Keith Yuan Patarroyo

Physicist, M.Sc. student in Computer Science & Computer Graphics Researcher at LIGUM, Université de Montréal

Personal Information

Born on January 16, 1997 in Bogotá D.C. (Colombia), single.

Interests

Image and Geometry Processing, Computer Graphics, Machine Learning, Digital Fabrication, Distributed Computing

Academic Training

2018– **M.Sc. in Computer Science**, *Université de Montréal*, Quebec, Canada.
I work on physically based computer graphics and digital fabrication at LIGUM under the supervision of Bernhard Thomaszewski.
• Selected CourseWork: Machine Learning at Mila/UdeM, Realistic Image Synthesis, Geometric Modeling and Shape Analysis, Computational Design for Digital Fabrication

2013–2018 **B.Sc. in Physics (Honorary Degree)**, *Universidad Nacional de Colombia*, Bogotá.
Universidad Nacional de Colombia is one of Colombia's leading university for high-level scientific training. Academic Average: 4.4/5.0.

1999–2010 **High School Degree**, *Liceo V.A.L.*, Bogotá.
Intensive preparation for Colombia's National Standardized Test for High Schools, *ICFES, Saber 11*, I ranked 11th out of 1,000 test takers in an indiscriminate group of 1,000.

Awards and Honors

2018 **Scholarship Bourse C (Bourse d'exemption des droits de scolarité supplémentaires)**, *Faculté des études supérieures et postdoctorales, Université de Montréal*, 21,000$ per year.

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2018 **Honorary Degree & Graduate Scholarship**, *Consejo Campus Sede Bogotá, Universidad Nacional de Colombia* .
The award is given to the graduates that were granted the Tuition Payment Exemption during the whole course of the degree.

2013–2018 **Tuition Payment Exemption**, *Consejo Facultad de Ciencias, Universidad Nacional de Colombia* , Obtained *every* academic term during my studies: 2013-2018.
The award is given each term to the top 15 GPA of current B.S. Physics students

2017 **XXI Colombian University Mathematical Olympiad Finalist**, *Olimpiadas Colombianas de Matemáticas, Universidad Antonio Nariño*.

2017 **6-Month Research Grant UREP–C 2017–II (Undergraduate Research Experience Purdue Colombia)**, *Universidad Nacional de Colombia and Purdue University*, 5000$.

2016 **6-Week DAAD German Winter Course in a University Scholarship (DAAD-Hochschulwinterkursstipendium)**, *DAAD*, 3000€.

Appointments

2021- **Research Affiliate**, *Wolfram Physics Project*, Alongside Stephen Wolfram we lead a new approach to discover the fundamental theory of physics..
I work on three projects: The first is about models of metamathematics derived from rewriting systems and the logic of sheafs. The second explores the discrete differential geometry of Hypergraphs. Finally the third attempts to bridge the gap of entropy and computation with the use of multi-way systems for Non-equilibrium Thermodynamics.

2018- **Research Assistant**, *Université de Montréal*, LIGUM, Physically based Computer Graphics supervised by professor Bernhard Thomaszewski.
I work on the improvement of physical modeling and interaction of slender mechanical structures. The current project pretends to obtain an accurate and efficient method for simulating plastic deformation of thin elastic rods with forming and other mechanical techniques. Some of the applications of these work lie on artistic and industrial manufacturing.

