

Wilder Lopes

Research Engineer and Entrepreneur

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I am the co-founder and CTO of Upstride, a startup that [optimized the performance of neural networks \(NNs\) via Geometric \(Clifford\) Algebras](#). As a co-founder and CTO, I was the one in charge of building the technical vision, improving the tech and product roadmap, and lead the tech/product teams. Upstride raised over EUR 3 million, of which EUR 1.6 million from venture capital. In July 2021, Upstride was acquired by ContentSquare.

Before founding Upstride, I was an applied scientist (machine learning and signal processing) at UCit.fr, where I was responsible for building their software to designing statistical-learning algorithms for computer vision and high-performance computing. In 2016 I earned a Ph.D. in Electronics Engineering (signal processing) from the University of Sao Paulo, Brazil, with a one year-long research period at the Technical University Munich (TU Munich), Germany. From 2016 to 2017, I was a Postdoc at Thales Research and Technology in Paris, France. My interests include machine learning, deep learning, signal processing, Clifford (Geometric) Algebra, adaptive filtering, optimization, computer vision, applied mathematics, integrated-circuits design, and high-performance computing.

Experience

2018–2021 **Co-founder and CTO.** *Upstride* (upstride.io), Paris, France.

Upstride enabled developers to optimize the performance of neural networks (NNs) via the use of Geometric (Clifford) Algebras. Upstride's product was a computational engine that leverages Geometric Algebra (GA) and served as backend for Tensorflow, enabling developers to design, train, and deploy NNs that are more compact, i.e., they have a lower count of free parameters when compared to the ones obtained with standard Tensorflow. The product is fully compatible with Tensorflow 2, Nvidia's CUDA and Intel's OneAPI. Moreover, the technology is compatible with other standard NN compression techniques such as quantization and pruning. As a co-founder and CTO, my role was to build the technical vision, improve the tech and product roadmap, and more importantly, strengthen the team culture in order to overcome the great challenges that come with building and selling a deep-tech product. Upstride raised over EUR 3 million, of which EUR 1.6 million from venture capital. In July 2021, Upstride was acquired by ContentSquare.

2017–2018 **Applied Scientist.** *UCit* (www.ucit.fr), Paris, France.

UCit is a company that builds and sells software for optimizing high-performance computing (HPC) systems. As their first applied scientist, I was responsible for setting up the R&D strategy and bringing state-of-the-art techniques to the core of their products. In particular, I designed machine-learning algorithms (classification, regression, and pattern recognition) to optimize the performance of supercomputers and HPC clusters via the analysis of their logs. Additionally, I designed artificial neural networks to model HPC job schedulers and predict the workload pattern at some point in the future. Finally, I helped their software engineers to write UCit's software suite, which packages the predictive power of the algorithms I designed.

- 2016–2017 **Postdoc Researcher.** *Thales Group (Research and Technology)*, Palaiseau, France.
During my postdoc I was based at the high-performance computing group of Thales, in the suburbs of Paris, working on topics in the scope of the European Project INFIERI (FP7-PEOPLE-2012-ITN, PITN-GA-2012-317446-INFIERI), a scientific collaboration led by CERN. My work was focused on designing statistical-learning and machine-learning algorithms for data partitioning in high-performance computing platforms composed by heterogeneous devices, e.g., CPUs, GPUs, FPGAs. Put simply, given a workload, its associated dataset, and the required quality of service (QoS), my algorithms optimize the cluster power consumption and workload execution speed. This research was motivated by the ongoing problem faced by CERN when processing the petabytes of data generated at each second during particle-collision experiments: this colossal amount of data can't be stored and thus must be processed in real-time on the appropriate device (ASIC, CPU, GPU, FPGAs). As part of the project, I attended multiple events and conferences around the world (Portugal, France, Brazil, USA) where I presented th research results. I was supported by the prestigious Marie Curie Research Fellowship from the European Union's Seventh Framework Programme.
- 2014–2015 **Visiting Ph.D. Researcher.** *TU Munich*, Munich, Germany.
Year-long research stay as part of my PhD (more details in the next section). I was based at the Chair of Media Technology, under the supervision of Prof. Eckehard Steinbach. My work was focused on improving the visual navigation of robots. In particular, I designed adaptive-filtering algorithms to solve, in real-time, the 3D registration of point clouds. Besides devising the mathematical framework (based on [Geometric Clifford Algebra](#)), there was an extensive programming campaign in order to implement those algorithms in C++ using the Point Cloud Library (PCL), a library widely used in the robotics and autonomous-driving communities. The research carried out in Munich eventually became the central part of my PhD thesis, which also incorporated work I had previously done in my home lab at the University of Sao Paulo, in Brazil.
- 2009–2010 **Analog and Mixed-Signal IC Engineer.** *LSITec*, Sao Paulo, Brazil.
LSITec is a spin-off of the University of Sao Paulo that provides custom chip design for several clients around the world. Fresh out of college, I joined their analog and mixed-signal (AMS) team to work full-time on the design of an ASIC for healthcare. Particularly, I worked on the acquisition and processing of electrocardiogram signals. Together with three colleagues, I designed several classical AMS blocks, e.g., digital-to-analog converters (DACs), operational amplifiers, frequency oscillators. Despite the great experience and learning about the integrated-circuit industry, by the end of 2009, I decided I wanted to go back to academia to further develop my mathematical skills, which led me to leave the company in February 2010 to join the Master in Electronics Engineering at the University of Sao Paulo (details in the next section).

