

Loic Landrieu

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Loic Landrieu

Structured machine learning for remote sensing

Summary I am a researcher at IGN—the French Mapping Agency—in the machine learning team STRUDEL (LaSTIG, Univ. Gustave Eiffel). I am interested in optimization and machine learning for spatially structured data such as 3D point clouds or satellite images time-series analysis. I am co-program chair of the ISPRS Congress, and a course instructor in machine learning at ENSG (IGN's school of geomatics).

Positions and Research Experience

2015–present : *Researcher, MATIS, IGN*

Structured learning for multi-source remote sensing.

2010–present: *Ingénieur des ponts, des eaux et des forêts, MEEDEEM*

2012 : *Research Assistant, INRIA*

Land cover prediction with continuously indexed Markov random fields.

Advisor: Guillaume Obozinski

2011 : *Research Assistant, INRIA*

Weakly supervised part-of-speech tagging in natural languages.

Advisor: Guillaume Obozinski

2011 : *Research Assistant, ENPC ParisTech*

Reviewer recommendations system from the citation graph.

Advisor: Jean-Yves Audibert

Teaching

- 2020 - present : ENSG, *Course Instructor*
Deep Learning for Remote Sensing (18 hours).
- 2020 - present : ENSG, *Course Instructor*
Introduction to Machine Learning (6 hours).
- 2019 : AIMS, Master AMMI, Kigali, Rwanda, *Teaching assistant*
Probabilistic Graphical Models (2 weeks intensive course).
- 2019-2020 : EUROS DR with EduSERV, *Course instructor*
Deep learning for remote sensing (2 week intensive course).
- 2019 : ENPC, Master IMI, *Teaching assistant*
Introduction to machine learning (9 hours).
- 2017–2019 : ENSG, Master PPMD, *Course instructor*
Structured classification (6 hours).
- 2016–2017 : ENSG, Master DesiGeo, *Course instructor*
Introduction to machine learning (18 hours).
- 2014 : ENS Cachan - Master MVA, *Teaching assistant*
Probabilistic graphical models.

Education

2012 - 2016, ENPC ParisTech - INRIA - ENS Ulm, PhD

PhD in computer science / machine learning: *Learning structured models on weighted graphs, with applications to spatial data analysis.*

Advisors: Francis Bach and Guillaume Obozinski

2011 - 2012, ENS Cachan, MSc

Master MVA, machine learning and computer vision.

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2011 - 2012, ENPC ParisTech, MSc

Master IMI, computers science and applied mathematics.

2007 - 2011, Ecole Polytechnique, MSc

Algorithmic and applied mathematics.

Supervision and Community

Supervision

In **bold**, current students.

- 12 Interns: Stephane Guinard (Univ. Laval), Simon Bailly (WANAKA), Omar Lahbib (Renault GCP), Joana Roussillon (IGN), Thomas Luo (Helix.Re), Anna Kondracka (Vermessung AVT), Lamiae El-Mendili (Univ. Laval), Paul-Alexandre Nasr, (ENSG) Ameer Zaibi (ENIM), Julien Baconat (IGN), Cédric Baron (WUR), **Félix Quinton** (ENSG).
- 6 PhD Students : Stephane Guinard (Univ. Laval), Mohamed Boussaha (Gambi-M), **Raphael Sulzer**, **Vivien Sainte Fare-Garnot**, **Damien Robert**, **Romain Loiseau**.
- 1 Post-Doc: **Ekaterina Kalinicheva**.

Organization

- I am co-**program chair** of the XXIV ISPRS Congress: expected 2500 participants and 1000+ papers.
- I am in the **organizing committee** of Earth Vision, a leading CVPR workshop centered on the intersection between remote sensing and computer vision.
- **Program chair** of the 2020 Conference on IGN Research, Theme: AI and Spatial Information, 800+ participants (virtual).
- **Program chair** of the 2019 Conference on IGN Research, theme: Temporal Data Modelling, 250+ participants.
- **Organizer** of the LaSTIG reading group on machine learning for remote sensing, 30+ presentations / years.
- **Organizer** of the *Deep Learning for 3D Point Cloud* Seminar at IGN, 25 participants.

