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. I develop optimization and learning algorithms leveraging the structure of real-life problems (spatial, temporal, spectral, or multi-modal) for improved precision and efficiency. I have a special interest in large-scale remote sensing applications, and am the co-programchair of the ISPRS Congress.. I am also a course instructor in machine learning at ENSG (IGN's school of geomatics) and ENPC.

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 langages.
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.

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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) Ameur 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 particpants and 1000+ papers.
- I am in the **organizing committee** of Earth Vision, a leading CVPR worskhop 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 STRUDEL reading group on machine learning for remote sensing, 6 presentations / years, 20-30 participants.
- **Organizer** of the *Deep Learning for 3D Point Cloud* Seminar at IGN, 25 participants.

Reviewing & Expertise

- **Reviewing:** ICML, 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), and SAMP.

Main Publications

Journal papers

- **2017, ISPRS:** Loic Landrieu, Hugo Raguet, 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 Raguet and Loic Landrieu, *Preconditioning of a Generalized Forward-Backward Splitting and Application to Optimization on Graphs.*
- **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.*

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, Clement 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, 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, *Supervized Segmentation with Graph-Structured Deep Metric Learning*.
- **2019, ICML Workshop:** Hugo Raguet 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 Oversegmentation 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.*

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- **2018, ICML:** Hugo Raguet 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` 566★ 177
- [] `loicland/cut-pursuit` 49★ 18
- [] `loicland/point-cloud-regularization` 29★ 12

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

- [] `/nicolas-chaulet/torch-points3d` 1369★ 217
- [] `/VSainteuf/pytorch-psetae` 79★ 20

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

2021

- **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**, 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.

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- **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
  Supervized 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 Analsysis
- **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.

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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.

Skills

Machine learning

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

Computer science

- Python
- OpenMP
- Matlab
- Tensorflow
- C++
- Java
- PyTorch
- LaTeX

Langage

French: Native speaker.
English: Fluent (TOEFL IBT 112, TOEIC 990), native speaker wife.
German: (Very) limited working proficiency.