Mokhtar Z. **Alaya**

Assistant Professor · Statistics Machine Learning

Laboratory LMAC, University of Technology of Compiègne

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Professional Experience

Assistant Professor — *Univ. of Technology of Compiègne*

Laboratory of Applied Mathematics of Compiègne - LMAC — *Sep. 2020 – present*

Postdoctoral Researcher — *University Rouen Normandy*

Laboratory of IT, Information Processing and Systems - LITIS — *Jan. 2019 - Aug. 2020*

Postdoctoral Researcher — *University Paris Nanterre*

Laboratory of Random Modelling and Applications - Modal'X — *Oct. 2017 - Sep. 2018*

Temporary Researcher and Teaching Assistant — *University Paris Nanterre*

Laboratory of Random Modelling and Applications - Modal'X — *Sep. 2016 - Aug. 2017*

Temporary Researcher and Teaching Assistant — *University Pierre and Marie Curie*

Laboratory of Theoretical and Applied Statistics - LSTA — *Sep. 2015 - Aug. 2016*

PhD. Candidate and Teaching Assistant — *University Pierre and Marie Curie*

Laboratory of Theoretical and Applied Statistics - LSTA — *Oct. 2012 - Aug. 2015*

Education

Ph.D. in Statistics Machine Learning — *University Pierre and Marie Curie*

Title: Segmentation of Counting Processes and Dynamical Systems — *2012 - 2016*

- Ph.D. defense in June, 27th 2016 under the supervision of Stéphane Gaiffas and Agathe Guilloux.
- **Comittee**: Pierre Alquier (Examinator, ENSAE), Sylvain Arlot (Examinator, Univ. Paris-Sud), Gérard Biau (Examinator, Univ. Pierre and Marie Curie), Stéphane Gaiffas (Supervisor, École Polytechnique), Agathe Guilloux (Supervisor, Univ. Pierre and Marie Curie), Erwan Le Pennec (Reviewer, École Polytechnique).

Master of Sciences in Statistics — *University Pierre and Marie Curie*

Master Thesis: Change-Point Detection in Gaussian Signals — *2011 - 2012*

- Supervision: Stéphane Gaiffas and Agathe Guilloux

Master of Sciences in Probabilities — *University Pierre and Marie Curie*

Master Thesis: Poisson Access Networks with Shadowing - Statistical Modelisation — *2010 - 2011*

- Supervision: Bartek Bartlomiej (INRIA-ENS) and Mohamed K. Karray (Orange Labs R&D).

Magisterium of Mathematics — *University Gabes Tunisia*

Magisterium Thesis: Backward Stochastic Differential Equations and Financial Mathematics — *2008 - 2010*

- Supervision: Said Hamadène (University of Maine) et Ibtissem Hdhiri (University Gabes Tunisia)

Distinctions

2017 **Postoctoral Fellowship Laureat of DIM Math Innov Program,** Fondation of Mathematical Sciences of Paris

2016 **Ph.D. Applied Mathematics with honors,** University Pierre and Marie Curie

2012 **Doctoral Scholarship,** University Pierre and Marie Curie

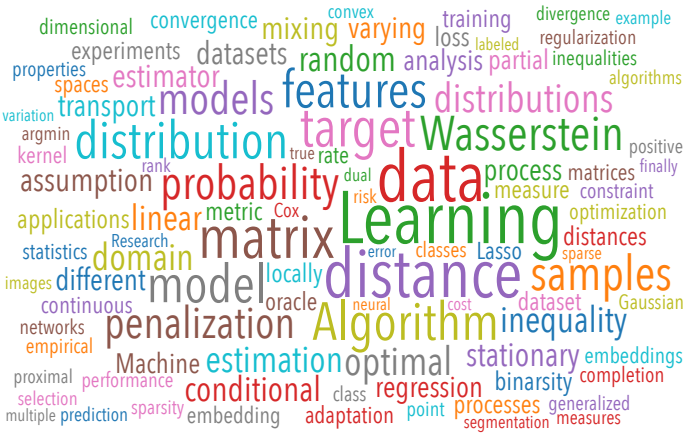
2012 **M.Sc. Statistics, rank-2**^{sd}**,** University Pierre and Marie Curie

Research

My research topics are machine learning mainly high-dimensional statistical learning, with a particular interest in sparse inference, matrix completion and survival analysis. Currently, I am interested in optimal transport techniques for machine learning applications.

