Curriculum vitae

Arnaud Breloy

32 years old (29/05/1989), French
Associate professor at University Paris Nanterre
Electrical Engineering department & LEME (EA4416) laboaraory

50, rue de Sèvres, 92410 Ville d'Avray
pro. : +33.01.40.97.48.15.
abreloy@parisnanterre.fr, a.breloy@gmail.com
[https://abreloy.github.io/]

Previous work experience

- *2015-2016* full-time **temporary assistant professor** (ATER)
  University Paris Nanterre, Electrical Engineering department
- *2012-2015* **Ph.D student** CNRS (DGA grant) and **Teaching Assistant** (Monitorat)
  SATIE (ENS-Cachan) and SONDRA (CentraleSupélec)
  University Paris Nanterre, Electrical Engineering department

Education

- *2020* **HDR** (Research Directorship Habilitation) **of University Paris Nanterre**
  Title: "*Some flavours of PCA*"
  Jury:
  - ⋆ Cédric Richard, Professor, University Côte d'Azur (Reviewer)
  - ⋆ Jean-Yves Tourneret, Professor, INP-ENSEEIHT (Reviewer)
  - ⋆ Olivier Besson, Professor, ISAE-SUPAERO (Examinator)
  - ⋆ Emilie Chouzenoux, CR, Inria Saclay (OPIS) (Examinator)
  - ⋆ Nicolas Le Bihan, DR, GIPSA-lab (Examinator)
  - ⋆ Mohammed Nabil El Korso, MCF University Paris Nanterre (Local Reviewer)
- *2015* **Ph.D of University Paris Saclay**
  Title: "*Estimation/detection algorithms in low-rank heterogeneous context*"
  Laboratories: SATIE (ENS-Cachan) and SONDRA (CentraleSupélec)
  Jury:
  - ⋆ Pierre Comon, CNRS research director, GIPSA-Lab (Chairman)
  - ⋆ Olivier Besson, Professor, ISAE-SUPAERO (Reviewer)
  - ⋆ Pascal Chevalier, Professor, CNAM (Reviewer)
  - ⋆ Chin Yuan Chong, Research Engineer, DSO (Examinator)
  - ⋆ Guillaume Ginolhac, Professor, University Savoie-Mont-Blanc (Director)
  - ⋆ Frédéric Pascal, Professor, CentraleSupélec (Advisor)
  - ⋆ Philippe Forster, Professor, University Paris Nanterre (Advisor)
- *2013* **Engineer degree from Ecole Centrale Marseille (ECM)**
- *2012* **Master's degree of University Aix-Marseille**

Research activities

Themes

My research activities concern statistics and optimization methods for various applications in machine learning and signal processing:

- **Dimension reduction** and variable selection: probabilistic/sparse PCA, robust subspace recovery, low-rank matrix factorization.
- **Information geometry**: performance bounds, Riemannian optimization, and classification/clustering with metrics induced by statistical models.
- **Statistical signal processing**: robust signal subspace and structured covariance matrix estimation, adaptive detection/beamforming.
- **Applications** in array processing (radar, interferometer calibration for radioastronomy), satellite image time-series analysis (change detection, clustering), and EEG signal classification.

I also recently started to work on the links between these approaches with graphical models, and their use for graph learning problems.

Conferences activities

Tutorials, lectures

• **SLSIP Workshop 2021**: "Riemannian geometry in elliptical distributions"
• **IEEE RadarConf 2020**: "Robust statistical framework for radar change detection applications". with G. Ginolhac.
• **EUSIPCO 2018**: "Robust Covariance and Subspace Learning: dealing with high-dimensionality and small sample support". with F. Pascal and G. Ginolhac.

Special sessions organization and invitations

• **EUSIPCO 2020**: "Recent advances in differential geometry for signal and image processing"
• **EUSIPCO 2018**: "Emerging Data Structure Paradigms for Subspace Estimation"
• 6 invited conference papers in special sessions.

