Anastasia Volkova

Associate Professor in Computer Science
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Research Interests

- Computer Arithmetic and certified computing
- Hardware Optimization
- Deep Neural Networks
- Digital Signal Processing

Professional experience

Sep 2019 - now **Associate Professor**, *Nantes Université, CS department and LS2N research lab, team OGRE*, Nantes, France.

Apr - Aug 2019 **Research resident**, *Intel Corporation – AI Research Group*, San Diego, USA.

Feb - Apr 2019 **Invited Researcher**, *Max Planck Institute for Software Systems*, Kaiserslautern, Germany.

2017 - 2019 **Postdoctoral researcher**, *Inria – ENS Lyon – LIP*, Lyon, France.

2014 - 2017 **PhD Candidate & Teaching Assistant**, *Sorbonne Universités – UPMC – LIP6*, Paris, France.

2012 - 2013 **Software engineer**, *IT department of Odessa National University*, Odessa, Ukraine.

Education

2014 - 2017 **PhD in Computer Science**, *Sorbonne University – UPMC*, Paris, France.
Thesis: "Towards reliable implementation of digital filters"
Advisors: Christoph Lauter, Thibault Hilaire

2012 - 2014 **Master en Applied Mathematics**, *Odessa National University I.I.Metchnikov*, Ukraine.
Mémoire : “Approximation methods for systems of fuzzy differential equations"

2008 - 2012 **Bachelor in Applied Mathematics**, *Odessa National University I.I.Metchnikov*, Ukraine.
Mémoire : “Linguistic models for large-scale fuzzy expert systems"

Student supervision

PhD:

2020 - now Rémi Garcia, working on optimization of hardware arithmetic operators, supervising 100%.

2021 - 2022 Wassim Seifeddine, workd on dynamic-precision training of DNN, supervisor 50%, with C. Jermann et S. Filip. Wassim quit the thesis after 12 months due to moving out of Nantes.

Masters (6 months internships):

2021 Mohammed-Bashir Mahdi, Master 2, worked on efficient rational approximations

2020 Killian Freteaud, Master 2, worked on error analysis and approximation of functions

2020 Rémi Garcia, Master 2, optimized recursive digital filter implementations

2018 Youcef Merah, Master 2, worked on code generation for mathematical functions

2016 Maminionja Ravoson, Master 2, worked on lattice-wave digital filter implementation

Bachelors:

2022 Naila Tilsahni et Raphaël Blanchard, 2 months, 2nd year students,introduction to DNNs

2021 Elizabeth Gandibleux, 1 month, 1st year student, introduction to cryptography

Teaching responsibilities

2021 - now Co-chair of the Master in Engleneering – Optimization, Computer Science and Mathematics track. Member of the Master and Bachelors bureau of the CS department.

2021 - now Co-head of the L1 module “Algorithms and programming”, $\sim$ 300 students/year

2020 - now Head of the L2 module “Algorithms and data structures 1” , $\sim$ 120 students/year

2019 - now Co-head of the L2 module “Numerical algorithms” , $\sim$ 70 students/year

Teaching

2014 - 2017 As a teaching assistant during PhD thesis, I did 192h of service at Polytech Sorbonne (not detailed)

2019 - 2022 Since starting the position in Nantes, I have tought the following courses

Année	Niveau	Module	CM	TD	TP	Responsable
2021 - 2022	L1	Algorithms and programming	18h	18h	12h	oui
2021 - 2022	L2	Algorithms and data structures 1	12h	48h	18h	oui
2021 - 2022	L2	Numerical algorithms	6h	26h	18h	oui
2021 - 2022	L2	Object-oriented programming	–	20h	12h	
2020 - 2021	L2	Algorithms and data structures 1	12h	24h	9h	oui
2020 - 2021	L2	Numerical algorithmss	6h	13h	9h	oui
2020 - 2021	L2	Object-oriented programming	–	20h	12h	
2020 - 2021	L3	Computer architecture	–	16h	12h	
2019 - 2020	L2	Numerical algorithms	6h	13h	9h	oui
2019 - 2020	L2	Algorithms and data structures 1	–	24h	18h	
2019 - 2020	L2	Object-oriented programming	–	20h	12h	
2019 - 2020	L3	Computer architecture	–	16h	12h	

Full list of publications

International journals:

[GVKGK'22] R. Garcia, **A. Volkova**, M. Kumm, A. Goldsztejn and J. Kühle, "Hardware-Aware Design of Multiplierless Second-Order IIR Filters With Minimum Adders," in **IEEE Transactions on Signal Processing**, vol. 70, pp. 1673-1686, 2022, doi: 10.1109/TSP.2022.3161158.

[KVF'22] M. Kumm, **A. Volkova** and S. -I. Filip, "Design of Optimal Multiplierless FIR Filters with Minimal Number of Adders," in **IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems**, doi: 10.1109/TCAD.2022.3179221.