2020-2021 **Winter Research Student**, *Wolfram Physics Winter School* - *Wolfram Research*, Remote Work under the supervision of Taliesin(Tali) Beynon, Date: 28^{th} December 2020– 15^{th} January 2021.
This study aimed to describe a possible path for obtaining large scale elastic phenomena from microscopic rules. For this, we investigated rewrite rules on Bravais lattices that move disclination and dislocation defects. This systematic study leads naturally to a discrete description of geometric concepts inside a Bravais Graph, different concepts like curvature, torsion, parallel transport, charts, and atlas can all be defined without referencing an embedding space. We hope that this treatment of a "lattice gas of defects" can be used as a possible foundation of elasticity and possibly model complicated phenomena like crack formation or tearing of materials - [WWS21] Defect movement in lattice rewriting systems

2017-2018 **Tutor Level: One**, *Tutor.com™ via LatinHire*, Live online tutoring platform for students and professionals, (Written and Spoken tutoring).
I tutored in the subjects: Pre-Calculus, Calculus(AB and BC), Physics(Algebra based and Calculus based). I've done over 100 tutoring sessions with a current average rating of 4.5/5.0 counting all the previous subjects.
https://www.tutor.com/tutor-search/tutor/keith-p--3395394

2017 **Visiting Researcher**, *Department of Mathematics, Purdue University*, West Lafayete, USA, supervised by professor Xiangxiong Zhang, Date: 6^{th} June – 6^{th} December 2017.

I studied the Discontinuous Galerkin (DG) method to solve Partial Differential Equations. My focus was to construct a weak-positivity interpolation considering some ideas of electrostatic optimization problems. This interpolation may be suitable to implement in a positivity-preserving DG scheme for the compressible Navier-Stokes Equations.

2016 **Winter Scholarship Student** , *interDaf e.V. am Herder-Institut der Universität Leipzig*, Leipzig, Germany, Date: 5^{th} January – 13^{th} February 2016.

I took an intensive German course that developed all language competence and skills. The course had special emphasis in oral expression for outdoors environments, many important city areas were examined in detail. The course finished with a final symposium, a written and oral final test - award of 8 ECTS

Published Articles

2019 **Preserving data moments in density estimation via diffusion using the finite element method, Boletín de Matemáticas 25(2), 101-121**, *Juan Galvis, Keith Y. Patarroyo, Francisco A. Gomez*, Mathematics Department, National University of Colombia. Département d'Informatique et de Recherche Opérationnelle, Université de Montréal.

2017 **Mean conservation for density estimation via diffusion using the finite element method, Boletín de Matemáticas 24(1), 91-99.**, *Keith Y. Patarroyo*, Physics Department. Universidad Nacional de Colombia, arXiv:1702.07962.

Unpublished Articles

2019 **A digression on Hermite polynomials**, *Keith Y. Patarroyo*, Departamento de Física, Universidad Nacional de Colombia & Département d'informatique et de recherche opérationnelle, Université de Montréal, arXiv:1901.01648.

2017 **Pronunciation recognition of English phonemes /ə/, /æ/, /ɑ:/ and /ʌ/ using Formants and Mel Frequency Cepstral Coefficients**, *Keith Y. Patarroyo and Vladimir Vargas-Calderón*, Physics Department. Universidad Nacional de Colombia, arXiv:1702.0707.

Oral Presentations

2020 **Physical Sound Synthesis and Connections with Neural Audio Synthesis**, *Keith Y. Patarroyo*, Music AI Reading Group with Guillaume Alain and Maxime Chevalier-Boisvert, MILA Québec , Montréal, Canada, March 2020.

2019 **Discrete Differential Geometry-DDG (A link between the continuous and the computational universe)**, *Keith Y. Patarroyo*, Conference, Math Department, Universidad Nacional de Colombia, Bogotá, Colombia, August 2019.

2018 **Discrete Elastic Rods with Arbitrary Cross Sections**, *Keith Y. Patarroyo*, Motograph18 Conference, Département d'informatique et de recherche opérationnelle (DIRO),Unversité de Montréal, Montréal, QC, Canada, November 2018.

2018 **High-order accurate DG(Discontinious Galerkin) methods for conservation laws(*Invited Talk*)**, *Keith Y. Patarroyo*, First Colombian Conference in Industrial and Applied Math, Bogotá, Colombia, August 2018.