Reviewing & Expertise

- **Reviewing:** ICML (top reviewer 2021), NeurIPS, ICCV, CVPR (outstanding reviewer 2021), ICLR, BMVC, IJCV, PAMI, IJDSA, IJPRS, and others.
- **Editing:** I am on the reviewing committee of Remote Sensing and guest-editor for the special issue 'Multi-Modal Learning in Photogrammetry and Remote Sensing' of IJPRS.
- **Expertise:** ANR Grants, the Dutch Research Council (NWO), and the Canadian Centres of Excellence Mitacs.

Projects and Grants

- I am the investigator of the ANR JCJC **READY3D**: REal-Time Analysis of DYnamic LiDAR 3D Point Clouds (total cost: 476k€, 194k€ subsidy).
- I am a participant of the **BIOM** ANR Project: Building Inside/Outside Modelling (total cost: 1 776k€, 723k€ subsidy).
- PHD financing from DGA to hire Stéphane Guinard, with Bruno Vallet (100k€ subsidy).
- Financing from AFP, including a PhD position for Vivien Sainte-Fare Garnot, with Sébastien Giordano (300k€ subsidy)
- Joint PhD between ENGIE, IGN and Univ. Paris Est (250k€ budget).

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Industry

- I am a **scientific advisor** for the company SAMP (samp.ai) which creates *digital twins* of industrial facilities from LiDAR data using AI.
- I offer **technical consulting** to companies who want to apply machine learning methods to their production lines. Notable clients: Helix.Re (helixre.com), Gambi-M (gambi-m.com), INGEDATA, and SAMP.

Main Publications

Journal papers

- **2020, Photogrammetric Engineering & Remote Sensing:** Sébastien Giordano, Simon Bailly, Loic Landrieu, Nesrine Chehata, *Improved Crop Classification with Rotation Knowledge using Sentinel-1 and-2 Time Series*.
- **2017, ISPRS:** Loic Landrieu, Hugo Raguét, Bruno Vallet, Clément Mallet, and Martin Weinmann, *A Structured Regularization Framework for Spatially Smoothing Semantic Labelings of 3D Point Clouds*.
- **2017, SIIMS/SIAM:** Loic Landrieu and Guillaume Obozinski, *Cut Pursuit: Fast Algorithms to Learn Piecewise Constant Functions on General Weighted Graphs*.
- **2015, SIIMS/SIAM:** Hugo Raguét and Loic Landrieu, *Preconditioning of a Generalized Forward-Backward Splitting and Application to Optimization on Graphs*.

Conferences

- **2021, ICCV:** Vivien Sainte Fare Garnot Loic Landrieu, *Panoptic Segmentation of Satellite Image Time Series with Convolutional Temporal Attention Networks*.
- **2021, SilviLaser (oral):** Ekaterina Kalinicheva, Loic Landrieu, Clément Mallet and Nesrine Chehata, *Vegetation Stratum Occupancy Prediction from Airborne LiDAR 3D Point Clouds*.
- **2021, Eurographics SGP:** Raphael Sulzer, Loic Landrieu, Renaud Marlet, Bruno Vallet *Scalable Surface Reconstruction with Delaunay-Graph Neural Networks*
- **2020, 3DV (oral):** Thomas Chaton, Nicolas Chaulet, Sofiane Horache, Loic Landrieu *Torch-Points3D: A Modular Multi-Task Framework for Reproducible Deep Learning on 3D Point Clouds*
- **2020, AALTD@ECML-PKDD:** Vivien Sainte Fare Garnot, Loic Landrieu, *Lightweight Temporal Self-Attention for Classifying Satellite Image Time Series*.
- **2020, CVPR (oral):** Vivien Sainte Fare Garnot, Loic Landrieu, Sébastien Giordano, Nesrine Chehata, *Satellite Image Time Series Classification with Pixel-Set Encoders and Temporal Self-Attention*.
- **2019, ICML Workshop:** Loic Landrieu and Mohammed Boussaha, *Supervised Segmentation with Graph-Structured Deep Metric Learning*.
- **2019, ICML Workshop:** Hugo Raguét and Loic Landrieu, *Parallel Cut Pursuit For Minimization of the Graph Total Variation*.
- **2019, IGARSS (oral):** Vivien Sainte Fare Garnot, Loic Landrieu, Sébastien Giordano, Nesrine Chehata, *Time-Space Tradeoff in Deep Learning Models for Crop Classification on Satellite Multi-Spectral Image Time Series*.
- **2019, CVPR:** Loic Landrieu and Mohammed Boussaha, *Point Cloud Oversegmentation with Graph-Structured Deep Metric Learning*.
- **2019, ISPRS Workshop:** Stéphane Guinard, Loic Landrieu, and Bruno Vallet *Piecewise-planar Approximation Of Large 3D Data As Graph-Structured Optimization*.