[VHL'20] **A. Volkova**, T. Hilaire and C. Lauter, "Arithmetic Approaches for Rigorous Design of Reliable Fixed-Point LTI Filters," in **IEEE Transactions on Computers**, vol. 69, no. 4, pp. 489-504, 1 April 2020, doi: 10.1109/TC.2019.2950658.

[VIDH'19] **A. Volkova**, M. Istoan, F. de Dinechin and T. Hilaire, "Towards Hardware IIR Filters Computing Just Right: Direct Form I Case Study", **IEEE Transactions on Computers**, 68(4), 597–608, 2019, doi:10.1109/TC.2018.2879432

International peer-reviewed conferences:

[HKKV'22] T. Habermann, J. Kühle, M. Kumm, **A. Volkova**, "Hardware-Aware Quantization for Multiplierless Neural Network Controllers" , in 18th IEEE Asia Pacific Conference on Circuits and Systems (APPCAS), to appear in November 2022, Shenzhen, China.

[GVK'22] R. Garcia, **A. Volkova**, and M. Kumm, "Truncated Multiple Constant Multiplication with Minimal Number of Full Adders," in International Symposium on Circuits and Systems (**ISCAS**) , 2022, Austin, United States. [Online]. Available: `https://hal.archives-ouvertes.fr/hal-03582935`

[BTDVJ'22] H. Becker, M. Tekriwal, E. Darulova, **A. Volkova**, and J.-B. Jeannin, "Dandelion: Certified Approximations of Elementary Functions", Interactive Theorem Proving (**ITP**), 2022. [Online] Available: `https://arxiv.org/abs/2202.05472`

[DFKV'21] F. de Dinechin, S.-I. Filip, M. Kumm and **A. Volkova**, "Towards Arithmetic-Centered Filter Design," 2021 IEEE 28th Symposium on Computer Arithmetic (**ARITH**), 2021, pp. 115-118, doi: 10.1109/ARITH51176.2021.00032.

[LV'20] C. Lauter and **A. Volkova**, "A Framework for Semi-Automatic Precision and Accuracy Analysis for Fast and Rigorous Deep Learning," 2020 IEEE 27th Symposium on Computer Arithmetic (**ARITH**), 2020, pp. 103-110, doi: 10.1109/ARITH48897.2020.00023.

[VM'19] **A. Volkova** and J. -M. Muller, "Semi-Automatic Implementation of the Complementary Error Function," 2019 IEEE 26th Symposium on Computer Arithmetic (**ARITH**), 2019, pp. 167-174, doi: 10.1109/ARITH.2019.00039

[DV'19] E. Darulova and **A. Volkova**. "Sound approximation of programs with elementary functions". In *31st International Conference on Computer-Aided Verification* ***(CAV)***, New-York, USA, 2019

[VCH'17] **A.Volkova**, C. Lauter and T. Hilaire. "Reliable verification of digital implemented filters against frequency specifications". In *IEEE 24th Symposium on Computer Arithmetic (**ARITH**)*, pp. 180-187, London, UK, 2017. doi: 10.1109/ARITH.2017.9

[QVTH'17] F. Qureshi, **A.Volkova**, J. Takala and T. Hilaire. "Multiplierless Unified Architecture for Mixed Radix-2/3/4 FFTs." In *25th European Signal Processing Conference (**EUSIPCO**)*, pp. 1334-1338, Kos, Greece, 2017. doi: 10.23919/EUSIPCO.2017.8081425

[HV'17] T. Hilaire and **A.Volkova**. "Error analysis methods for the fixed-point implementation of linear systems". In *IEEE Workshop on Signal Processing Systems (**SiPS**)*, pp. 1-6, Lorient, France, 2017. doi: 10.1109/SiPS.2017.8109991

[HVR'16] T. Hilaire, **A. Volkova** and M. Ravoson, "Reliable Fixed-Point Implementation of Linear Data-Flows," In *IEEE International Workshop on Signal Processing Systems* (**SiPS**), 2016, pp. 92-97, doi: 10.1109/SiPS.2016.24.

[VHL'15b] **A.Volkova**, T. Hilaire and C. Lauter. "Reliable evaluation of the worst-case peak gain matrix in multiple precision." In *IEEE 22nd Symposium on Computer Arithmetic (**ARITH**)*, pp. 96-103, Lyon, France, 2015. doi: 10.1109/ARITH.2015.14

[VHL'15a] **A.Volkova**, T. Hilaire and C. Lauter. "Determining fixed-point formats for a digital filter implementation using the worst-case peak gain measure." In *49th Asilomar Conference on Signals, Systems and Computers (**ASILOMAR**)*, pp. 737-741, Pacific Grove, CA, USA, 2015. doi: 10.1109/ACSSC.2015.7421231