Conferences, Workshops & Schools

2020-2021 **Wolfram Physics Winter School**, *Wolfram Research*, Remote Assistance with Jonathan Gorard, Max Piskunov and Xerxes Arsiwalla, Date: 28^{th} December 2020– 15^{th} January 2021.

2019 **Motograph19 Conference**, *Computational Motion Group, David R. Cheriton School of Computer Science*, University of Waterloo, Waterloo, ON, Canada, Date: 7^{th} – 8^{th} December 2019.

2018 **Motograph18 Conference**, *LIGUM(Laboratoire d'Informatique Graphique de l'Université de Montréal)*, Unversité de Montréal, Montréal, QC, Canada, Date: 17^{th} – 18^{th} November 2018.

2018 **First Colombian Conference on Industrial and Applied Math**, *Sociedad Colombiana de Matemáticas*, Universidad Nacional de Colombia – Universidad de los Andes, Bogotá, Colombia, Date: 10^{th} February – 11^{th} August 2018.

2018 **Course: Preparatory Course for the LPIC-1 Certification**, *Ubuntu Colombia and Fundación Correlibre*, Bogotá, Colombia with Alexander Sandoval and Diego Armando Forigua, Date: 6^{th} February – 10^{th} March 2018.

2017 **Course: First Workshop in Lattice Boltzmann Methods**, *Facultad de Ciencias, Universidad Nacional de Colombia*, Bogotá, Colombia with Jose Munoz and Miller Mendoza, Date: 11^{th} December – 15^{th} December 2017.

2017 **International Conference on Current Trends and Challenges in Numerical Solution of Partial Differential Equations**, *Purdue University, Department of Mathematics*, West Lafayette, IN, USA., Date: 7^{th} February – 8^{th} July 2017.

2016 **Course: Introduction to Scientific Programming and Symbolic Calculation using Python**, *Facultad de Matemática e Ingenieria, Fundación Universitaria Konrad Lorenz*, Bogotá, Colombia with Alejandro Cárdenas-Avendaño, Date: 27^{th} June – 1^{st} July 2016.

2016 **Seminar about Neutrino Physics**, *Departamento de Física, Universidad Nacional de Colombia*, Bogotá, Colombia with Roberto Martínez Martínez, Date: 5^{th} June – 29^{th} June 2016.

Languages

Spanish **Native Speaker**

English **Bilingual (TOEFL: 106/120)** *R:28, L:29, S:24, W:25*

German **Intermediate (Goethe Zertifikat B1)**

French **Elementary Proficiency (B1)**

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Computer skills

Wolfram Language Knowledge in pattern matching, symbolic computation, specially in rewrite systems.

python Knowledge and experience in object oriented programming, specially for Machine Learning (NumPy, scikit-learn, PyTorch)

JavaScript Vast experience in web technologies specially 3D applications.

C++ Knowledge and experience in object oriented programming

Other Java, LaTeX, Linux, MATLAB ,GNUPlot, HTML5, CSS, LibIGL, Three.js, Django, SQL.

Other Skills

Website **Administrator**, *A Sudden Burst of Beauty*.
Personal Website with some popularization, technical and other Articles mainly about Math, Physics and Computer Science: https://keithpatarroyo.wordpress.com/

Communities I was part of the Mila reading group on AI and Music lead by Guillaume Alain and Maxime Chevalier-Boisvert

Extra Amateur Piano and FreeDrums Player, Enthusiast about Air-devices (Drones, Boomerangs, Frisbee, Xzylo, Planes, etc.)

References

Bernhard Thomaszewski , *Department of Computer Science and Operations Research Université de Montréal*, Montréal, Québec, Canada.
Email: bernhard@iro.umontreal.ca

Juan Galvis-Arrieta , *Departamento de Matemáticas, Facultad de Ciencias, Universidad Nacional de Colombia*, Bogota, Colombia.
Email: jcgalvisa@unal.edu.co

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Place: Montréal, QC, Canada