Lucas Valença

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Education

McGill University — *Montreal, QC, Canada*

Ph.D. in Computer Science — *Sep. 2023 - Aug. 2027 (expected)*

- **Advisor:** Paul Kry
- **Co-advisor:** Jean-François Lalonde
- **Focus areas:** computer animation, geometry processing, generative neural networks
- **Coursework:** Advanced Image Synthesis; Computer Animation; Matrix Computations; Shape Analysis in Computer Vision; Reinforcement Learning (expected)

Université Laval — *Québec, QC, Canada*

M.Sc. in Computer Science — *Aug. 2021 - Sep. 2023*

- **GPA:** 4.33/4.33
- **Focus areas:** generative neural networks, photorealistic image compositing
- **Thesis:** **[Honour List]** Modeling Outdoor Illumination on Natural Images
- **Advisor:** Jean-François Lalonde
- **Co-advisor:** Yannick Hold-Geoffroy *(in collaboration w/ Adobe)*
- **Collaborators:** Michael Gharbi and Kalyan Sunkavalli *(Adobe)*; Jinsong Zhang *(Université Laval)*
- **Coursework:** Machine Learning; Algorithmic Photography; 3D Vision for Autonomous Vehicles; Directed Readings (GANs, HDR, light estimation, compositing)

UFPE – Federal University of Pernambuco — *Recife, PE, Brazil*

Bachelor of Computer Science — *May 2016 - May 2021*

- **GPA:** 8.27/10
- **Focus areas:** geometric/classical computer vision, augmented reality, computer graphics
- **Thesis:** **[Evaluated 10/10]** Real-Time 6DoF Tracking of Rigid 3D Objects Using a Monocular RGB Camera
- **Advisor:** Veronica Teichrieb
- **Co-advisor:** Francisco Simões *(in collaboration w/ HP Inc.)*
- **Collaborators:** L. Cossio and S. Tandel *(HP Inc.)*; J. Lima and L. Figueiredo *(UFRPE)*; L. Silva, T. Chaves, and A. Gomes *(Voxar Labs)*
- **Relevant coursework:** Computer Graphics; Graphics Processing (parametric curves and surfaces); Virtual Reality; Linear Image Processing; Advanced Topics in Multimedia (projective geometry and NURBS); Musical Computing and Sound Processing; Advanced Topics in AI (bio-inspired computing); Autonomous Agents; Intelligent Systems; Numerical Analysis; Advanced Linear Algebra for Computer Science (linear programming, matrix methods); Linear Algebra and Analytic Geometry; Differential and Integral Calculus; Physics for Computer Science; Statistics and Probability; Implementation of 2D Games; Advanced Topics in Interfaces (creative computing); Human-Computer Interfaces; Theory of Computation; Propositional Logic; Discrete Mathematics; Algorithms and Data Structures

Research Experience

McGill Graphics Lab @ McGill University — *Montreal, QC, Canada*

Graduate Research Assistant — *Sep. 2023 - Aug. 2027 (expected)*

Working under Profs. Kry and Lalonde on CGI and animation techniques aided by deep learning, geometry processing, and computer vision.

Institute of Intelligence and Data @ Université Laval — *Québec, QC, Canada*

Graduate Research Assistant — *Aug. 2021 - Aug. 2023*

Worked under Profs. Lalonde and Hold-Geoffroy in collaboration w/ Adobe developing deep generative AI pipelines for natural image lighting.

Summer Geometry Initiative @ MIT — *Boston, MA, USA (remote)*

SGI Fellow — *Summer 2021*

Summer program that introduces students to research in geometry processing. Projects in groups of 3 students and 1 mentor.

Research Projects

- **Incompressible Flow on Meshes**: mentored by Paul Kry (McGill University), created an algorithm for incompressible Eulerian fluid simulations over 3D triangular meshes based on Jos Stam's stable fluids. The core idea was to diffuse at barycenters and advect by walking geodesics.
- **Self-Similarity Loss for Shape Descriptor Learning in Correspondence Problems**: mentored by Tal Shnitzer (MIT), used a contextual loss to improve deep functional maps between 3D shapes by minimizing the impact of symmetries.
- **Subdivision Surface Fitting**: mentored by Paul Zhang (MIT), derived a custom gradient descent algorithm to find mesh decimation schemes that, when subdivided in real-time, resembled the original high-poly mesh. Differentiable schemes implemented were Catmull-Clark and Loop.

