Sara Pérez Vieites

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Summary

I am a **postdoctoral researcher** at Aalto University's Finnish Center for Artificial Intelligence (FCAI), working in the *Cyber-Physical Systems* group with Prof. Dominik Baumann and collaborating with Prof. Simo Särkkä. Previously, I was a postdoctoral researcher at IMT Nord Europe (with Prof. Víctor Elvira) and a visiting researcher at the University of Edinburgh. I obtained my PhD in Statistical Signal Processing from Universidad Carlos III de Madrid in 2022, under the supervision of Prof. Joaquín Míguez.

My research to date has focused on **online and scalable Bayesian inference** for dynamical systems and time series, with contributions to nested filtering including neural network-based approaches. More recently, I have expanded into **Bayesian experimental design (BED)**, i.e., combining online inference with adaptive data acquisition. I am also developing broader interests at the intersection of probabilistic machine learning, reinforcement learning, and continual learning, aiming to design data acquisition methods that are uncertainty-aware and robust in long-run, dynamic environments.

Professional Experience

Postdoctoral Researcher Feb 2024 - present

Finnish Center for Artificial Intelligence **(FCAI), Aalto University** (Espoo, Finland)
Cyber-Physical Systems group (Prof. Dominik Baumann), and collaboration with *Sensor Informatics and medical technology* group (Prof. Simo Särkkä).

- Research mainly on Bayesian experimental design (BED) and reinforcement learning.
- Co–supervising a PhD student on BED and control in industrial applications.
- Teaching contribution in *Digital and Optimal Control*.

Postdoctoral Researcher Sep 2022 - Sep 2023

Institut Mines-Télécom **(IMT) Nord Europe** (Lille, France)
Advised by Prof. Víctor Elvira.

- Research on neural network methods for approximate Bayesian inference in time series models.

Visiting Researcher Jan 2023 - July 2023

School of Mathematics, **University of Edinburgh**, (Edinburgh, UK)
Advised by Prof. Víctor Elvira.

PhD Researcher Dec 2016 - May 2022

Department of Signal Theory & Communications, **Universidad Carlos III de Madrid** (Madrid, Spain)
Supervised by Prof. Joaquín Míguez.

- Research on computational methods for approximate Bayesian inference in time series models.
- Teaching assistant: *Linear Systems*, and *Linear networks analysis and synthesis*.

Visiting Researcher Apr 2019 - July 2019

Department of Mathematics and Statistics, **University of Reading** (Reading, UK)
Supervised by Prof. Jochen Broecker.

- Research on stochastic parameterizations in probabilistic state-space models.

Visiting Researcher Jan 2019

MeteoGalicia (Santiago de Compostela, Spain)

– Application of stochastic filtering in weather forecasting.

Visiting Researcher July 2018

Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) (Barcelona, Spain)

– Bayesian inference for engineering problems (multiple target tracking, high-dimensional estimation).

Education

Sep 2017 - Jan 2022 PhD in Statistical Signal Processing (Honors: *cum laude*)
At **Universidad Carlos III de Madrid** (Madrid, Spain)
Supervised by Prof. Joaquín Míguez.
Dissertation: *Nested filtering methods for Bayesian inference in state space models.*
Research on Bayesian filtering methods, from a practical and theoretical point of view, for accurate parameter estimation and prediction in high-dimensional time-varying systems.

Sep 2015 - Sep 2017 Master's Degree in Telecommunications Engineering
At **Universidad Carlos III de Madrid** (Madrid, Spain)

Sep 2015 - July 2017 Master's Degree in Multimedia and Communications
At **Universidad Carlos III de Madrid** (Madrid, Spain)
Master specialised in topics such as machine learning, computer vision, and signal processing.

Sep 2011 - June 2015 Bachelor's Degree in Telecommunication Technologies Engineering
At **Universidade de Vigo** (Vigo, Spain)
With specialization in *Sound and Image Processing*.