Committees

• **NCMIP 2019**: Scientific committee member
• **EUSIPCO 2018, 2020**: TPC member

Reviewing service

• **Associate Editor** for Elsevier Digital Signal Processing (DSP) since April 2021
• **International journals** : IEEE Trans. on Signal Processing, IEEE Signal Processing letters, IEEE Trans. on Aerospace And Electronic Systems, Signal Processing Elsevier, Digital Signal Processing Elsevier, EURASIP Journal on Advances in Signal Processing.
• **International conferences** : ICASSP, EUSIPCO, SSP, ISIT, IEEE RadarConf.

Research projects and grants

ANR projects

ANR-JCJC	**Principal Investigator**	**2022-26**	**235k€**
MASSILIA (Matrices spectral structures in graph learning) This project aims at tackling current problems related to graph learning and its applications in a unified way centered around the spectral decomposition of the graph Laplacian. The central objective of this project is to model graph structures (distributions on spectral parameters) and leverage this formalism in to a) improve graph learning processes; b) handle graphs as main features of classification/clustering algorithms. Project members: F. Bouchard, A. Mian, T. Vayer, R. Flamary, C. Richard			

ANR-ASTRID	**Sub-tasks manager**	**2017-22**	**78k€**
MARGARITA (Modern Adaptive Radar), Ref. ANR-17-ASTR-0015 [link]. PI: G. Ginolhac In this project, I was responsible of sub-task 1.1 (Robust structured covariance matrix estimation) and sub-task 2.1 (Bayesian subspace methodologies for detection) In was also involved in the supervision of the post-doc A. Hippert-Ferrer (funded by this project) I contributed to 13 journal publications within this project [Publication list]			

Other projects

Univ. Paris Lumières research grant	**Principal investigator**	**2019-22**	**14k€**
Sparse PCA for EEG signals classification Project members : M.N. El Korso and L. Boubchir			

PNTS	**Collaborator**	**2019-20**	**15k€**
Statistical learning in SAR image time series with missing data Project members : Y. Yan (PI), G. Ginolhac, M.N. El Korso, A. Hippert-Ferrer			

PHC-PROCORE	**Collaborator**	**2019-20**	**14k€**
Robust signal processing and detection without secondary data Project members : M.N. El Korso (PI-Fr), M. Pesavento (PI-Ger), P. Forster, C. Ren			

Young researcher GDR-ISIS	**Co-Principal investigator**	**2016-18**	**7k€**
Project ON FIRE (robust calibration of future large interferometers) Project members : M.N. El Korso (PI), Rémi Flamary, Franck Iutzeler			

Ph.D. grants obtained from call for projects

DGA 1/2 thesis grant	**Co-Principal investigator**	**2017-20**	**50k€**
Thesis of Bruno Meriaux, "*Robust adaptive signal processing without secondary data*" Project members: P. Forster (PI), M.N. El Korso, C. Ren			

Digiteo-DigiCosme grant	**Co-Principal investigator**	**2016-19**	**100k€**
Thesis of Gordana Drašković, "*Robust estimation analysis for signal and image processing*" Project members : F. Pascal (PI), F. Tupin			

International collaborations

• **HKUST, Hong Kong**, with Prof. Daniel P. Palomar: 1 month as invited Ph.D student in July 2015. Two journal and three conferences articles (latest in 2021).

• **Aalto University, Finland**, with Prof. Esa Ollila: 6 months as invited researcher in 2021 (CRCT). One conference (December 2019) and one journal article is under revision for IEEE Trans. on Signal Processing (January 2022).

• **Xidian University, China**, with Prof. Yongchan Gao: one journal article in 2021.

• **NC State University (NCSU), Raleigh, USA**, with Prof. Hamid Krim: 2 weeks as invited researcher in October 2016. One conference article and co-organization of a special session at the conference EUSIPCO 2018.

