

Loic Landrieu

**Email:**  
loic.landrieu  
@ign.fr

**Website:**  
loiclandrieu.com

**Github:**  
loicland

**ORCID:**  
0000-0002  
7738-8141

**Phone number:**  
(+33)6 77 18 92 53

50 rue du Capitaine  
Marchal  
Paris, 75020  
France

# Loic Landrieu

## Structured machine learning for geospatial data

**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, MEEDDEM*

#### 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 : EUROSDR 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.

Loic Landrieu

**Email:**

loic.landrieu  
@ign.fr

**Website:**

loiclandrieu.com

**Github:**

loicland

**ORCID:**

0000-0002  
7738-8141

**Phone number:**

(+33)6 77 18 92 53

50 rue du Capitaine  
Marchal  
Paris, 75020  
France

## 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.

- 13 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), **Yaping Lin (Univ. twente)**.
- 6 PhD Students : Stephane Guinard (Univ. Laval), Mohamed Boussaha (Gambi-M), Vivien Sainte Fare-Garnot (ETH/Univ. Zurich), **Raphael Sulzer**, **Damien Robert**, **Romain Loiseau**.
- 1 Post-Doc: **Ekaterina Kalinicheva**.

## Organization

- I am **program chair** of the XXIV ISPRS Congress: 1000+ submitted papers and expected 2500 participants.
- 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, 20+ presentations / years.
- **Organizer** of Machine Learning Seminars: *Deep Learning for 3D Point Cloud*(2020), *Deep Learning for Environment Monitoring*(2021) , 250+ participants.

## Reviewing & Expertise

- **Reviewing:** ICML (top reviewer 2021), CVPR (outstanding reviewer 2021), NeurIPS, ICCV, ICLR, BMVC, IJCV, PAMI, IJDSA, IJPRS, ISPRS Congress (outstanding reviewer 2022).
- **Editing:** I am on the **editorial advisory board** of IJPRS (Elsevier), **reviewing committee** of Remote Sensing (MDPI), and was **guest-editor** for the special issue 'Multi-Modal Learning in Photogrammetry and Remote Sensing' of IJPRS (Elsevier).
- **Expertise:** ANR Grants, the Dutch Research Council (NWO), and the Canadian Centres of Excellence Mitacs.
- I participated in 2 PhD jury, 2 mid-PhD committees, 1 MCF Jury.

## 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).

Loic Landrieu

**Email:**

loic.landrieu  
@ign.fr

**Website:**

loiclandrieu.com

**Github:**

loicland

**ORCID:**

0000-0002  
7738-8141

**Phone number:**

(+33)6 77 18 92 53

50 rue du Capitaine  
Marchal  
Paris, 75020  
France

- Financing from AFP, including a PhD position for Vivien Sainte Fare Gar-not, with Sébastien Giordano (300k€ subsidy)
- Joint PhD between ENGIE, IGN and Univ. Paris Est (250k€ budget).

### 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.

## 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
- $\LaTeX$

### Langage

**French:** Native speaker.

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

Loic Landrieu

**Email:**  
loic.landrieu  
@ign.fr

**Website:**  
loiclandrieu.com

**Github:**  
loicland

**ORCID:**  
0000-0002  
7738-8141

**Phone number:**  
(+33)6 77 18 92 53

50 rue du Capitaine  
Marchal  
Paris, 75020  
France

## Research

I have published more than 30 articles, including in some of the best ML/CV conferences: **CVPR** (2018, 2019, 2020<sup>o</sup>, 2022<sup>o</sup>, 2022W), **ICML** (2018, 2019W), **ICCV** (2021), **3DV** (2020<sup>o</sup>, 2021), **BMVC** (2021), **ECML** (2020W), **SGP** (2021). <sup>o</sup> indicates an oral, W a workshop.

### Journals

- **2022, IJPRS:** Vivien Sainte Fare Garnot, Loic Landrieu, Nesrine Chehata, *Multi-Modal Temporal Attention Models for Crop Mapping from Satellite Time Series*.
- **2021, Remote Sensing:** Félix Quinton, Loic Landrieu, *Crop Rotation Modeling for Deep Learning-Based Parcel Classification from Satellite Time Series*.
- **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

- **2022, CVPRW EarthVision** Ekaterina Kalinicheva, Loic Landrieu, Clément Mallet and Nesrine Chehata, *Multi-Layer Modeling of Dense Vegetation from Aerial LiDAR Scans*.
- **2022, CVPR:** Damien Robert, Bruno Vallet, Loic Landrieu, *Learning Multi-View Aggregation In the Wild for Large-Scale 3D Semantic Segmentation*.
- **2022, ICPR:** Raphael Sulzer, Loic Landrieu, Alexandre Boulch, Renaud Marlet, Bruno Vallet *Deep Surface Reconstruction from Point Clouds with Visibility Information*,
- **2021, BMVC:** Vivien Sainte Fare Garnot, Loic Landrieu, *Leveraging Class Hierarchies with Metric-Guided Prototype Learning*.
- **2021, 3DV:** Romain Loiseau, Tom Monnier, Mathieu Aubry, Loic Landrieu, *Representing Shape Collections with Alignment-Aware Linear Models*.
- **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*.