Education

Degrees

- 2012–2016 **Doctorate (Ph.D.) in Electronic Systems Engineering.** *University of Sao Paulo*, Sao Paulo, SP - Brazil.
Thesis: "Geometric-Algebra Adaptive Filters". The main contribution of this research is the generalization of adaptive-filtering theory by reformulating it in light of Geometric (Clifford) Algebra. A dense mathematical study of Geometric-Algebra Adaptive Filters (GAAFs) is carried out and a convergence proof, together with corroborating experiments, is provided. In terms of applications, the research highlights the benefits of using GAAFs in 3D registration of point clouds (PCDs) instead of standard matrix-based methods – namely, GAAFs are able to solve the registration using 80% less data compared to standard methods. Code and notes are shared at openga.org.
- 2010–2012 **M.S. in Electronic Systems Engineering.** *University of Sao Paulo*, Sao Paulo, SP - Brazil.
Thesis: "Incremental Strategies in Combination of Adaptive Filters". This work introduces a new strategy for combination of adaptive filters. Inspired by incremental schemes and cooperative adaptive filtering, the standard convex combination of parallel-independent filters is rearranged into a series-cooperative configuration, while preserving computational complexity. Two new algorithms are derived employing recursive least-squares (RLS) and least-mean-squares (LMS) algorithms as the component filters. The main result shows that the series combination of RLS and LMS creates an overall filter that is robust to non-stationary colored noise, able to work in conditions otherwise unachievable with the standard parallel combination.

2003–2008 **B.S. in Electrical Engineering.** *Federal University of Bahia, Salvador, BA - Brazil.*
Final Work: "Digital Audio Signal Processing Using Wavelet Transform" (in Portuguese). This work implements a software capable to extract the audio signature of any musical instrument via signal-processing algorithms based on the Wavelet Transform.

Complementary Courses

2012 **CLTP 3 - CanSat Leader Training Program.** *Tokyo Metropolitan University, Tokyo - Japan.*

[Five-weeks course on picosatellites.](#) Construction and test of a Can Satellite (CanSat) with fully functional circuitry. Design of embedded systems and software according to the same specifications used by the Japanese Space Agency (JAXA). [Launch of a rocket](#) carrying the CanSat as a payload. Training courses given by JAXA engineers and scientists.

2008–2009 **Analog and Mixed-Signal IC Design (IC Brazil).** *CTI Renato Archer, Campinas - Brazil.*
Specialization course (6 months) on design of analog and mixed-signal (AMS) integrated circuits. Trained by Cadence Design Systems as part of a partnership between the Brazilian Ministry of Science and Cadence. Tools used: Virtuoso AMS Designer, Virtuoso UltraSim Full-chip Simulator, Spectre Simulation, Virtuoso Layout.