Supervision experience

Ph.D. Students (current)

• **Hugo Brehier**, SONDRA, defense expected for 2024
Title: "*Detection and Classification for Radar Through The Wall from subspaces model*"
Co-supervisors: G. Ginolhac (director), C. Ren, I. Hinostroza
Funding: SONDRA

• **Hoa Vu**, ONERA, defense expected for 2023
Title: "*Robust SAR interferometry*"
Co-supervisors: G. Ginolhac (director), Y. Yan, F. Brigui
Funding: ONERA

• **Yassine Mhiri**, SATIE, defense expected for 2023
Title: "*Statistical processing of signals observed by the future large radio telescopes* "
Co-supervisors: P. Larzabal (director), M.N. EL Korso
Funding: Paris-Saclay ADUM grant

• **Antoine Collas**, SONDRA, defense expected for 2022
Title: "*Robust clustering for satellite image time series*"
Co-supervisors: J-P. Ovarlez (co-director), G. Ginolhac (co-director), C. Ren
Funding: SONDRA
Publications: 2 journal papers and 1 international conferences

Ph.D. Students (past)

• **Bruno Meriaux**, SONDRA, defended the 05/10/2020
Title : "*Robust adaptive signal processing without secondary data*"
Co-supervisors: P. Forster (director), M.N. El Korso, C. Ren
Funding: 1/2 DGA grant completed by SONDRA
Publications: 3 journal papers and 5 international conferences

• **Gordana Drašković**, L2S, defended the 27/09/2019
Title : "*Robust estimation analysis for signal and image processing*"
Co-supervisors: F. Pascal (director), F. Tupin
Funding: DigiCosme grant, Paris-Saclay
Publications: 2 journal papers and 1 international conferences

• **Rayen Ben Abdallah**, LEME, defended the 4/11/2019
Title: "*Statistical signal processing exploiting low-rank priors with applications to detection in Heterogeneous Environment*"
Co-supervisors: D. Lautru (director), M.N. El Korso
Funding: University Paris Nanterre, ED 139
Publications: 2 journal papers and 3 international conferences

Master's degree students

• **Douba Jafuno**, M2 Sciences Sorbonne Université, March-September 2021
Topic : "Feature selection for EEG signals classification"
Co-supervisors: L. Boubchir, M.N. El Korso

• **Hugo Brehier**, ENSAI Master's degree, March-September 2020
Topic : "Robust sparse PCA"
Co-supervisors: M.N. El Korso

• **Bruno Meriaux**, ENS Paris Saclay Master's degree, April-September 2017
Topic : "Robust estimation of structured scatter matrices"
Co-supervisors: P. Forster, M.N. El Korso, C. Ren

• **Taha Essalih**, Ecole Centrale Marseille Master's degree, April-September 2017
Topic: "Robust calibration of large radio-interferometers"
Co-supervisors: M.N. El Korso, Rémi Flamary, Franck Iutzeler

Publications

In the following list of publications, underlined authors are interns/Ph.D. students I supervised, and *underlined-italics* authors are students I worked with (not as supervisor). A switch back to the standard typography means that the work was conducted after their graduation.

Papers can be found on [my website] or [my scholar page]

Book chapters

[B1] A. Mian, G. Ginolhac, J.P. Ovarlez, **A. Breloy**, F. Pascal, "An overview of covariance-based change detection methodologies in multivariate SAR image time series," ISTE WILEY (Book chapter), 2021

Journals

[J19] A. Hippert Ferrer, M.N. El Korso, **A. Breloy**, G. Ginolhac, "Robust low-rank covariance matrix estimation with a general pattern of missing values," in Signal Processing, 2022

[J18] A. Collas, F. Bouchard, **A. Breloy**, G. Ginolhac, C. Ren, J.P. Ovarlez, "A Riemannian Geometry for Probabilistic PCA with Compound Gaussian Signals," in IEEE Trans. on Sig. Proc., vol. 69, 2021

[J17] A. Hippert Ferrer, M.N. El Korso, **A. Breloy**, G. Ginolhac, "Robust mean and covariance matrix estimation under heterogeneous mixed-effects model with missing values," in Signal Processing, vol. 188, 2021

[J16] **A. Breloy**, G Ginolhac, Y. Gao, F. Pascal, "MIMO Filters based on Robust Rank-Constrained Kronecker Covariance Matrix Estimation," in Signal Processing, vol. 187, 2021

[J15] **A. Breloy**, S. Kumar, Y. Sun, D.P. Palomar, "Majorization-Minimization on the Stiefel Manifold with application to Robust Sparse PCA," in IEEE Trans. on Sig. Proc., vol. 69, 2021

