentation.
- [24] M. Abalēnkovs*, F. Costen, and J.-P. Bérenger, “Huygens subgridding with filtering for Finite-Difference Time-Domain method,” The University of Manchester, UK, Nov. 25, 2009, poster presentation.

Positions of Responsibility

06/2015–03/2018 **ResLife Advisor, University halls, Manchester**
 09/2007–12/2011

- *Supervision*: Providing advice and assistance to ≈ 70 undergraduate students, encouraging interpersonal sensitivity and commitment to study.
- *Teamwork*: Working in a team of ≈ 20 advisors and three officers to support undergraduate students during their first years at the University.

08/2013–present **Scientific Journal Reviewer**

- Active reviewer for the IEEE Transactions on Antennas and Propagation (TAP), Antennas and Wireless Propagation Letters (AWPL) and the IET Microwaves, Antennas and Propagation (MAP) journals.

01/2018–present **Research Staff Representative, The University of Manchester**

- Keen member of the research staff committee at the School of Mathematics facilitating the needs and current developments of post-doctoral researchers to the faculty administration, co-organising monthly post-doctoral meetings and the grant writing club.

03/2013–05/2015

President, IEEE Student Branch, Télécom Bretagne

- *Leadership:* Organising and leading monthly meetings of the IEEE student branch planning activities and setting priorities for the coming month. Presenting the IEEE to new students stimulating an increased interest and growth of the branch.
- *Coordination:* Coordinating the committee and communicating with senior university staff that results in quick preparation and smooth running of the events such as “Smart Cities” and “IEEE Day”.
- *Supervision:* Initiated and led weekly training sessions for the IEEE Xtreme 24-hour programming competition. Two teams of three people participated in the final competition in 2013. One team took the 51st place out of 1500 teams in the world.
- *Organisation:* Created and co-organised events of the IEEE Day: scientific presentations, T-shirt printing, quiz and photo contest.

09/2008–12/2011

Student Representative, The University of Manchester

- *Organisation:* Organised monthly seminars in the department and persuaded young researchers to present their work.
- *Administration:* Created a mailing list for all PhD students and Research Associates in the department stimulating better and faster communication amongst colleagues.

10/2008–12/2011

International Society Trip Leader, The University of Manchester

- *Time management:* Supervised large groups of international students (50–70 people), planned and communicated visit times to ensure timely arrival and departure.

10/2008–10/2009

Chess Club Co-Founder / Secretary, The University of Manchester

- *Communication:* Efficiently negotiated with the Manchester Chess Federation and secured services of an experienced coach, which tripled the number of weekly meeting attendance.

Computer Skills

Programming: Fortran, C, Java, C++, Python, Julia, OpenMP, StarPU, MPI, GPGPU (incl. CUDA, OpenCL), MATLAB, GNU Octave, SQL, open-source and command line enthusiast

Computational Electromagnetics: FEKO, COMSOL Multiphysics

Mathematics: MAPLE, Mathematica

Meshers: GiD, MeshLab

Operating Systems: Linux, Unix, macOS, Microsoft Windows

Collaboration: Git, Mercurial, Subversion, AccuRev, JIRA, Confluence, LISTSERV

Professional Affiliations

- The Institute of Electrical and Electronics Engineers (IEEE) (since 2010)
- The Society for Industrial and Applied Mathematics (SIAM) (since 2010)
- The Applied Computational Electromagnetics Society (ACES) (since 2013)

Languages

- Speak four European languages fluently: English, German, Russian and Latvian.
- Learning French at level B2.

Interests

- In my free time I like to do Taiji, learn to play guitar and build a single-speed bicycle.