Publications (peer-reviewed)

Selected papers

1. **Pérez-Vieites, S.**, Molina-Bulla, H., & Míguez, J. (2025). Nested smoothing algorithms for inference and tracking of heterogeneous multi-scale state-space systems. *Foundations of Data Science*.
Summary and relevance: Introduces novel nested approximate inference methods (building on my earlier work) to handle heterogeneous multi-scale systems with different temporal structures. Enables online Bayesian inference in more complex time-series models. (1 citation)

2. Iqbal, S., Abdulsamad, H., **Pérez-Vieites, S.**, Särkka, S., & Corenflos, A. (2024). Recursive nested filtering for efficient amortized Bayesian experimental design. In *NeurIPS 2024 Workshop on Bayesian Decision-making and Uncertainty*.
Summary and relevance: Connects online Bayesian inference with amortized strategies in BED, making recursive posterior updates feasible even when exact inference is intractable. Ongoing work extends theoretical guarantees. Marks my first direct contribution to BED. (1 citation)

3. Cox, B., **Pérez-Vieites, S.**, Zilberstein, N., Sevilla, M., Segarra, S., & Elvira, V. (2024). End-to-end learning of Gaussian mixture proposals using differentiable particle filters and neural networks. In *ICASSP 2024* (pp. 9701-9705). IEEE.
Summary and relevance: Combines deep learning with online Bayesian inference, developing a differentiable framework to learn proposal distributions for particle filters in time-series problems. Showcases my collaborative work at the interface of ML and signal processing, expanding Bayesian

methods to neural architectures. (7 citations)

4. **Pérez-Vieites, S.**, & Míguez, J. (2021). Nested Gaussian filters for recursive Bayesian inference and nonlinear tracking in state space models. *Signal Processing*, 189, 108295.
   Summary and relevance: Proposes the first fully Gaussian nested filtering approach, improving scalability in online Bayesian inference. This paper established the methodological basis for later advances in filtering and experimental design. (17 citations)

5. **Pérez-Vieites, S.**, Mariño, I. P., & Míguez, J. (2018). Probabilistic scheme for joint parameter estimation and state prediction in complex dynamical systems. *Physical Review E*, 98(6), 063305.
   Summary and relevance: Early work on scalable online Bayesian inference, introducing a probabilistic framework for joint state–parameter estimation in dynamical systems. Demonstrates applications to physics-inspired models and marked my first major publication, shaping my trajectory in Bayesian inference. (26 citations)

Other publications

6. Sevilla, M., Zilberstein, N., Cox, B., **Pérez-Vieites, S.**, Elvira, V., & Segarra, S. (2023). State and Dynamics Estimation with the Kalman–Langevin filter. In *Asilomar 2023* (pp. 1372-1376). IEEE.

7. **Pérez-Vieites, S.**, & Elvira, V. (2023). Adaptive Gaussian nested filter for parameter estimation and state tracking in dynamical systems. In *ICASSP 2023* (pp. 1-5). IEEE.

8. **Pérez-Vieites, S.**, & Míguez, J. (2020). A nested hybrid filter for parameter estimation and state tracking in homogeneous multi-scale models. In *FUSION 2020* (pp. 1-8). IEEE.

9. **Pérez-Vieites, S.**, & Míguez, J. (2020). Kalman-based nested hybrid filters for recursive inference in state-space models. In *EUSIPCO 2020* (pp. 2468-2472). IEEE.

10. **Pérez-Vieites, S.**, Vilà-Vals, J., Bugallo, M. F., Míguez, J., & Closas, P. (2019). Second Order Subspace Statistics for Adaptive State-Space Partitioning in Multiple Particle Filtering. In *CAMSAP 2019* (pp. 609-613). IEEE.

PhD thesis

Pérez Vieites, S. (2022). Nested filtering methods for Bayesian inference in state space models. *PhD thesis*, Universidad Carlos III de Madrid.

Software (open-source contributions)

GitHub repository for Physical Review E paper (2018) Link to repository PRE2018
GitHub repository for Signal Processing paper (2021) Link to repository SProc2021

GitHub repositories including implementations of several nested filtering methods, in Matlab and Python.

Invited Talks

17 July 2025	GTS Seminar (Universidad Carlos III de Madrid, Spain)
29 Apr 2025	UQ Hybrid Seminar (Aachen University and KAUST, held online)
19 Mar 2025	Data Meets Models and Beyond Workshop (LUT, Finland)
11 Sep 2024	Data Assimilation Workshop (LUT, Finland)
17 May 2024	Workshop in sequential Monte Carlo (SMC) 2024 (Edinburgh, UK)
28 Feb 2023	Statistics Seminar (University of Edinburgh, UK)

Conferences

Talks in conferences

28 July–1 Aug 2025	**Contributed talk**, International Conference on Monte Carlo Methods and Applications (MCM) 2025 (Chicago, USA). (special session: Nested expectations)
29–30 June 2024	**Contributed talk**, BAYSM 2024 - The Bayesian Young Statisticians Meeting (Venice, Italy).
13–17 May 2024	**Invited talk**, 6th International Workshop on Sequential Monte Carlo Methods (SMC 2024), University of Edinburgh (Edinburgh, UK).
26–30 June 2023	**Contributed talk**, 14th International Conference on Monte Carlo Methods and Applications (MCM) 2023 (Paris, France).
2–7 Sep 2019	**3 minutes thesis talk**, 27th European Signal Processing Conference (EUSIPCO 2019) (A Coruña, Spain).