[J14] F. Bouchard, **A. Breloy**, G. Ginolhac, A. Renaux, F. Pascal, "A Riemannian Framework for Low-Rank Structured Elliptical Models," in IEEE Trans. on Sig. Proc., vol. 69, 2021

[J13] B. Mériaux, C. Ren, **A. Breloy**, M. N. El Korso, P. Forster, "Mismatched Robust Estimation of Kronecker Product of Linearly Structured Scatter Matrices," in IEEE Trans. on Sig. Proc., vol. 69, 2021

[J12] *A. Mian*, A. Collas, **A. Breloy**, G. Ginolhac, J-P. Ovarlez, "Robust Low-rank Change Detection for Multivariate SAR Image Time Series," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 13, 2020

[J11] *A. Bouiba*, M. N. El Korso, **A. Breloy**, P. Forster, M. Hamadouche, M. Lagha, "Two dimensional robust source localization under non-Gaussian noise," in Circuits, Systems & Signal Processing, 2020.

[J10] R. Ben Abdallah, **A. Breloy**, M. N. El Korso, D. Lautru, "Bayesian Signal Subspace Estimation with Compound Gaussian Sources," in Signal Processing, vol. 167, 2020.

[J9] G. Draškovic, **A. Breloy**, F. Pascal, "On the performance of robust plug-in detectors using M-estimators," in Signal Processing Journal, vol. 167, 2020

[J8] G. Draškovic, **A. Breloy**, F. Pascal, "On the asymptotics of Maronna's robust PCA," in IEEE Trans. on Sig. Proc., vol. 67, no. 19, 2019.

[J7] B. Mériaux, C. Ren, M. N. El Korso, **A. Breloy**, P. Forster, "Robust estimation of structured scatter matrices in (mis)matched models," in Signal Processing, vol. 165, 2019.

[J6] R. Ben Abdallah, *A. Mian*, **A. Breloy**, A. Taylor, M. N. El Korso, D. Lautru, "Detection Methods Based on Structured Covariance Matrices for Multivariate SAR Images Processing," in IEEE Geoscience and Remote Sensing Letters, vol. 16 , no. 7, 2019.

[J5] B. Mériaux, C. Ren, M. N. El Korso, **A. Breloy**, P. Forster, "Asymptotic Performance of Complex M-Estimators for Multivariate Location and Scatter Estimation," in IEEE Signal Processing Letters, vol. 26, no. 2, 2019.

[J4] **A. Breloy**, G. Ginolhac, A. Renaux, *F. Bouchard*, "Intrinsic Cramér–Rao Bounds for Scatter and Shape Matrices Estimation in CES Distributions," in IEEE Signal Processing Letters, vol. 26, no. 2, 2019.

[J3] **A. Breloy**, G. Ginolhac, F. Pascal, P. Forster, "Robust Covariance Matrix estimation in Low-Rank Heterogeneous Context", IEEE Trans. on Sig. Proc., vol. 64, no. 22, 2016.

[J2] Y. Sun, **A. Breloy**, P. Babu, D.P. Palomar, F. Pascal, G. Ginolhac, "Low-Complexity Algorithms for Low Rank Clutter Parameters Estimation in Radar Systems", IEEE Trans. on Sig. Proc., vol. 64, no. 8, 2016.

[J1] **A. Breloy**, G. Ginolhac, F. Pascal, P. Forster, "Clutter Subspace Estimation in Low Rank Heterogeneous Noise Context," in IEEE Trans. on Sig. Proc., vol. 63, no. 9, 2015.