Computer skills

Programming **Python, C/C++, Matlab, Cuda, Verilog, SystemC, HTML, CSS, JavaScript.**
AI Libraries **TensorFlow, PyTorch, scikit-learn.**
Embedded Systems **Nvidia Jetson, Raspberry Pi.**
Editors **Visual Studio Code, Vim.**
O.S. **Linux, Windows.**
Other **Cloud Infrastructure Management, Git, Docker, RESTful APIs, CMake, Point Cloud Library, Cadence Tools (AMS Designer, Ultrasim, Spectre, Layout), MS Office, \LaTeX .**

Languages

Fluent **English, French, Portuguese**
Advanced **German**

Publications

Lopes, Wilder B.; *Lopes, Cassio G.* "[Geometric-Algebra Adaptive Filters](#)". IEEE Transactions on Signal Processing, 2019.

Lopes, Wilder B.; *Al-Nuaimi, Anas; Lopes, Cassio G.* "[Geometric-Algebra LMS Adaptive Filter and its Application to Rotation Estimation](#)" IEEE Signal Processing Letters, 2016.

Al-Nuaimi, Anas; **Lopes, Wilder B.;** *Steinbach, Eckehard; Lopes, Cassio G.* "[6DOF Point Cloud Alignment using Geometric Algebra-based Adaptive Filtering](#)" IEEE WACV 2016 - Lake Placid, NY, USA.

Al-Nuaimi, Anas; **Lopes, Wilder B.;** *Zeller, Paul; Garcea, Adrian; Lopes, Cassio G.; Steinbach, Eckehard* "[Analyzing LiDAR Scan Skewing and its Impact on Scan Matching](#)" IEEE IPIN 2016 - Madrid, Spain.

Lopes, Wilder B.; *Lopes, Cassio G.* "[Incremental Combination of RLS and LMS Adaptive Filters in Nonstationary Scenarios](#)" IEEE ICASSP 2013 - Vancouver, Canada.

Chamon, Luiz F. O.; **Lopes, Wilder B.;** *Lopes, Cassio G.* "[Combination of Adaptive Filters with Coefficients Feedback](#)" IEEE ICASSP 2012 - Kyoto, Japan.

Lopes, Wilder B.; *Lopes, Cassio G.* "[Incremental-Cooperative Strategies in Combination of Adaptive Filters](#)" IEEE ICASSP 2011 - Prague, Czech Republic.

Conferences and Workshops

- March 2017 **IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2017)**. *The world's largest and most comprehensive technical conference on signal processing and its applications. Poster presentation of Signal Processing Letters paper "Geometric-Algebra LMS Adaptive Filter and its Application to Rotation Estimation"*. New Orleans, USA.
- Jan./Feb. 2017 **4th Summer School on Intelligent Signal Processing for Frontier Research and Industry (INFIERI Summer School)**. *Two weeks-long summer school. It provided lectures, laboratory practice, and poster sessions on the most advanced technologies in the fields of semiconductors, very deep submicron and 3D technologies, advanced packaging and interconnects, telecommunications, real-time signal processing, filtering and massive parallel computing. Such topics cover the signal-processing demands of new Physics domains to be explored. Poster presentation of postdoc research at Thales: "Techniques for Dynamic Workload Partitioning in High-Performance Heterogeneous Computing Platforms"*. Sao Paulo, Brazil.
- Oct. 2016 **INtelligent, Fast, Interconnected and Efficient devices for Frontier Exploitation in Research and Industry (INFIERI) 8th Workshop**. *Periodic meeting of INFIERI network. Seminars on technologies for astrophysics, medical physics, and particle physics. Visit to facilities of the Fermi National Accelerator Laboratory (Fermilab). Oral and poster presentation of postdoc research at Thales: "Techniques for Dynamic Workload Partitioning in High-Performance Heterogeneous Computing Platforms"*. Fermilab – Chicago, USA.
- April 2016 **INtelligent, Fast, Interconnected and Efficient devices for Frontier Exploitation in Research and Industry (INFIERI) 7th Workshop**. *Periodic meeting of INFIERI network. Seminars on technologies for astrophysics, medical physics, and particle physics. Oral presentation of Ph.D. research: "Signal Processing and Adaptive Filtering: Overview and Applications"*. Lisbon, Portugal.
- March 2016 **IEEE Winter Conference on Applications of Computer Vision (WACV 2016)**. *One of the main conferences for computer vision applications and systems. Oral and poster presentation of paper "6DOF Point Cloud Alignment using Geometric Algebra-based Adaptive Filtering"*. Lake Placid, USA.
- May 2013 **IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2013)**. *The world's largest and most comprehensive technical conference on signal processing and its applications. Poster presentation of paper "Incremental Combination of RLS and LMS Adaptive Filters in Nonstationary Scenarios"*. Vancouver, Canada.
- August 2012 **Noshiro Space Event**. *CanSats (Can Satellites) and amateur rocket competition. Launching and test of my own CanSat designed during the CLTP 3 course at Tokyo Metropolitan University. Poster presentation: "An Overview of the Research Activities in the Signal Processing Laboratory at University of Sao Paulo"*. Noshiro, Japan.
- March 2012 **IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2012)**. *The world's largest and most comprehensive technical conference on signal processing and its applications. Poster presentation of paper "Combination of Adaptive Filters with Coefficients Feedback"*. Kyoto, Japan.
- May 2011 **IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2011)**. *The world's largest and most comprehensive technical conference on signal processing and its applications. Poster presentation of paper "Incremental-Cooperative Strategies in Combination of Adaptive Filters"*. Prague, Czech Republic.

