

# Joaquin Gajardo

Zürich, Switzerland  
joaquin.gajardocastillo@gmail.com

PhD candidate & ML Researcher

GitHub: Joaquin-Gajardo  
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PhD candidate at ETH Zürich and MSc from EPFL specializing in 3D computer vision and neural scene representations, with expertise in multi-view geometry, semantic understanding, and real-time reconstruction pipelines for complex dynamic scenes. 5+ years developing and deploying cutting-edge AI and physics-based solutions for challenging real-world 3D perception problems.

## SKILLS

<b>3D Computer Vision</b>	Neural Radiance Fields (NeRFs), 3D Gaussian Splatting (3DGS), Signed Distance Functions (SDFs), Multi-view Geometry, Structure-from-Motion, Multi-view Stereo, Monocular Depth Estimation, Scene Understanding, Semantic Segmentation, Differential Geometry, Point Cloud Processing, Object Tracking, 3D Data Structures, Photogrammetry and Remote Sensing
<b>Machine Learning</b>	Deep Learning, Neural Rendering, Generative Models, Computer Vision, VAE, GANs, Diffusion Models, Transformers, ConvNets, RNNs, Neural Differential Equations
<b>Programming &amp; Tools</b>	Python, C++, JavaScript, Bash, PyTorch, Tensorflow, Git, Docker, HPC, Slurm, COLMAP, Agisoft Metashape, Meshlab, Blender, Numpy, OpenCV, Open3D
<b>Communication</b>	English (C2), Spanish (native), French (B1), German (B1), Italian (A2)

## EDUCATION

<b>PhD student in Computer and Agricultural Sciences</b> , <i>Swiss Federal Institute of Technology Zürich (ETH Zürich)</i>	2023 — 2026
Topic: neural methods for 4D reconstruction and understanding in real-world scenes. Published in top-tier computer vision venues.	
<b>MSc. in Environmental Sciences and Engineering</b> , <i>Swiss Federal Institute of Technology Lausanne (EPFL)</i>	2018 — 2021
Master Thesis Prize CSD Ingénieurs 2021. Thesis: "Neural Controlled Differential Equations for Crop Classification"	
Academic Exchange, Swiss Federal Institute of Technology Zürich (ETH Zürich), Winter semester 2020 — 2021	
<b>Industrial Engineer Diploma</b> , <i>Pontificia Universidad Católica de Chile (PUC)</i>	2012 — 2017
Distinguished result in Engineering degree exams: Specialization (Top 1%) and Fundamentals of Engineering (Top 10%)	
Academic Exchange, Karlsruhe Institute of Technology (KIT), Winter semester 2017 — 2018	

## TECHNICAL EXPERIENCE

<b>ETH Zürich</b> <i>PhD Candidate</i>	<b>Zürich, Switzerland</b> <i>February 2023 — Present</i>
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- **4D Scene Reconstruction and Understanding:** 4D reconstruction of dynamic scenes with changing topology from multi-view images and point clouds using Gaussian Splatting and SDFs, developing novel techniques for maintaining temporal consistency, structural integrity and enabling semantic part-based decomposition and tracking in complex evolving structures like plants (two manuscripts in preparation)
- **3D Instance Segmentation:** Developed robust 3D instance segmentation method for scene decomposition and analysis of multiple small objects using 3D Gaussian Splatting, with demonstrated application to agricultural sciences in real-world outdoor conditions. **Paper accepted at CVPRW 2025.** Project webpage: <https://zdwww.github.io/wheat3dgs/>
- **Multi-view geometry:** Developing multiple fully-automated pipelines in COLMAP and Agisoft Metashape, for processing newly captured real-world datasets for multi-view 3D reconstruction, including camera pose estimation, Structure-from-Motion, Multi-view Stereo, automatic markers detection and point cloud processing
- **Generative models:** Experimentation with VAEs, GANs and latent diffusion models for image time series inter/extrapolation.
- **Advanced coursework** Completed Machine Perception and 3D Computer Vision courses with hands-on projects on NeRFs, 3D Gaussian Splatting. Audited Computer Vision and Digital Avatars courses
- **Research mentorship:** Supervision of several Computer Science master student's master thesis and semester projects.