Key words:

Machine Learning; Deep Learning; Optimal Transport; High-Dimensional Statistics; Sparse Inference; Change-Point Detection; Survival Analysis; Matrix Completion; Convex Optimization



Wordcloud generated by parsing text of my published papers.

Summary of some Works:

Supervised Learning

- In the context of high-dimensional supervised learning, a classical (and often necessary) pre-processing consists in standardizing the columns of the matrix of explanatory variables. Another approach is to discretize them, for example by a binarization process called one-hot encoding. In [12], we were interested in combining the trick of one-hot encoding with a new penalization called binarsity. In each group of binary variables resulting from the one-hot encoding of a single raw variable, this penalty uses a variation-total regularization accompanied by an additional linear constraint to avoid collinearity within the groups. Theoretical results are obtained in the form of fast non-asymptotic oracle inequalities verified by generalized linear models, and the numerical performance of this approach is illustrated on several logistic regression datasets.
- In [11] we considered the problem of joint completion of matrices with multiple and heterogeneous data sources. Several cases are studied: a family of exponential laws of the matrix entries, then a family of exponential laws of the noise and a free distribution for the matrix entries. The estimation procedures are based on the minimization of the sum of a matching term and the penalty by the nuclear norm of the whole joint matrix. Theoretical estimation results lead to fast convergence speeds, which are illustrated by numerical experiments.

Change-Point Detection

- To address the problem of detecting multiple change-points by explanatory variables in high dimension, we have introduced in [6] a prognostic method called binacox. The latter is based on the Cox model and combines one-hot coding with the binarsity penalty [12]. Theoretical guarantees are obtained for prediction and estimation via fast oracle inequalities in terms of Kullback-Leibler divergence. The statistical performance of the approach is evaluated on simulated and genetic cancer data, and compared with state-of-the-art methods for threshold detection in survival analysis. Binacox significantly outperforms existing univariate methods for detection in terms of detection and computation time.

Machine Learning with Optimal Transport

- In [10] we proposed a new algorithm SCREENKHORN to efficiently approximate the OT distance. The algorithm combines a pre-processing step to identify dual variables with an L-BFGS-B algorithm step constrained on the identified variables. The authors illustrated the effectiveness of SCREENKHORN on complex tasks such as dimensionality reduction and domain adaptation in a deep learning context.
- In [8] we considered the partial optimal transport problem, which arises when the considered distributions do not have the same total mass to be transported, a setting in which a classical EO is no longer valid. They considered the partial EO of Wasserstein and Gromov-Wasserstein for which they proposed an algorithm based on Frank-Wolfe optimization to compute the partial transport scheme. Empirically, partial OT is shown to be effective in positive unlabeled learning (PU-learning).
- In [4] we addressed the problem of aligning distributions whose supports do not necessarily lie in the same metric space. They considered a method of projecting the measured metric spaces onto a common Euclidean space, for which the EO is computed on the projected distributions. This leads to a robust Wasserstein sub-embedding distance (SERW). It is shown that the SERW distance defines a proper distance and behaves like the Gromov-Wasserstein distance. The performance of the new SERW distance is illustrated on real applications such as matching and alignment in text-image data.
- In [9] we developed a two-stage optimal transport approach that maps from a source distribution to a target distribution. The target has the particularity of presenting new classes not present in the source domain. The first step of the procedure aims at rejecting the samples from these new classes using an optimal transport scheme. The second step solves the change in the target (class ratio) still as an optimal transport problem. The optimization problem is solved in each step of the proposed method and this two-step approach leads to results that outperform recent literature.
- In [7] I contributed to the python library for optimal transport called `POT`[1]. `POT` implements several key ideas in optimal transport for the statistical learning community. It contains implementations of a number of seminal EO works for machine learning, such as the Sinkhorn algorithm and Wasserstein barycenters, but also provides generic solvers that can be used to conduct new fundamental research. `POT` is open source with an MIT license.