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- **2018, ICML:** Hugo Raguey and Loic Landrieu, *Cut-Pursuit Algorithm for Regularizing Nonsmooth Functionals with Graph Total Variation*.
- **2018, IGARSS:** Sébastien Giordano, Simon Bailly, Landrieu, Loic, and Nesrine Chehata, *Temporal Structured Classification of Sentinel 1 and 2 Time Series for Crop Type Mapping*.
- **2018, CVPR:** Loic Landrieu and Martin Simonovski, *Large-scale Point Cloud Semantic Segmentation with Superpoint Graphs*.
- **2017, IGARSS (oral):** Loic Landrieu, Clément Mallet, and Martin Weinmann, *Comparison of Belief Propagation and Graph-Cut Approaches for Contextual Classification of 3D LiDAR Point Cloud Data*.
- **2017, ISPRS:** Stéphane Guinard and Loic Landrieu, *Weakly Supervised Segmentation-Aided Classification of Urban Scenes From 3D LiDAR Point Clouds*.
- **2016, AISTATS:** Loic Landrieu and Guillaume Obozinski, *Cut Pursuit: Fast Algorithms to Learn Piecewise Constant Functions*.
- **2014, UAI:** Loic Landrieu and Guillaume Obozinski, *Continuously Indexed Potts Models on Unoriented Graphs*.

Software Development

I have an active github profile github.com/loicland, with several open-source repositories:

- [] [loicland/superpoint-graph](https://github.com/loicland/superpoint-graph) 578★ 182🔗
- [] [loicland/cut-pursuit](https://github.com/loicland/cut-pursuit) 50★ 17🔗
- [] [loicland/point-cloud-regularization](https://github.com/loicland/point-cloud-regularization) 30★ 12🔗

I also participated in the following open-source project as advisor (among other):

- [] [nicolas-chaulet/torch-points3d](https://github.com/nicolas-chaulet/torch-points3d) 1477★ 236🔗
- [] [VSainteuf/pytorch-psetae](https://github.com/VSainteuf/pytorch-psetae) 88★ 22🔗
- [] [VSainteuf/pastis-benchmark](https://github.com/VSainteuf/pastis-benchmark) 22★ 6🔗

My students and I released the following public datasets:

- **S2-Agri:** 200 000 agricultural parcels satellite time series, with Vivien Sainte-Fare Garnot.
- **PASTIS:** satellite image time series dataset with panoptic annotation covering $> 2B$ pixels and 4000km^2 , with Vivien Sainte-Fare Garnot.

Talks in Conferences and Invited Talk

oral keynote tutorial poster organising

2022

- XXIV ISPRS Congress**, hybrid
co-program chair

2021

- MACLEAN (ML for EO)**
3D Deep Learning for Remote Sensing
- LiDAR Workshop Lyon**, invited talk
3D Deep Learning for Remote Sensing
- ISPRS congress 2021**, invited talk
3D Deep Learning for Remote Sensing

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⚙️ **CVPRW Earth Vision**, virtual, co-organizer
Leading remote sensing workshop.

🎤 **Institute for Computational Science at University of Zurich (UZH)**,
invited talk, Advances in Deep Learning for 3D Point Clouds Analysis

🎤 **Sony CSL Paris**, invited talk
Advances in Deep Learning for 3D Point Clouds Analysis
2020

🎤 **3DV**, virtual, oral presentation
Torch-Points3D: A Modular Multi-Task Framework-for Reproducible
Deep Learning on 3D Point Clouds.

🖼️ **AALTD**, virtual, poster
Lightweight Temporal Self-Attention for Classifying Satellite Image
Time Series.

🎤 **CVPR**, virtual, oral presentation
Satellite Image Time Series Classification with Pixel-Set Encoders and
Temporal Self-Attention.

🎤 **Conference on IGN Research**, virtual, oral presentation
Deep Learning for 3D Analysis.

⚙️ **Conference on IGN Research**, France, organizer
Theme: AI and Spatial Information.

🎓 **EuroSDR Marne-La-Vallée**, France, lecturer
Deep Learning for Remote Sensing.

🎤 **Quant Cube Technology Paris**, France, invited talk
Recent Advances in Large-Scale Learning for Remote Sensing.