<b>Empa - Swiss Federal Laboratories for Material Science and Technology</b> <i>Data Scientist &amp; ML Researcher</i>	<b>St. Gallen, Switzerland</b> <i>April 2021 — January 2023</i>
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- **Technical Leadership:** Led design and development of AI-powered mobile application (**Coldtivate**) incorporating physics-based digital twins with IoT sensor data and ML price forecasting systems, successfully transitioning research prototypes to production systems. Supervised data science interns and ML model development teams while developing headless containerized solutions for deploying complex physical simulations in mobile applications. **Project featured in documentary video.**
- **Large-Scale Computer Vision:** Applied research on large-scale mapping with multi-modal satellite imagery time series, achieving robust performance in data-scarce environments through deep learning and classical ML models, in supervised, semi-supervised and multi-task learning settings. **Published two papers in Remote Sensing journals**
- **Geo-spatial intelligence:** Developed interactive **Google Earth Engine web application** in JavaScript for optimal location mapping of cold storage rooms

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- **Infrastructure & Deployment:** Acquisition, setup and maintenance of GPU computing infrastructure and virtual machines. Additionally, collaborated on operationalizing research software into production systems hosted on partner platforms

## ETH Zürich

Master thesis student at Ecovision Lab

Zürich, Switzerland

September 2020 — March 2021

- **Deep Learning:** Implemented Neural Controlled Differential Equations architecture in PyTorch for multi-modal and irregular-length continuous temporal sequence modeling of satellite images for the first time. Thesis: *Neural Controlled Differential Equations for Crop Classification*
- **Technical contribution:** Developed and tested Stacked Neural Controlled Differential Equations architecture with comprehensive performance evaluation
- **Skills:** Performed extensive experimentation and distributed multi-GPU training on ETH's high-performance computing cluster

## Empa - Swiss Federal Laboratories for Material Science and Technology

Scientist (part-time)

St. Gallen, Switzerland

September 2020 — January 2021

- **Grant Writing & Funding:** Assisted in writing project proposals as ML specialist, helping secure \$1 million in funding from [data.org](https://data.org) for AI application development in collaboration with Basel Agency for Sustainable Energy
- **Signal Processing:** Analyzed and characterized temperature time series data using Fourier spectral analysis and advanced signal processing techniques
- **3D Digital Twin Development:** Pioneered development of stand-alone Java-based 3D physics simulation applications with Finite Element Modelling using COMSOL Multiphysics API as backend. *Work featured in COMSOL industry showcase.*
- **Leadership:** Co-organized Machine Learning workshop at Empa with 200+ attendees

Intern

March 2020 — August 2020

- **Physics-Based Modeling:** Developed sophisticated 3D digital twin systems in Python for real-time food quality prediction in cold-storage, solving the heat equation with Robin boundary conditions to model thermal transport from multi-modal sensor data
- **Numerical Computing:** Implemented custom numerical PDE and ODE solvers in pure NumPy for high-performance scientific computing
- **Data Analytics:** Generated actionable insights from Digital Twin using advanced statistical analysis with Pandas
- **Industry Collaboration:** Communicated technical progress and insights to partner sensor company through weekly presentations

## HONORS AND AWARDS

Master Thesis prize CSD Ingénieurs 2021 - Best thesis in master program	October 2021
Distinguished result in exam for obtaining Engineer degree part II (Specialization exam) - Top 1%	October 2017
Distinguished result in exam for obtaining Engineer degree part I (Fundamentals of Engineering exam) - Top 10%	October 2015

## COURSES AND CERTIFICATIONS

Machine Learning Specialization — Coursera	December 2022
Intro to Data Structures and Algorithms — Udacity	July 2022
Deep Learning Specialization — Coursera	November 2021
The Unix Workbench — Coursera	April 2020

## SELECTED RESEARCH OUTPUT

### Manuscripts

- **Gajardo, J.**, et al. "PlantSplat: Structure-Aware 4D Gaussian Splatting for Plant Growth Reconstruction and Tracking" (2025) - *In preparation*
- **Gajardo, J.**, et al. "Dynamic Part-based Plant Surface Reconstruction with Topological Changes" (2025) - *In preparation*

### Published Papers

- Zhang\*, D., **Gajardo\***, J., Medic, T., Katircioglu, I., Boss, M., Kirchgessner, N., Walter, A., & Roth, L. (2025). "Wheat3DGS: In-field 3D Reconstruction, Instance Segmentation and Phenotyping of Wheat Heads with Gaussian Splatting." *Proceedings of the Computer Vision and Pattern Recognition Conference (CVPR) Workshops*, pp. 5369-5379.
- **Gajardo, J.**, Volpi, M., Onwude, D., & Defraeye, T. (2025). "Evaluating the role of training data origin for country-scale cropland mapping in data-scarce regions: A case study of Nigeria." *ISPRS Open Journal of Photogrammetry and Remote Sensing*, 17, 100091.
- Li, D., **Gajardo, J.**, Volpi, M., & Defraeye, T. (2023). "Using machine learning to generate an open-access cropland map from satellite images time series in the Indian Himalayan region." *Remote Sensing Applications: Society and Environment*, 32, 101057.

### Thesis

- **Gajardo, J.** (2021). "Neural Controlled Differential Equations for Crop Classification." *Master's Thesis*, École Polytechnique Fédérale de Lausanne (EPFL). **Awarded Master Thesis Prize by CSD Ingénieurs**