Voxar Labs @ Federal University of Pernambuco — *Recife, PE, Brazil*

Undergraduate Research Assistant — *Jan. 2018 - April 2021*

Lab that focuses on R&D projects with the industry. Main research areas are AR, VR, computer vision, robotics, HCI, and deep learning.

Research Projects (all collaborations with HP Inc.)

- **HP Expressive Avatars *(Oct. 2020 - Feb. 2021)***: under NDA until October 2025.
- **HP Federated Learning *(Mar. 2020 - Jul. 2020)***: under NDA until March 2025.
- **HP Nonflat AR *(Jan. 2018 - Mar. 2020)***: NDA expired on January 2023. Developed state-of-the-art tracking and detection techniques in 6DoF, targeted at rigid 3D objects and capable of running in real-time on mobile devices. These approaches were used on AR applications targeting HP Sprocket prototypes. Additionally, improved proprietary, flexible invisible markers through print-scan-resilient steganography approaches.

Teaching Experience

McGill University *Montreal, QC, Canada*

Teaching Assistant *Winter 2024*

T.A. for COMP 557 – Fundamentals of Computer Graphics under Prof. Paul Kry.

Summer Geometry Initiative @ MIT *Boston, MA, USA (remote)*

Student Volunteer *Summer 2022, 2023*

- **T.A. for the Tutorial Week *(Summer 2022, 2023)*:** topics included the fundamentals of geometry processing; curves and surfaces; shape correspondence and surface maps; shape deformation; numerical robustness. 66 fellows, undergraduate as well as M.Sc. (plus multiple invitees).
- **Computational Design of Ship Models** ↗ ***(Summer 2023)*:** for 2 weeks, aided Prof. Oded Stein (USC) in guiding fellows on how to perform developable segmentation of 3D meshes for fabrication purposes (printing and rebuilding).
- **Learning on Surfaces *(Summer 2022)*:** for 1 week, aided Ruben Wiersma (TU Delft) in guiding fellows on how to apply anisotropic diffusion to denoise arbitrary surfaces using neural networks.
- **Augmenting 3D Point Cloud Data *(Summer 2022)*:** for 1 week, aided Xiangru Huang (MIT) in guiding fellows on how to segment objects from point clouds captured with a LIDAR, with the goal of generating new composite scenes to train neural networks.
- **Characterizing the Latent Geometry of Point Cloud Networks *(Summer 2022)*:** for 1 week, aided Prof. Tolga Birdal (Imperial College London) in guiding fellows on how to investigate the geometry of latent spaces in point cloud networks.

UFPE – Federal University of Pernambuco *Recife, PE, Brazil*

Teaching Assistant *Aug. 2016 - Jul. 2019*

- **T.A. for Virtual and Augmented Reality *(Jan. 2019 - Jul. 2019)*:** about 20 students, undergraduate as well as M.Sc. and Ph.D.
- **T.A. for Graphics Processing *(Aug. 2018 - Jul. 2019)*:** about 100 undergraduate students.
- **T.A. for Linear Algebra and Analytic Geometry *(Aug. 2016 - Jan. 2018)*:** over 200 undergraduate students.
- **T.A. for Algorithms and Data Structures *(Jan. 2017 - Jul. 2017)*:** about 50 undergraduate students.
- **IT Teacher *(Sep. 2016 - Jan. 2018)*:** free IT courses for the local community (MS Office, Windows, internet and cloud basics). Over 150 students.

SSHL – Sigtunaskolan Humanistiska Läroverket *Sigtuna, Sweden*

Course Instructor (student volunteer) *Jan. 2014 - Apr. 2014*

Taught *"Programming Logic in C/C++"* to about a dozen fellow International Baccalaureate (IB) students as *CAS* hours (creativity, activity, service).

Organization and Service

ECCV, WACV, ICCV, and CVPRW Conferences *Remote*

Peer Reviewer *2022 - Present*

- **ECCV**: peer reviewer, 2024.
- 🎗 **[Outstanding Reviewer] WACV**: algorithms track, 2023.
- **ICCV**: external reviewer, 2023.
- **CVPR Workshops**: external reviewer, 2022.