International conferences

[C28] F. Bouchard, **A. Breloy**, A. Mian, G. Ginolhac, "On-line Kronecker product structured covariance estimation with Riemannian geometry for t-distributed data", EUSIPCO 2021

[C27] Y. Mhiri, M. N. El Korso, L. Bacharach, **A. Breloy**, P. Larzabal,, "Expectation-Maximization based direction of arrival estimation under a mixture of Noise", EUSIPCO 2021

[C26] A. Collas, F. Bouchard, **A. Breloy**, C. Ren, G. Ginolhac, J-P. Ovarlez, "A Tyler-type estimator of location and scatter leveraging Riemannian optimization," IEEE ICASSP 2021

[C25] F. Bouchard, **A. Breloy**, G. Ginolhac, A. Renaux, "A Riemannian approach to blind separation of t-distributed sources," EUSIPCO 2020

[C24] B. Mériaux, C. Ren, **A. Breloy**, M. N. El Korso, and P. Forster, "Efficient estimation of Kronecker product of linear structured scatter matrices under t-distribution," EUSIPCO 2020

[C23] F. Bouchard, **A. Breloy**, G. Ginolhac, F. Pascal, "Riemannian framework for robust covariance matrix estimation in spiked models," IEEE ICASSP 2020

[C22] F. Bouchard, **A. Breloy**, A. Renaux, G. Ginolhac, "Riemannian geometry and Cramér-Rao bound for blind separation of Gaussian sources," IEEE ICASSP 2020.

[C21] **A. Breloy**, E. Ollila, F. Pascal, "Spectral Shrinkage of Tyler's M-Estimator of Covariance Matrix," IEEE CAMSAP 2019.

[C20] B. Mériaux, C. Ren, **A. Breloy**, M. N. El Korso, P. Forster, "Modified Sparse Subspace Clustering for Radar Detection in Non-Stationary Clutter," IEEE CAMSAP 2019.

[C19] R. Ben Abdallah, A. Breloy, M. N. El Korso, D. Lautru, "Bayesian Robust Signal Subspace Estimation in Non-Gaussian Environment," EUSIPCO 2019.

[C18] R. Ben Abdallah, **A. Breloy**, A. Taylor, M. N. El Korso, D. Lautru, "Signal Subspace Change Detection in Structured Covariance Matrices," EUSIPCO 2019.

[C17] B. Mériaux, C. Ren, **A. Breloy**, M. N. El Korso, P. Forster, J.-P. Ovarlez, "On the Recursions of Robust COMET Algorithm for Convexly Structured Shape Matrix," EUSIPCO 2019.

[C16] *A. Mian*, **A. Breloy**, G. Ginolhac, J-P. Ovarlez, "Robust Low-rank Change Detection for SAR Image Time Series," IEEE IGARSS 2019.

[C15] B. Mériaux, C. Ren, M.N. El Korso, **A. Breloy**, P. Forster, "Efficient Estimation of Scatter Matrix with Convex Structure under t-distribution", IEEE ICASSP 2018.

[C14] **A. Breloy**, M. N. El Korso, A. Panahi, H. Krim, "Robust Subspace Clustering for Radar Detection," EUSIPCO 2018.

[C13] B. Meriaux, C. Ren, M. N. El Korso, **A. Breloy**, P. Forster, "Robust-COMET for Covariance Estimation in Convex Structures: Algorithm and Statistical Properties," IEEE CAMSAP 2017.

[C12] R. Ben Abdallah, **A. Breloy**, M. N. El Korso, D. Lautru, H. Ouslimani, "Minimum Mean Square Distance Estimation of Subspaces in presence of Gaussian sources with application to STAP detection", International Conference on New Computational Methods for Inverse Problems (NCMIP), IOP publishing in the series "Journal of Physics : Conference Series," 2017.

[C11] *Q. Hoarau*, **A. Breloy**, G. Ginolhac, A.M. Atto, J.M. Nicolas, "A subspace approach for shrinkage parameter selection in undersampled configuration for regularized Tyler estimators," IEEE ICASSP 2017.

[C10] G. Drašković, F. Pascal, **A. Breloy**, J-Y. Tourneret, "New asymptotic properties for the Robust ANMF," IEEE ICASSP 2017.

[C9] T. Bao, **A. Breloy**, M.N. El Korso, K. Abed-Meraim, H.H. Ouslimani, "Performance analysis of direction-of-arrival and polarization estimation using a non-uniform linear COLD array," Seminar on Detection Systems: Architectures and Technologies 2017.

