Sara Pérez Vieites

✉ sara.perezvieites@aalto.fi | ✉ sara.perezvieites@helsinki.fi

🎓 scholar.google.com/citations?user=MzPUI0AAAAAJ

🌐 sarapv.github.io | ⬭ github.com/sarapv

Summary

I am an **HIIT postdoctoral fellow** at the University of Helsinki (starting Feb. 2026), working in the *Multi-source probabilistic inference* group with Prof. Arto Klami. My research focuses on probabilistic machine learning, with an emphasis on online Bayesian inference and adaptive data acquisition (Bayesian experimental design) for dynamical systems. Previously, I was a postdoctoral researcher at Aalto University in the *Cyber-Physical Systems* group with Prof. Dominik Baumann, collaborating with Prof. Simo Särkkä. I have also held postdoctoral and visiting positions at IMT Nord Europe and the University of Edinburgh (with Prof. Víctor Elvira). 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.

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.*

Professional Experience

HIIT Postdoctoral Fellow Feb 2026 – present

Helsinki Institute for Information Technology **(HIIT), University of Helsinki** (Finland)
Multi-source probabilistic inference group (Prof. Arto Klami).

Postdoctoral Researcher Feb 2024 – Jan 2026

Finnish Center for Artificial Intelligence **(FCAI), Aalto University** (Helsinki, 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).

PUBLICATIONS (PEER-REVIEWED)

Selected papers

[1] **Pérez-Vieites, S.**, Iqbal, S., Särkkä, S., & Baumann, D. (2025). Online Bayesian experimental design for partially observable dynamical systems. *arXiv preprint arXiv:2511.04403.* (Submitted)
arxiv.org/abs/2511.04403
Summary and relevance: Develops a scalable Bayesian experimental design (BED) framework for partially observable systems, combining online Bayesian inference with adaptive design selection. Introduces a new estimator for the expected information gain (EIG) that deals with intractable likelihoods, and provides theoretical analysis of its consistency.

[2] 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.
doi.org/10.1109/ICASSP48485.2024.10447783
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.

[3] **Pérez-Vieites, S.**, & Míguez, J. (2021). Nested Gaussian filters for recursive Bayesian inference and nonlinear tracking in state space models. *Signal Processing*, 189, 108295.
arxiv.org/abs/2103.12666 | doi.org/10.1016/j.sigpro.2021.108295
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.

[4] **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.*
arxiv.org/abs/2204.07795 | doi.org/10.3934/fods.2025002
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.

[5] 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.*
arxiv.org/abs/2409.05354 | openreview.net/forum?id=D9kVWeBlId
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. Serves as an early step in my ongoing research line on scalable sequential BED.

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.

[11] **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.

PhD thesis

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

Awards and Funding

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

Submitted/pending

2025	**MSCA Postdoctoral Fellowship** (submitted)
	Host: University of Oxford; Supervisor: Prof. Tom Rainforth.
	Decision expected on February 2026.

Software (open-source contributions)

GitHub repository for Physical Review E paper (2018)   github.com/sarapv/NestedHybrid
GitHub repository for Signal Processing paper (2021)   github.com/sarapv/NestedGaussian
GitHub repository with Lorenz dynamical models (2023)   github.com/sarapv/Lorenz-models

GitHub repositories including implementations of several nested filtering methods and state-space models, 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	SMC 2024 - Workshop in Sequential Monte Carlo Methods (Edinburgh, UK)
28 Feb 2023	Statistics Seminar (University of Edinburgh, UK)

CONFERENCES

Talks in conferences (contributed talks)

July 2025   MCM 2025 - International Conference on Monte Carlo Methods and Applications 2025 (Chicago, USA). Special session: *Nested expectations*.

June 2024   BAYSM 2024 - The Bayesian Young Statisticians Meeting (Venice, Italy).

June 2023   MCM 2023 - 14th International Conference on Monte Carlo Methods and Applications 2023 (Paris, France).

Sep 2019   (3 minutes thesis talk) EUSIPCO 2019 - 27th European Signal Processing Conference 2019 (A Coruña, Spain).

Poster presentations

July 2024   2024 ISBA World Meeting (Venice, Italy)

June 2023   ICASSP 2023 - 2023 IEEE International Conference on Acoustics, Speech, and Signal Processing (Rhodes Island, Greece).

Sep 2022   MDS 2022 - SIAM Conference on Mathematics of Data Science (San Diego, USA)

May 2022   SMC 2022 - Workshop in Sequential Monte Carlo Methods 2022

Jan 2021   EUSIPCO 2020 - 28th European Signal Processing Conference 2020

July 2020   FUSION 2020 - Conference on Information Fusion 2020

June 2018   2018 ISBA World Meeting (Edinburgh, UK)

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

Attendance

June 2025   Attendance to Workshop in Accelerating statistical inference and experimental design with ML (Cambridge, UK).

Dec 2024   Attendance at NeurIPS 2024 (Vancouver, Canada).

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

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**

TEACHING AND SUPERVISION EXPERIENCE

2025–present	**Co-supervision of one PhD student** at Aalto University on BED and control in industrial applications (collaborating with *ABB*).
2024–present	**Guest lecturer** in *Digital and Optimal Control*. Part of the Master's programme in Control, Robotics, and Autonomous Systems, at Aalto University.
Oct–Nov 2024	**Mini-tutorials on Monte Carlo methods** in the *Cyber-Physical Systems* group, Aalto University. All materials are available in this GitHub repository: github.com/sarapv/MiniLectures.
2024–2025	**Co-supervision of one BSc thesis** (*Variational Inference Approaches to Bayesian Optimal Experimental Design*, Aditya Agrawal).
2017–2019	**Teaching Assistant** at Universidad Carlos III de Madrid. (1) *Linear Systems* – **112 hours** (BSc in Mobile & Space Communication Engineering, BSc in Telecommunication Technologies Engineering, BSc in Telematics Engineering). (2) *Linear Networks Analysis and Synthesis* – **5 hours** (BSc in Telecommunication Technologies Engineering). At Universidad Carlos III, detailed **polls** are anonymously filled by students at the end of each course. All the grades obtained have been averaged over all courses and all academic years yielding: **4.1/5**.

ACADEMIC SERVICE

2020–present	**Reviewer** for journals (Statistics & Computing, Foundations of Data Science, IEEE Transactions on Signal Processing, IEEE Signal Processing Letters) and conferences (EUSIPCO, ICASSP).
2024–present	**Reviewer** for the American Statistical Association (ASA) Section on Bayesian Statistical Science (SBSS) Student Paper Competition.
July 2025	**PhD defence committee**, Universidad Carlos III de Madrid (Spain).
June 2025	**Organising committee**. SIC 2025 - Workshop on Signal Processing, Information Theory and Communications. Universidade de Vigo (Vigo, Spain).
May 2022	**Local arrangements committee**. SMC 2022 - Workshop in Sequential Monte Carlo Methods 2022 (Madrid, Spain).

ADMINISTRATIVE SERVICE

2024–present	**Communications support**, managing research group's LinkedIn account: updates on papers, talks, and events.
2023–present	**Regular proposals for thesis topics** for BSc/MSc programmes (Aalto University).
2023–present	**Coordinator**, FCAI's Causal Reinforcement Learning team. Arranging/scheduling meetings for a cross-department team.
2023–2024	**Curriculum/project support** in workshops of control courses (Aalto University). Proposed and supervised group projects within MSc programmes (literature review, reproduction, and extension of an existing work or paper).

Languages

English	Professional proficiency
Italian	Intermediate proficiency
Spanish	Native
Galician	Native

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