Loic Landrieu

**Email:**

loic.landrieu  
@ign.fr

**Website:**

loiclandrieu.com

**Github:**

loicland

**ORCID:**

0000-0002  
7738-8141

**Phone number:**

(+33)6 77 18 92 53

50 rue du Capitaine  
Marchal  
Paris, 75020  
France

- **2020, CVPR (oral):** Vivien Sainte Fare Garnot, Loic Landrieu, Sebastien 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, Sebastien 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 Over-segmentation with Graph-Structured Deep Metric Learning*.
- **2019, ISPRS Workshop:** Stephane Guinard, Loic Landrieu, and Bruno Vallet *Piecewise-planar Approximation Of Large 3D Data As Graph-Structured Optimization*.
- **2018, ICML:** Hugo Raguét 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*.

Loic Landrieu

**Email:**  
loic.landrieu  
@ign.fr

**Website:**  
loiclandrieu.com

**Github:**  
loicland

**ORCID:**  
0000-0002  
7738-8141

**Phone number:**  
(+33)6 77 18 92 53

50 rue du Capitaine  
Marchal  
Paris, 75020  
France

## Software Development

I have an active github profile [github.com/loicland](https://github.com/loicland), with several open-source repositories:

- [🔗]loicland/superpoint-graph 613★ 196👤
- [🔗]loicland/cut-pursuit 56★ 17👤
- [🔗]loicland/point-cloud-regularization 34★ 13👤

I also participated in the following open-source project as advisor:

- [🔗]nicolas-chaulet/torch-points3d 1506★ 299👤
- [🔗]VSainteuf/pytorch-psetae 113★ 27👤
- [🔗]VSainteuf/lightweight-temporal-attention 33★ 5👤
- [🔗]VSainteuf/utae-paps 36★ 15👤
- [🔗]VSainteuf/metric-guided-prototypes-pytorch 12★ 2👤
- [🔗]VSainteuf/pastis-benchmark 55★ 14👤
- [🔗]romainloiseau/deep-linear-shapes 22★ 0👤
- [🔗]drprojects/DeepViewAgg 41★ 5👤
- [🔗]ekalinicheva/plot\_vegetation\_coverage 8★ 2👤

My students and I released the following public datasets:

- **HelixNet:** 10B annotated 3D points captured by a moving vehicle, with Romain Loiseau (to come).
- **PASTIS:** satellite image time series dataset with panoptic annotation covering  $> 2B$  pixels and  $4000\text{km}^2$ , with Vivien Sainte Fare Garnot.
- **PASTIS-R:** companion dataset with associated radar time series, with Vivien Sainte Fare Garnot.
- **S2-Agri:** 200k agricultural parcels satellite time series with crop type annotation, with Vivien Sainte Fare Garnot.
- **Multi-Year Sentinel:** satellite image time series dataset with 100k observations and annotations across 3 years, with Felix Quinton.
- **StrataNet:** aerial LiDAR scan of 200 forest plots with stratum occupancy, with Ekaterina Kalinicheva.
- **WildForest3D:** densely annotated aerial LiDAR scan of 29 plots of wild forests, with Ekaterina Kalinicheva.



Loic Landrieu

**Email:**

loic.landrieu  
@ign.fr

**Website:**

loiclandrieu.com

**Github:**

loicland

**ORCID:**

0000-0002  
7738-8141


**Phone number:**

(+33)6 77 18 92 53


50 rue du Capitaine  
Marchal  
Paris, 75020  
France

## Talks in Conferences and Invited Talk

Exchanging ideas and presenting our work is for me the best part of research—but not on Zoom.

 oral  keynote  tutorial  poster  organization


### 2022

 **CVPRW Earth Vision**, co-organizer & oral presentation

Deep Learning for Forestry

 **I2M Univ Aix-Marseille**, invited talk


3D Deep Learning

 **XXIV ISPRS Congress**, invited talk

Temporal Attention for Satellite Time Series

 **XXIV ISPRS Congress**, tutorial

3D Deep Learning for Remote Sensing

 **XXIV ISPRS Congress**, program chair

 **GoeVic LIX**, invited talk

Geospatial Deep Learning

 **Valeo Research**, invited talk

3D Structured Learning

 **IMAGINE, ENPC**, invited talk

Geospatial Deep Learning


### 2021

 **MACLEAN (ML for EO)**

3D Deep Learning for Remote Sensing


 **ICCV Workshop Urban3D**, keynote speaker

3D Deep Learning : Beyond Scaling Windows

 **Seminar on Deep Learning for Environment Monitoring**, online organizer: 6 speakers, 250+ participants


 **LiDAR Workshop Lyon**, invited talk

3D Deep Learning for Remote Sensing

 **ISPRS congress 2021**, invited talk

3D Deep Learning for Remote Sensing

 **CVPRW Earth Vision**, co-organizer


 **Institute for Computational Science at 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.

Loic Landrieu

**Email:**

loic.landrieu  
@ign.fr

**Website:**

loiclandrieu.com

**Github:**

loicland

**ORCID:**

0000-0002  
7738-8141

**Phone number:**


(+33)6 77 18 92 53


50 rue du Capitaine  
Marchal  
Paris, 75020  
France

 **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.


 **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.



Loic Landrieu

**Email:**

loic.landrieu  
@ign.fr

**Website:**

loiclandrieu.com

**Github:**

loicland

**ORCID:**

0000-0002  
7738-8141


**Phone number:**

(+33)6 77 18 92 53

50 rue du Capitaine  
Marchal  
Paris, 75020  
France

**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  
 $\ell_0$ -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.*