Open-Source Project

OpenGA.org - Open-source Geometric Algebra (OpenGA) is a hub for tools and algorithms devised in light of Geometric (Clifford) Algebra (GA). GA generalizes many of the standard algebraic systems used for describing geometric transformations, e.g., linear/matrix algebra, complex algebra, quaternions etc. GA-based algorithms are good candidates for applications where multidimensional quantities need to be estimated.

Grants

Marie Curie Research Fellowship (FP7-PEOPLE-2012-ITN, PITN-GA-2012-317446-INFIERI). *From April 2016 to January 2017.* Funded by the [INFIERI network \(an European Training Network\) as an Experienced Researcher \(ER\)](#) to carry out postdoctoral research at Thales Research and Technology. This is one of Europe's most prestigious grants.

CAPES-PDSE (number BEX14601/13-3). *From May 2014 to May 2015.* Funded by the Brazilian Ministry of Science and Technology to carry out part of my Ph.D. research at TU Munich.

CAPES-DS, Programa de Demanda Social. *From March 2012 to March 2014, and from June 2015 to February 2016.* Funded by the Brazilian Ministry of Science and Technology to carry out Ph.D. research at the University of Sao Paulo.

PRPG-USP Travel Grant. *From October 2013 to November 2013.* Funds of the University of Sao Paulo to cover expenses during a one month-long research stay at TU Munich.

IEEE Signal Processing Society Travel Grant. *May 2013.* IEEE grant to support student's travel expenses to attend the ICASSP 2013 in Vancouver, Canada.

PAE-USP. *From February to June 2013.* Funds of the University of Sao Paulo to support my activities as a Graduate Teaching Assistant.

PAE-USP. *From July to November 2012.* Funds of the University of Sao Paulo to support my activities as a Graduate Teaching Assistant.

IEEE Signal Processing Society Travel Grant. *March 2012.* IEEE grant to support student's travel expenses to attend the ICASSP 2012 in Kyoto, Japan.

PRPG-USP Travel grant. *May 2011.* Funds of the University of Sao Paulo to cover the travel expenses to attend the ICASSP 2011 conference.

Courses Taught

Two semesters in 2012–2013 **Experimental Electronics I.** *Graduate teaching assistant, from July to November 2012 and from February to June 2013 at the Electronic Systems Department of University of Sao Paulo.* Discipline outline: transistors (BJT, JFET, MOSFET), rectifiers, voltage and current sources, switching transistors, power transistors, differential amplifiers, operational amplifiers, small-signal amplifiers. Responsibilities: undergrad students tutoring, preparation of laboratory equipment, periodic review of the experimental procedures, grading reports and exams. Average of 6 hours per week.

2012 **Experimental Electronics I.** *Graduate teaching assistant, from July to November 2012 at the Electronic Systems Department of University of Sao Paulo.* Discipline outline: transistors (BJT, JFET, MOSFET), rectifiers, voltage and current sources, switching transistors, power transistors, differential amplifiers, operational amplifiers, small-signal amplifiers. Responsibilities: undergrad students tutoring, preparation of laboratory equipment, periodic review of the experimental procedures, grading reports and exams. Average of 6 hours per week.