IEEE ISMAR, SIBGRAPI, and SBGames Conferences *Recife, PE, Brazil (remote)*

Student Volunteer *November 2020*

Moderated paper sessions, managed the streaming backstage, and provided support to attendees.

PET Informática *Recife, PE, Brazil*

Student Volunteer (Sep. 2016 - Jan. 2017), Scholarship Holder (Feb. 2017 - Jan. 2018) *Sep. 2016 - Jan. 2018*

PET is the Brazilian government's special training program for high-achieving students. It has three pillars: teaching, research, and extension.

- **Blood donation organization** with HEMOPE (blood donor center of the state of Pernambuco). Over 300 donations.
- **Olympiad organization and graphic design**: 2016 and 2017 editions of OPEI (Informatics Olympiad of Pernambuco). Over 740 participants.

Invited Talks and Events

Shadow Harmonization for Realistic Compositing *Sydney, NSW, Australia*

ACM SIGGRAPH Asia *2023*

Panel on Graduate School Applications *Boston, MA, USA (remote)*

Summer Geometry Initiative @ MIT *2023*

Real-Time Monocular 6DoF Tracking of Textureless Objects using Photometrically Enhanced Edges *Vienna, Austria (remote)*

VISIGRAPP/VISAPP – 16th International Conference on Computer Vision Theory and Applications *2021*

Alleviating Motion Sickness Through Face Tracking in Mobile Phones *Recife, PE, Brazil*

Voxar Labs @ UFPE – Federal University of Pernambuco *2018*

Publications

Shadow Harmonization for Realistic Compositing (Project Page, ACM Digital Library)
L. Valença, J. Zhang, M. Gharbi, Y. Hold-Geoffroy, J.F. Lalonde
ACM SIGGRAPH Asia 2023 – Conference Proceedings

LM-GAN: A Photorealistic All-Weather Parametric Sky Model (arXiv)
L. Valença, I.J. Maquignaz, H. Moazen, R. Madan, Y. Hold-Geoffroy, J.F. Lalonde
arXiv preprint arXiv:2302.00087

The Impact of Domain Randomization on Cross-Device Monocular Deep 6DoF Detection (ResearchGate)
K. Cunha, C. Brito, **L. Valença**, L. Figueiredo, F. Simões, V. Teichrieb
Elsevier Pattern Recognition Letters – 159th Volume, July 2022

Real-Time Monocular 6DoF Tracking of Textureless Objects using Photometrically Enhanced Edges (ScitePress Library)
L. Valença, L. Silva, T. Chaves, A. Gomes, L. Figueiredo, L. Cossio, S. Tandel, J. Lima, F. Simões, V. Teichrieb
VISIGRAPP/VISAPP – 16th International Conference on Computer Vision Theory and Applications, 2021

A Study on the Impact of Domain Randomization for Monocular Deep 6DoF Pose Estimation (ResearchGate)
K. Cunha, C. Brito, **L. Valença**, F. Simões, V. Teichrieb
[Best Paper Award] *SIBGRAPI – 33rd Brazilian Conference on Graphics, Patterns and Images, 2020*

GoThrough: a Tool for Creating and Visualizing Impossible 3D Worlds Using Portals (ResearchGate)
L. Silva, **L. Valença**, A. Gomes, L. Figueiredo, V. Teichrieb
[Best Paper Runner-Up] *SBGames – 19th Brazilian Symposium on Computer Games and Digital Entertainment, 2020*

Patents

Read Curved Visual Marks
L. Figueiredo, J. Teixeira, J.P. Lima, L. Maggi, T. Chaves, F. Simões, **L. Valença**, V. Teichrieb, L. Cossio
US Patent Application - US20210303957A1

Neural Networks to Provide Images to Recognition Engines
T. Souza, F. Simões, T. Chaves, H. Felix, **L. Valença**, K. Cunha, R. Roberto, J. Teixeira, J.P. Lima, V. Teichrieb, L. Cossio
WO Patent Application - WO2021126268A1

Book Chapters

Encouraging the teaching of information technology in the basic education of the state of Pernambuco
L. Silva, D. Neto, E. Michiles, H. Botelho, **L. Valença**, M. Melo, M. Lima, M. Vieira, P. Rodrigues, R. Calegario, R. Barbosa, S. Cohen, F. Souza.
Tutorial Education Program at the Federal University of Pernambuco: Pathways and Diversities, UFPE Press, 2019.