Additional invited talks in departmental seminars in Edinburgh, Madrid, Aachen.

Poster presentations

1-7 July 2024	**2024 ISBA** World Meeting (Venice, Italy)
4-10 June 2023	2023 IEEE International Conference on Acoustics, Speech, and Signal Processing (**ICASSP 2023**) (Rhodes Island, Greece).
26-30 Sep 2022	**SIAM Conference on Mathematics of Data Science** (MDS22). Hybrid conference (San Diego, USA)
4-6 May 2022	**Workshop in Sequential Monte Carlo** 2022 (SMC 2022)
18-22 Jan 2021	28th European Signal Processing Conference (**EUSIPCO 2020**)
6-9 July 2020	Conference on Information Fusion (**FUSION 2020**)
24-29 June 2018	**2018 ISBA** World Meeting (Edinburgh, UK)

Several others (2017–2022) in Bayesian statistics, signal processing and data assimilation workshops.

Attendance / Organisation

30 June–3 July 2025	**Part of the organization committee**. Workshop on Signal Processing, Information Theory and Communications (SIC'25). Universidade de Vigo (Vigo, Spain).
23–27 June 2025	**Attendance** to Workshop in Accelerating statistical inference and **experimental design with ML** (Cambridge, UK).
10–15 Dec 2024	**Attendance at NeurIPS 2024** (Vancouver, Canada).
4–6 May 2022	**Part of the local arrangements committee**. Workshop in Sequential Monte Carlo 2022 (SMC 2022)

Earlier participation in summer schools and workshops (e.g., Imperial College London 2018 & 2019 workshops, LMS Summer School Warwick 2018).

Supervision and Teaching

2025–present	**Co-supervision of one PhD student** at Aalto University on BED and control in industrial applications (collaborating with ABB).
2024–2025	**Co-supervision of one B.Sc. thesis** (*Variational Inference Approaches to Bayesian Optimal Experimental Design*, Aditya Agrawal)
2024–2025	**Guest lecturer** in Digital and Optimal Control, Department of Electrical Engineering and Automation, Aalto University.
2017–2019	**Teaching assistant** at Universidad Carlos III de Madrid. (1) *Linear Systems* – 112 hours (B.Sc. in Mobile & Space Communication Engineering, B.Sc. in Telecommunications Engineering, B.Sc. in Telematics Engineering). (2) *Linear Networks Analysis and Synthesis* – 5 hours (B.Sc. in Telecommunication Technologies Engineering).

Awards and Funding

July 2024	**Travel grant** (ISBA 2024), **400USD**.
Feb 2019	**Travel grant** (Universidad Carlos III de Madrid), **3150€**. Competitive grant supporting mobility during PhD.
11 Sep–9 Apr 2019	**PIPF Predoctoral Fellowship** (Universidad Carlos III de Madrid,). Competitive fellowship supporting PhD research.

Major Collaborations

- Prof. Dominik Baumann, Prof. Simo Särkkä (Aalto University, Finland); Prof. Adrien Corenflos (University of Warwick, UK) – **Bayesian experimental design**
- Prof. Dominik Baumann (Aalto University, Finland) – **Control and reinforcement learning**
- Prof. Joaquín Míguez (Universidad Carlos III de Madrid, Spain), Prof. Jana de Wiljes (TU Ilmenau, Germany), Prof. Víctor Elvira (University of Edinburgh, UK), Prof. Jochen Broecker (University of Reading, UK) – **Bayesian inference in state-space models**
- Prof. Pau Closas (Northeastern University, USA), Prof. Santiago Segarra (Rice University, USA) – **Machine learning and signal processing**

Reviewer Activities

Journals	Foundations of Data Science, IEEE Transactions on Signal Processing, IEEE Signal Processing Letters.
Conferences	EUSIPCO, ICASSP.

Languages

English	Professional proficiency
Spanish	Native
Italian	Intermediate proficiency
Galician	Native