

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 graph-structured 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 for large-scale remote sensing applications. 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, 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

- 2019 : AIMS, Master AMMI, *Teaching assistant* Probabilistic Graphical Models.
- 2019 : EUROS DR with EduSERV, *Course instructor* Deep learning for remote sensing.
- 2018–present : ENPC, Master IMI, *Teaching assistant* Introduction to machine learning.
- 2017–present : ENSG, Master PPMD, *Course instructor* Structured classification.
- 2016–2017 : ENSG, Master DesiGeo, *Course instructor* Introduction to machine learning.
- 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.

2011 - 2012, ENPC ParisTech, MSc

Master IMI, computers science and applied mathematics.

2007 - 2011, Ecole Polytechnique, MSc

Algorithmic and applied mathematics.

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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*.

Conferences

- **2020, CVPR:** 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 Raguet and Loic Landrieu, *Parallel Cut Pursuit For Minimization of the Graph Total Variation*.
- **2019, IGARSS:** 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*.
- **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:** 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:

- [\[🔗\]/superpoint-graph](https://github.com/loicland/superpoint-graph) 429 ★ 136 📄
- [\[🔗\]/cut-pursuit](https://github.com/loicland/cut-pursuit) 42 ★ 16 📄
- [\[🔗\]/point-cloud-regularization](https://github.com/loicland/point-cloud-regularization) 23 ★ 12 📄

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Talks in Conferences and Invited Talk

2020

-  **Conference on IGN Research**, France, organizer
Theme: AI and Spatial Information
-  **ISPRS Conference, Nice**, tutorial
Theme: Deep Learning for 3D Data
-  **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.
-  **Conference on IGN Research**, France, organizer
Theme: Temporal Data Analysis
-  **EuroSDR** Barcelona, Spain, lecturer
Deep Learning for 3D Point Clouds Analysis.

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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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Supervision and Community

Supervision

- 6 Interns: Stephane Guinard, Simon Bailly, Omar Lahbib, Joana Roussillon, Thomas Luo (Helix.Re), Anna Kondracka (Vermessung AVT).
- 4 PhD Students: Stephane Guinard, Vivien Sainte Fare-Garnot, Mohamed Boussaha, Raphael Sulzer.

Organization

- Organizer of the 2020 Conference on IGN Research, Theme: AI and Spatial Information, 250+ participants.
- Organizer 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

I review or have reviewed for: ICML, NeurIPS, ICCV, CVPR, IJDSA, ANR Grants, ISPRS, and others.

I am on the reviewing committee of Remote Sensing and guest-editor for the special issue 'Multi-Modal Learning in Photogrammetry and Remote Sensing' for ISPRS Journal.

Projects and Grants

- I am the investigator of the ANR JCJC Grant **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 Stephane Guinard, with Bruno Vallet (100k€ subsidy).
- Financing from AFP, including a PhD position for Vivien Sainte-Fare Garnot, with Sébastien Giordano (300k€ subsidy)

Industry

- I am a Scientific Advisor for the company SAMP (samp.ai) which does *digital twins* of industrial facilities from LiDAR data.
- I do technical consulting for companies who wants to apply our methods to their production line. Notable clients: Helix.Re (helixre.com), Gambi-M (gambi-m.com).

Skills

Machine learning

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

Computer science

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

Langage

French: Native speaker.

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

German: Limited working proficiency.