Certificates

2020 **TOEFL iBT (Home Edition) - Score 119 out of 120**, Educational Testing Service (ETS)
2020 **Fundamentals of Accelerated Computing with CUDA C/C++**, NVIDIA Instructor-Led Remote Training
2020 **Fundamentals of Accelerated Computing with CUDA Python**, NVIDIA Instructor-Led Remote Training
2020 **Fundamentals of Deep Learning for Multi-GPUs**, NVIDIA Instructor-Led Remote Training
2020 **Fundamentals of Deep Learning**, NVIDIA Instructor-Led Remote Training
2016 **C Programming Language**, Integrated Center of Information Technology (Citi)
2012 **Advanced Java Programming**, Qualiti Software Processes
2012 **Basic Java Programming**, Qualiti Software Processes
2012 **Programming Logic**, Qualiti Software Processes

Languages

Portuguese, English bilingual
Spanish advanced
French, Swedish intermediate

Preferred Tools

Code Python, C/C++, CUDA C, MATLAB, GLSL, Java
Add-On PyTorch, Blender Python API, OpenCV, OpenGL, gptoolbox, Android NDK
Other Blender, Photoshop, Premiere Pro, Illustrator, Meshlab, Git

Honours and Publication Awards

2023 **Outstanding Reviewer,** WACV – IEEE/CVF Winter Conference on Applications of Computer Vision
Awarded for peer reviewing (algorithms track).

2023 **Honour List,** Faculty of Graduate and Postdoctoral Studies, Université Laval
Awarded to the M.Sc. thesis "Modeling Outdoor Illumination in Natural Images"

2020 **Best Paper Award,** SIBGRAPI – Brazilian Symposium on Computer Graphics and Image Processing
Awarded to "A Study on the Impact of Domain Randomization for Monocular Deep 6DoF Pose Estimation"

2020 **Best Paper Runner-Up Award,** SBGames – Brazilian Symposium on Games and Digital Entertainment
Awarded to "GoThrough: a Tool for Creating and Visualizing Impossible 3D Worlds Using Portals"

Funding Awards

2023 **Graduate Excellence Award,** School of Computer Science, McGill University
4-year award covering PhD tuition and other university fees (est. $24,000 CAD) plus a differential fee waiver (est. $60,000 CAD).

2022 **Project Proposal Scholarship,** Faculty of Computer Science and Software Engineering, Université Laval
Awarded $650 CAD for the proposed MSc research project.

2021 **Scholarship of Excellence,** Institute of Intelligence and Data, Université Laval
Fee waiver (est. $20,000 CAD) awarded to 1 non-Québécois student per year.

2019 **Scientific Commencement Scholarship,** Office of Research and Innovation, Federal University of Pernambuco
Awarded $4,400 BRL for the undergraduate research project "Tracking Based on Natural Features for AR".

2018 **Innovation Scholarship,** Developmental Support Foundation, Federal University of Pernambuco
2-year undergraduate research scholarship (est. $45,000 BRL) sponsored by HP Inc.

Media Coverage

2022 **UFPE News,** *Ph.D. candidate from CIn-UFPE presents an academic article about efficient computer vision solutions (...)*

2021 **MIT EECS News,** *The Shape Of Success: The Summer Geometry Initiative*

2021 **UFPE News,** *Voxar Labs, from CIn-UFPE, wins 3 paper awards in national conferences*

2019 **UFPE News,** *CIn UFPE students amplify contributions to Wikipedia*

Selected Open Source Contributions

2022 **skylibs** (github.com/soravux/skylibs)
Improvements (BVH, AA, color, GUI) to a Blender plug-in that pre-bakes illumination for Lambertian diffuse scenes

2022 **gptoolbox** (github.com/alecjacobson/gptoolbox)
quick bugfix to *png2poly* (converting PNG images into polygons)