Publications

[1] Adversarial Semi-Supervised Domain Adaptation for Semantic Segmentation: A New Role for Labeled Target Samples
M. Kchaou, M. Z. Alaya, R. Herault, G. Gasso
Computer Vision and Image Understanding 2025

[2] Gaussian-Smoothed Sliced Probability Divergences
M. Z. Alaya, A. Rakotomamonjy, M. Bérar, G. Gasso
Transactions on Machine Learning Research 2023

[3] Neutron Spectrum Unfolding using two Architectures of Convolutional Neural Networks
M. Bouhadida, A. Mazzi, M. Brovchenko, T. Vinchon, M. Z. Alaya, W. Monange, F. Trompier
Nuclear Engineering and Technology 2023

[4] Theoretical Guarantees for Bridging Metric Embedding and Optimal Transport
M. Z. Alaya, M. Bérar, G. Gasso, A. Rakotomamonjy
Neurocomputing 2022

[5] Optimal Transport for Conditional Domain Matching and Label Shift
A. Rakotomamonjy, R. Flamary, G. Gasso, M. Z. Alaya, M. Bérar, N. Courty
Machine Learning 2021

[6] Automatic Cut-Points Estimation in High-Dimensional Cox Model
S. Bussy, M. Z. Alaya, A. Guilloux, A. S. Jannot
Biometrics 2019

[7] POT: Python Library for Optimal Transport in Machine Learning
R. Flamary N. Courty, A. Gramfort, M. Z. Alaya, A. Boisbunon, S.Chambon and L. Chapel, A. Corenflos, K. Fatras, N. Fournier, L. Gautheron, N. T.H. Gayraud, H. Janati, A. Rakotomamonjy, I. Redko, A. Rolet, A. Schutz, V. Seguy, D. J. Sutherland, R. Tavenard, A. Tong, T. Vayer
Journal of Machine Learning Research 2021

[8] Partial Optimal Transport with Applications on Positive Unlabeled Learning
L. Chapel, M. Z. Alaya, G. Gasso
NeurIPS 2020 Proceedings 2020

[9] Open Set Domain Adaptation using Optimal Transport
M. Kechaou, R. Hérault, M. Z. Alaya, G. Gasso
ECML-PKD 2020 Proceedings 2020

[10] Screening Sinkhorn Algorithm for Regularized Optimal Transport
M. Z. Alaya, M. Bérar, G. Gasso, A. Rakotomamonjy
NeurIPS 2019 Proceedings 2019

[11] Collective Matrix Completion
M. Z. Alaya, O. Klopp
Journal of Machine Learning Research 2019

[12] Binarsity: a Penalization for One-Hot Encoded Features in Linear Supervised Learning
M. Z. Alaya, S. Bussy, S. Gaiffas, A. Guilloux
Journal of Machine Learning Research 2019

[13] Learning the Intensity of Time Events with Change-Points
M. Z. Alaya, S. Gaiffas, A. Guilloux
IEEE Trans. on Information Theory 2015

Preprints

[1] PatchTrAD: A Patch-Based Transformer focusing on Patch-Wise Reconstruction Error for Time Series Anomaly Detection
S. Vilhes, G. Gasso, M. Z. Alaya
arXiv 2025

[2] Bounds in Wasserstein Distance for Locally Stationary Functional Time Series *arXiv*
J. G. Tinio, M. Z. Alaya, S. Bouzebda *2025*

[3] Sparsified-Learning for Heavy-Tailed Locally Stationary Processes *arXiv*
Y. Wang, M. Z. Alaya, S. Bouzebda, X. Liu *2025*

[4] Bounds in Wasserstein Distance for Locally Stationary Processes *arXiv*
J. G. Tinio, M. Z. Alaya, S. Bouzebda *2024*

[5] Heteregenous Wasserstein Discrepancy for Incomparable Distributions *arXiv*
A. Rakotomamonjy, M. Z. Alaya, G. Gasso, M. Bérar *2022*

[6] High-Dimensional Time-Varying Aalen and Cox Models *arXiv*
M. Z. Alaya, T. Allart, A. Guilloux, S. Lemler *2018*

Service of Review

2020- **International Conference on Neural Information Processing Systems - NeurIPS**
2020- **International Conference on Artificial Intelligence and Statistics - AISTATS**
2022- **International Conference on Learning Representations - ICLR**
2020- **Journal of Machine Learning Research - JMLR**
2021- **IEEE Transactions on Pattern Analysis and Machine Intelligence - PAMI**
2022- **Neurocomputing**
2022- **Biometrical Journal**
2023- **Image and Vision Computing**
2025- **Pattern Recognition**
2023- **Entropy**