2019

🎓 **Norwegian Institute of Bioeconomy Research Oslo**, seminar
Machine Learning and Deep Learning for Practitioners.

🔍 **2nd International Workshop Point Cloud Processing**, Stuttgart, keynote
Superpoint-Based Methods for 3D Point Clouds Analysis.

🎤 **Valeo.ai Research**, Paris, invited talk
Superpoint-Based Methods for 3D Point Clouds Analysis.

🔍 **Journées Nationales de la Recherche en Robotique**, France, keynote
Deep Learning for Point Cloud Semantic Segmentation.

🖼️ **ICML Graph Reasoning Workshop**, Long Beach, USA, poster
Supervised Segmentation with Graph-Structured Metric Learning.

🖼️ **ICML Graph Reasoning Workshop**, Long Beach, USA, poster
Parallel Cut Pursuit For Minimization of the Graph Total Variation

🖼️ **CVPR**, Long Beach, USA, poster. Point Cloud Oversegmentation with
Graph-Structured Metric Learning.

🖼️ **CVPR 3D Scene Understanding Workshop**, Long Beach, USA Point
Cloud Oversegmentation with Graph-Structured Metric Learning.

🎓 **ISPRS Geospatial week**, Univ. of Twente, Netherlands, tutorial
Deep Learning for Point Clouds Semantic Segmentation.

🎤 **Univ. Montpellier**, France, invited talk
Cut Pursuit for Optimizing with Graph-Structured Regularizers.

🎤 **Facebook AI Research**, Paris, invited talk
Optimization and Learning with Graph Sparsity

🎓 **JURSE 2019**, Vannes, France, tutorial
Deep Learning for Point Clouds Semantic Segmentation.

🎤 **Univ. Paris-Est**, France, invited talk
Deep Learning for 3D Point Cloud Semantic Segmentation.

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⚙️ **Conference on IGN Research**, France, organizer
Theme: Temporal Data Analysis

🎓 **EuroSDR** Barcelona, Spain, lecturer
Deep Learning for 3D Point Clouds Analysis.

2018

🎤 **Univ. of Erlangen**, Germany, invited talk
Deep Metric Learning on Point Clouds.

🎓 **Optimization in Image Analysis Summer School** by DTU and DIKU,
Copenhagen, lecturer

🖼️ **ICML**, Stockholm, Sweden, poster
Cut-Pursuit Algorithm for Regularizing Non smooth Functionals with
Graph Total Variation.

🎤 **RFIAP**, ENSG, France, oral
Large-scale Point Cloud Semantic Segmentation with Superpoint Graphs.

🖼️ **CVPR**, Salt lake City, USA, poster
Large-scale Point Cloud Semantic Segmentation with Superpoint Graphs.

🎤 **IGN Research Conference**, ENSG, France, oral
Large-scale Point Cloud Semantic Segmentation with Superpoint Graphs.

🎤 **SIAM symposium** in Bologna, Italy, invited talk
Cut Pursuit for Optimizing with Graph-Structured Regularizers.

🎤 **NoMADS, Politecnico di Milano**, Italy, invited talk
Cut Pursuit for Optimizing with Graph-Structured Regularizers.

🎤 **FOSS-4G**, ENSG, France, oral
Presentation of the SuperPointGraph Repository.

2017

⚙️ **IGN**, 3D Analysis Symposium, France, organizer
Deep Learning for 3D Point Clouds.

🖼️ **Polytechnique Data Science Summer School**, France, poster
Structured Optimization for Remote Sensing Applications.

🎤 **IGN Research Conference**, France, oral
Structured Optimization for Remote Sensing Applications.

2016

🎤 **GDR ISIS**, Paris, France, oral
 ℓ_0 -cut pursuit algorithm for graph-structured greedy optimization.

🖼️ **AISTATS**, Cádiz, Spain, poster
Cut Pursuit: Fast Algorithms to Learn Piecewise Constant Functions.

2015

🖼️ **UAI**, Quebec City, Canada, poster
Continuously Indexed Potts Models.

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Skills

Machine learning

- functional optimization
- deep learning
- LiDAR data
- superspectral imagery
- graphical models
- signal processing
- graph theory
- time-sequences

Computer science

- Python
- PyTorch
- C++
- Octave
- OpenMP
- Tensorflow
- Java
- L^AT_EX

Langage

French: Native speaker.

English: Fluent (TOEFL IBT 112, TOEIC 990), native speaker wife.

German: (Very) limited working proficiency.