Released Datasets

2023 **Shadow Compositing** (github.com/lvsn/shadowcompositing)
Urban dataset with path-traced, HDR, soft shadow ground truths; plus shadow compositing variations of ISTD, DESOBA, and SRD

2022 **Parametric Laval Skies** (hdrdb.com/sky)
Over 25,000 HDRIs from the Laval Skies Dataset paired with editable, synthetic equivalents

2021 **3DPO – 3D-Printed Object Pose Estimation Dataset** (github.com/voxarlabs/3DPO-Dataset)
Challenging benchmark for 6DoF tracking of rigid objects with annotated video sequences and CAD models

2020 **3D Printed Objects for Pose Estimation** (github.com/o-kbc/3dprinted-objects-6dof)
Over 110,000 annotated frames, real and synthetic

Publication-Related Open Software

Shadow Harmonization for Realistic Compositing (github.com/lvsn/shadowcompositing)
Université Laval & Adobe, 2023
Code, Docker container, and pre-trained weights of a generative compositing pipeline to insert virtual objects into arbitrary real images with correct lighting and shadow interactions. Also includes differentiable augmentation algorithm for real shadow removal and detection data; and algorithms to randomize and render synthetic frames and soft shadow ground truths where the object is guaranteed to be fully-visible, on a surface, and partially shaded (body and own shadow) by an arbitrarily-shaped occluder.

LM-GAN: A Photorealistic All-Weather Parametric Sky Model (TBA after publication)

Université Laval & Adobe, TBA

Code, Docker container, and pre-trained weights of a GAN to generate photorealistic environment maps of the sky with any weather configuration, given 11 parameters as input. Also includes a state-of-the-art multi-step non-linear optimization algorithm for parameterizing real HDRI environment maps through the Lalonde-Matthews sun-sky model, preserving the lighting on new, editable synthetic skies.

Open Software Projects

Fast Differentiable Rendering Loss (upon request, to be published after LM-GAN)

Université Laval, 2024

Using a light transport matrix and taking advantage of the additive properties of light, the code relights in real time any pre-baked path-traced Lambertian scene. It is differentiable, vectorized, and compatible with PyTorch.

Lalonde-Matthews Sky Model (github.com/lvsn/lm-model)

Université Laval, 2023

Official implementation of the Lalonde-Matthews parametric sky model. Differentiable, vectorized, and compatible with PyTorch and NumPy.

ShapeNet Cycles (github.com/lvrma/cycles-shapenet)

Université Laval & Adobe, 2022

Quick fix that enables Cycles (Blender's path tracer) to trace ShapeNet objects with the materials displayed correctly.

Sheet Music Page Turner (upon request, unpublished research)

UFPE, 2021

Tablet application that allows musicians to flip sheet music PDF pages without the need to stop playing using a chosen facial or head gesture.

CaLib (github.com/lvrma/CaLib)

UFPE, 2020

GUI tool that guides the user through OpenCV's camera calibration (checkerboard pattern).

CUDA Path Tracer (upon request, course project)

UFPE, 2020

Port of the "Ray Tracing in a Weekend" renderer to CUDA in C++. All recursions converted into iterative loops.

Inertia (upon request, unpublished research)

UFPE, 2018

Mobile reading app which adjusts the text by following the user's face, reducing perceptible motion and drastically improving motion sickness when reading inside moving vehicles.

Proprietary Software Projects

6DoF Textureless Object Tracker

UFPE & HP Inc., 2021

Part of the Real-Time Monocular 6DoF Tracking of Textureless Object publication. State-of-the-art real-time multi-object tracker running on a single core of a mobile CPU (per object), requiring 10MB of RAM and using the GPU for AR.

Written Steganography

UFPE & HP Inc., 2020

GUI tool to draw messages or patterns in frequency space and embed them into images imperceptibly.

Synthetic Domain Randomization

UFPE & HP Inc., 2019

Dataset generation tool creating annotated, path-traced renders of an object with arbitrary material, lights, background, ground, and 6DoF pose.

Marker Field Pose Annotation

UFPE & HP Inc., 2019

GUI tool to annotate video sequences, frame-by-frame, with the 6DoF pose of an object. First estimation uses ArUco markers, then a 6DoF tracker fine-tunes the pose of the CAD. Also allows for manual adjustments in 3D, fast-forward, and undo/rewind.