Manuscripts

Segmentation of Counting Processes and Dynamical Systems *University Pierre and Marie Curie*
Doctoral Thesis *2016*

Change-Point Detection in Gaussian Signals *University Pierre and Marie Curie*
Master Thesis *2012*

Poisson Access Networks with Shadowing - Statistical Modelisation and Statistical Inference *University Pierre and Marie Curie*
Master Thesis *2011*

Backward Stochastic Differential Equations and Financial Mathematics *University Gabes Tunisia*
Magisterium Thesis *2010*

Talks

Journée Scientifique, chaire industrielle SAFE AI *UTC*
Seminar *October, 2022*

SIAM conference on Mathematics for Data Science *Zoom*
Conference *September, 2022*

Journées MAS 2022 de SMAI *Rouen*
Conference *August, 2022*

MLMDA Group - Borelli Center ENS-Paris-Sacaly *Paris-Sacaly*
Seminar *June, 2022*

Laboratory LMM - University Le Mans
Seminar
Zoom
Mars, 2021

NeurIPS
Conference
Zoom
December, 2020

Data Sciences UTC
Seminar
Zoom
November, 2020

Laboratory CMAP - École polytechnique
Seminar
Zoom
June, 2020

Laboratory CREST - ENSAI Rennes
Seminar
Zoom
May, 2020

NeurIPS
Conference
Vancouver, Canada
December, 2019

Summer School on Applied Harmonic Analysis and Machine Learning
Workshop
Genoa, Italy
September, 019

GDR ISIS/MIA MEETING
Workshop
CNRS, Paris
July, 2019

Startup LumenAI
Seminar
Paris
September, 2018

4th International Society for NonParametric Statistics
Conference
Salerno, Italy
June, 2018

50ème Journées Françaises de Statistique
Conference
Paris Saclay
May, 2018

Laboratory Modal'X
Seminar
University Paris Nanterre
May, 2017

48ème Journées Françaises de Statistique
Conference
Montpellier
June, 2016

47ème Journées Françaises de Statistique
Conference
Lille
June, 2015

46ème Journées Françaises de Statistique
Conference
Rennes
June, 2014

Laboratory LSTA
Seminar
University Pierre and Marie Curie
Mars, 2015

Teaching

Machine Learning
Lecturer
Univ. of Technology of Compiègne
Spring 2021 - 2025

Multivariate Functions and Applications
Lecturer
Univ. of Technology of Compiègne
Spring 2022

Probability and Applications — *Univ. of Technology of Compiègne*
Teaching Assistant — *Autumn 2021*

Linear Algebra and Applications — *Univ. of Technology of Compiègne*
Teaching Assistant — *Autumn 2020, 2021, 2022*

Statistics for Psychology — *University Paris Nanterre*
Teaching Assistant, Licence 1 and 2 — *2016 - 2017*

Mathematical for Economics — *University Paris Nanterre*
Teaching Assistant, Licence 1 — *2016 - 2017*

Certificate of Computer Sciences — *University Paris Nanterre*
Teaching Assistant, Licence 2 et 3 — *2016 - 2017*

Times Series — *University Pierre and Marie Curie*
Teaching Assistant, Master 1 — *2015 - 2016*

Mathematical Statistics — *University Pierre and Marie Curie*
Teaching Assistant, Licence 3 — *2015 - 2016*

Multivariate Regression — *University Pierre and Marie Curie*
Teaching Assistant, Master 1 — *2013 - 2014*

Linear Algebra and Geometry — *University Pierre and Marie Curie*
Teaching Assistant, Licence 2 — *2012 - 2014*

Probabilities and Statistics — *University Pierre and Marie Curie*
Lecturer, 3-th Year Mechanical Engineering — *2012 - 2013*

Skills

Scientific Programming Python (2/3), Jupyter Notebook, R, Matlab, C++
Librairies Python Scikit-Learn, Pandas, Numpy, Scipy, Matplotlib, Bokeh, Cython, Pytorch, TensorFlow, MlFlow,
Operations Systems GNU/Linux, Mac OS X , Git, PyCharm, CLion
Typography LaTeX, Microsoft Office, LibreOffice