[C8] **A. Breloy**, Y. Sun, P. Babu, G. Ginolhac, D.P. Palomar, "Robust Rank Constrained Kronecker Covariance Matrix Estimation," IEEE Asilomar Conference on Signals, Systems, and Computers 2016.

[C7] **A. Breloy**, Y. Sun, P. Babu, D.P. Palomar, F. Pascal, G. Ginolhac, "A robust signal subspace estimator," IEEE Workshop on Statistical Signal Processing 2016.

[C6] **A. Breloy**, Y. Sun, P. Babu, D.P. Palomar, "Low-Complexity Algorithms for Low Rank Clutter Parameters Estimation in Radar Systems," EUSIPCO, 2016.

[C5] J-P. Ovarlez, F. Pascal, **A. Breloy**, "Asymptotic Detection Performance Analysis of the Robust Adaptive Normalized Matched Filter," IEEE CAMSAP 2015.

[C4] **A. Breloy**, G. Ginolhac, F. Pascal, P. Forster, "Robust estimation of the clutter subspace for a low rank heterogeneous noise under high clutter to noise ratio assumption," IEEE ICASSP 2014.

[C3] **A. Breloy**, G. Ginolhac, F. Pascal, P. Forster, "CFAR property and robustness of the low rank adaptive normalized matched filters detectors in low rank compound Gaussian context," IEEE SAM 2014.

[C2] **A. Breloy**, L. Le Magoarou, G. Ginolhac, F. Pascal, P. Forster, "Numerical performances of low rank STAP based on different heterogeneous clutter subspace estimators," International RADAR Conf. 2014.

[C1] **A. Breloy**, L. Le Magoarou, G. Ginolhac, F. Pascal , P. Forster, "Maximum likelihood estimation of clutter subspace in non-homogeneous noise context," EUSIPCO 2013.

Teaching activities

Degrees: I mostly teach for the first and second years of D.U.T. of the Electrical engineering (GEII) department (I.U.T. de Ville d'Avray). I am also involved in several courses for Master's degree (E2SC) and the FIPMECA formation (engineering degree).

Courses: My courses consist mostly in practicals (TP) and supervised group work (TD). I also supervise several student projects with various formats: individual or group projects, either autonomous or fully supervised on a series of practicals.

Topics : My teachings concern analog electronics, programming, microcontrollers, and digital signal processing. Below is a list of the courses I was involved in

- **Analog Electronics** (1^{st} and 2^{nd} year D.U.T GEII).
- **C/C++/Matlab programming** (1^{st} and 2^{nd} year D.U.T GEII).
- **Mathematics of signal analysis** (1^{st} and 2^{nd} year D.U.T GEII).
- **Microcontrollers, embedded systems** (1^{st} year D.U.T GEII).
- **Digital signal processing** (2^{nd} year D.U.T GEII, FIPMECA, M2-E2SC).
- **Automation, Control theory** (2^{nd} year, D.U.T GEII).
- **Probability and statistics** (2^{nd} year D.U.T GEII, M2-E2SC).
- **Statistical signal processing** (M2-E2SC).
- **Students projects**
  - 1^{st} **year D.U.T. GEII** (semi-autonomous, $\sim 30h$)
    - Labyrinth challenge (robotC programming, LEGO-NXT)
    - Line tracking robot challenge (arduino programming)
  - 2^{nd} **year D.U.T. GEII** (autonomous, $\sim 4h$/week for 8 months)
    - GEII Robotics cup, organized by Cachan I.U.T..
    - BB-8 robot prototype.
  - **M2-E2SC and FIPMECA** (autonomous, $\sim 70h$)
    - Shazam algorithm.
    - "Audio beat tracking" (IEEE signal processing cup 2017)
    - Audio sources localization.

Synthesis: In order to shorten the exposition, my teaching hours are simply reported below:

Teaching service synthesis				
Year	CM	TD	TP	Total (eqTD)
2015-2016	26	55.5	229.5	324 h
2016-2017	0	79	148	227 h
2017-2018	4	108	168	282 h
2018-2019	8	115	201	328 h
2019-2020	0	64.5	179.5	244 h
2020-2021	0	50	92	142 h + 1/2 CRCT