[VH'15] **A. Volkova** and T. Hilaire. "Fixed-point implementation of lattice wave digital filter: Comparison and error analysis." In *23rd European Signal Processing Conference (**EUSIPCO**)*, pp. 1118-1122, Nice, France, 2015. doi: 10.1109/EUSIPCO.2015.7362557

Abstract-based conferences :

[GV'22] R. Garcia and **A. Volkova**. "Toward the Multiple Constant Multiplication at Minimal Hardware Cost", at EURO: European Operation Research Conference, Espoo, Finland, 2022

[GVG'22] R. Garcia and **A. Volkova**. "A New Model for the Multiple Constant Multiplication Problem", at ROADEF: Congrès annuel de la Société Française de Recherche Opérationnelle et d'Aide à la Décision, Lyon, France, 2022

[V'19] A. Volkova, "FiXiF toolbox: validated numerics for sound digital filter implementations", at 18th International Symposium on Scientific Computing and validated Numerics, Tokyo, Japan, 2019.

Submitted manuscripts:

[GV'2022] R. Garcia and **A. Volkova**. "Towards the Multiple Constant Multiplication at Minimal Hardware Cost". Submitted to **IEEE Transactions on Circuits and Systems**, 2022. [Online] Available : `https://arxiv.org/abs/2210.02742`

[GV'2022] R. Garcia and **A. Volkova**. " Multiple Constant Multiplication: From Target Constants to Optimized Pipelined Adder Graphs ". Submitted to **DATE**, 2022. Not available online due to double-blind.

[LJDV'22] D. Lohrar, C. Jeangoudoux, E. Darulova, **A. Volkova**. "Sound Mixed Fixed-Point Quantization of Neural Networks", Submitted to ACM SIGPLAN Conference on Programming Language Design and Implementation 2023 (**PLDI**). Not available online due to double-blind.

Scholarships and funding

2021 LeanAI: Labex CominLabs, 3-year research project, co-head with S. Filip, 300 000 €

2020 ACCENT: RFI Atlanstic2020 1-year research project, 10 000 €

2020 ACCENT-SI: RFI Atlanstic2020 travel grant for collaboration with Max Planck Institute, 3 300 €

2019 Intel Corporation AI Fellowship for a 2-year research residency in the area of AI acceleration

2017 Inria Fellowship for a postdoctoral research at team Aric, Lyon

2013 Ukrainian governement grant for a 6-month research internship at Sorbonne, France

Software

FIRopt A tool for the design of optimal digital filters implemented as multiplierless architectures on FPGA. Licence GNU GPL v3.0. Available at `https://gitlab.com/filteropt/firopt`

FiXiF toolbox Fixed-point LTI filter code-generation tool. Licence GNU GPL v3.0. Disponible à `https://github.com/fixif/FiXiF.git`

Daisy+Metalibm A Metalibm plugin for elemntary function approximation, incrporated into the Daisy static analysis tool, copyright MPI-SWS. Available at `https://github.com/malyzajko/daisy`

ERFCgenerator A tool for semi-automatic code-generation for the complementary error function, licence CeCILL-B. Available at `https://gforge.inria.fr/projects/erfcgenerator`

WCPGLib	Algorithm for the worst-case peak gain evaluation in arbitrary precision, licence CeCILL-B. Available at `https://scm.gforge.inria.fr/anonscm/git/metalibm/wcpg.git`
FxPFlib	A math library for the reliable computation of safe fixed-point formats for LTI filters, licence CeCILL-B. Available at `https://scm.gforge.inria.fr/anonscm/git/fxpf/fxpf.git`

Services and activites

Services:

Organizer of OGRE eam scientific seminars

Program committee memeber, IEEE ARITH Symposium 2022, SCAN 2023

Reviewer for IEEE TC, AICAS, TCAS, TETC journals

Scientific event organisation and scientific popularization

Sep 2023	Program Co-Chair for IEEE Arith 2023 symposium
Sep 2023	Co-general chair of the SCAN international conference in Nantes
Nov 2022	Organizer of GT-ARITH national days, RAIM, in Nantes
2022 - now	Co-creator of the “Women in CS@NantesUniversité” initiative promoting diversity in CS at Nantes University
2020 - now	Scientific popularization in Nantes high schools, participant of national initiative Déclic
2015-2016	Member of the organization committee for PhD seminars at LIP6, UPMC

Invited speaker:

2022	ReCAP: International Workshop on Reliable Computing and Computer-Assisted Proofs, plenary speaker, Japan
2021	CANUM: Calcul et Algorithmique Numérique, invited to special session on reliable computing, France
2019	DARS: Design and Analysis of Robust Systems workshop at CAV’19, invited speaker, USA
2018	SCAN: International Symposium on Scientific Computing, Computer Arithmetic, and Verified Numerical Computations, invited special session speaker at SCAN, Japan

Languages

French, English	Full proficiency
German	Elementary level
Ukrainian, Russian	Mother tongues