Andreas Van Barel

PhD Mathematical Engineering / Computer Science

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COMPETENCES

Programming	Python, Julia (excellent); Java, SQL, Matlab (good); C, C++, GLSL, Fortran (some experience)
Technical	Applied Mathematics, Mathematical Optimization, Differential Equations, Analysis, Machine Learning Algorithms, Probability Theory, Statistics, Computer Graphics, Cloud Computing
	PyTorch, Numpy, Pandas, FastAPI, OpenGL, Linux/Unix, Git, Azure
General	Scientific Research & Development, Software Engineering, International Collaboration, Problem Solving, Presenting, Teaching, Project Management, Business Development
Languages	Dutch (native); English (fluent); French, Italian (intermediate)

EXPERIENCE

2022 – Now Companion.energy startup – Mathematical Advisor

2023 – 2024 Companion.energy startup – Software Engineer

Developed a prototype platform for industrial energy management and energy optimization, used by early customers, that allowed the startup to raise >€2M seed funding. Was involved in full stack software engineering, business development, data science, research.

2016 – 2021 KU Leuven, CS-NUMA – Research Scientist

Managed my own research agenda and obtained my own funding.
Published in the top journals of the field, such as SIAM/OPT, SIAM/UQ, and Num. Math.
Presented at >10 international conferences and at several other events/occasions.

Investigated the multilevel Monte Carlo (MLMC) method in the context of robust optimization of PDEs with random coefficients, leading to speedups of 100x to 10000x.

Combined MG/OPT (a multigrid optimization framework) and MLMC to exploit structure in both the physical domain of the PDE as well as the stochastic domain in a way that retains the advantages (and thus speed-ups) of both methods simultaneously.

Developed novel mathematical theory and a practical implementation of the multilevel quasi-Monte Carlo method for robust optimization.

2017 – 2019 SIAM Student Chapter – Event Organiser and Webmaster

2015 KU Leuven, ESAT-COSIC – Research Engineer

Wrote fast C++ software for side channel attacks to crack smart cards. Provided an important general insight on how to efficiently implement such side channel attacks on any platform.

EDUCATION

2016 – 2021 PhD Mathematical Engineering / Computer Science – KU Leuven
Multilevel Monte Carlo methods for robust optimization of partial differential equations
Supervised by Prof. dr. ir. Stefan Vandewalle

2014 – 2016 Master of Science: Mathematical Engineering – KU Leuven
Graduated summa cum laude (top ~1%)

2011 – 2014 Bachelor of Science: Electrical Engineering & Computer Science – KU Leuven
Graduated summa cum laude (top ~1%)

PROJECTS

Neuron.jl – A toy parallelized CPU based ML library written from scratch using only Julia's standard library.

Java CPU based ray tracer – For rendering analytical shapes as well as triangle meshes. Features bounding volume hierarchies, materials system, environment maps, multiple light sources, anti-aliasing, depth of field, etc.

Julia compute shader engine – A toy Julia GPU 2d rendering engine using OpenGL and compute shaders (GLSL) to do real time particle simulations, render fractals, evaluate Conway's game of life, develop 2d computer games, etc.

SimpleCanvas.jl – A Julia package for easily rendering matrix data to the screen in real time using OpenGL.

CirculantEmbedding.jl – A Julia package for very fast sampling of Gaussian stochastic fields using FFTs.

KEY PUBLICATIONS

(For a full academic CV with all publications and conference talks, see www.avanbarel.com/publications)

Van Barel, A., and Vandewalle, S., *MG/OPT and multilevel Monte Carlo for robust optimization of PDEs*. SIAM Journal on Optimization 31, 3 (2021), 1850–1876.

Van Barel, A., and Vandewalle, S., *Robust optimization of PDEs with random coefficients using a multilevel Monte Carlo method*. SIAM/ASA Journal on Uncertainty Quantification 7, 1 (2019), 174–202.

TEACHING & MENTORING

2016 – 2021	Analysis I exercise sessions (Fall), Analysis II exercise sessions (Spring)
2017 – 2020	(Co-)supervisor of 4 master's theses (various subjects)

AWARDS

2016 – 2021	4 Golden Chalk teaching awards, elected by students
2017	First Prize poster award at Woudschoten conference, Zeist, Netherlands
2011	First Prize in the Flemish Math Olympiad (VWO) with additional distinction for best formulated and structured answers
2009	First Prize in the Junior Flemish Math Olympiad (JWO)

GRANTS

2017 – 2021	FWO (Research Foundation Flanders) PhD fellowship (> €125k)