
Sara Pérez Vieites

✉ sara.perezvieites@helsinki.fi | 🌐 sarapv.github.io | 🐙 github.com/sarapv

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

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](#). 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 focuses on **developing the foundations of Bayesian experimental design for changing environments and long-running systems**. I study how data-acquisition strategies should adapt when the underlying system, the statistical model, or the objective defining which information is valuable evolves over time. This programme builds on my previous research on scalable online Bayesian inference for dynamical systems and time series, including nested filtering and neural network-based approaches. That background provides the computational tools for updating uncertainty as data arrive, while Bayesian experimental design adds the decision layer of choosing which data should be collected next. I also draw on ideas from probabilistic machine learning, continual learning, and reinforcement learning to address adaptation, long horizons, and robustness.

EDUCATION

Sep 2017 – Jan 2022	PhD in Statistical Signal Processing At Universidad Carlos III de Madrid (Madrid, Spain) Supervised by Prof. Joaquín Míguez. Dissertation: <i>Nested filtering methods for Bayesian inference in state space models</i> . 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.	(Honors: <i>cum laude</i>)
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 <i>Sound and Image Processing</i> .	

PROFESSIONAL EXPERIENCE

HIIT Postdoctoral Fellow	Feb 2026 – present
Helsinki Institute for Information Technology (HIIT), University of Helsinki (Finland) <i>Multi-source probabilistic inference</i> group (Prof. Arto Klami), and collaboration with <i>RainML</i> research group in the University of Oxford (Prof. Tom Rainforth).	
– Competitive postdoctoral fellowship awarded based on an independent research proposal, with a mentor assigned to support the development of an independent research agenda. – Research on Bayesian experimental design (BED) approaches for longer-horizon decision-making, including dynamical settings, unknown or changing downstream objectives, and continual learning approaches. – Co-supervision of one ELLIS PhD student on Bayesian experimental design and prior elicitation.	

- Teaching contributions in the Master’s Programme in Data Science at the University of Helsinki, coordinating a course in reinforcement learning with Dr. Petrus Mikkola.

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

MeteoGalicía (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. (2026). Online Bayesian experimental design for partially observable dynamical systems. *ICML 2026*. (To appear)

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=D9kVWeBIId

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

- 2026 **MSCA Postdoctoral Fellowship**: rejected, awarded *Seal of Excellence*.
The MSCA Seal of Excellence is a quality label awarded to applicants who achieved a high score in their applications (85% or higher) but unfortunately were not awarded funding due to budgetary constraints.
- 2026 **Silver Reviewer Recognition** (ICML 2026).
Travel support (ICML 2026), covering registration and accommodation.
- 2024 **Travel grant** (ISBA 2024), **400USD**.
- 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.

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 repository for ICML paper (2026)** github.com/sarapv/badpods

GitHub repositories including implementations of several nested filtering methods, Bayesian experimental design 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 2026	ICML 2026 (Seoul, South Korea)
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).

TEACHING AND SUPERVISION EXPERIENCE

2026–present	Course coordination of a reinforcement learning course for the Master's Programme in Data Science at the University of Helsinki, jointly coordinated with Petrus Mikkola, first time offered in fall 2026.
2026–present	Co-supervision of one ELLIS PhD student at University of Helsinki on Bayesian experimental design and prior elicitation.
2025–present	Co-supervision of one PhD student at Aalto University on BED and control in industrial applications (collaborating with <i>ABB</i>).
2024–2025	Guest lecturer in <i>Digital and Optimal Control</i> . 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 <i>Cyber-Physical Systems</i> group, Aalto University. All materials are available in this GitHub repository: github.com/sarapv/MiniLectures .
2024–2025	Co-supervision of one BSc thesis (<i>Variational Inference Approaches to Bayesian Optimal Experimental Design</i> , Aditya Agrawal).
2023–2025	BSc/MSc thesis topic proposals at Aalto University, contributing project ideas for student research and supervision.
2017–2019	Teaching Assistant at Universidad Carlos III de Madrid. (1) <i>Linear Systems</i> – 112 hours (BSc in Mobile & Space Communication Engineering, BSc in Telecommunication Technologies Engineering, BSc in Telematics Engineering). (2) <i>Linear Networks Analysis and Synthesis</i> – 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 was: **4.1/5**.

MAJOR COLLABORATIONS

- Prof. Tom Rainforth (University of Oxford, UK), Prof. Dominik Baumann, Prof. Simo Särkkä (Aalto University, Finland) – **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**

ACADEMIC SERVICE

2026 **Local organizer.** [ELLIS Summer School 2026: AI for Research](#) (Helsinki, Finland). Supported the organisation of travel grants, handled participant inquiries, and contributed to participant screening.

2020–present **Reviewer** for journals (Statistics & Computing, Foundations of Data Science, IEEE Transactions on Signal Processing, IEEE Signal Processing Letters) and conferences (ICML, 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

2025 **Pre-screening panel member** for an FCAI hiring call, contributing to the initial screening of PhD and postdoctoral applications.

2025 **Co-organizer** of the Theoretical Importance Sampling (TIS) reading group, held online with members based across Europe.

2024–2025 **Communications support** for the *Cyber-Physical Systems group* at Aalto University, managing the group's LinkedIn account and preparing updates on papers, talks, and events.

2023–2025 **Coordinator**, FCAI Causal Reinforcement Learning team, arranging and scheduling meetings for a cross-departmental research team.

LANGUAGES

English	Professional proficiency
Italian	Intermediate proficiency
Spanish	Native
Galician	Native

RESEARCH VISION AND FUTURE PLANS

My research asks **what data to collect from an unknown system in order to make better decisions** about it. Depending on the problem, the objective may be to learn the system itself, improve a downstream decision, elicit a user's preferences, or balance several of these goals at once. This therefore combines inference and optimisation: we need to infer what is unknown about the system, while also optimising how the data are collected. I am particularly interested in adaptive, sequential settings, where each observation changes what should be collected next, and in long-running systems whose environment or task may evolve over time. I see this as a timely objective in AI for two main reasons. First, selecting informative observations can reduce the need to collect, process, and store large amounts of data indiscriminately, improving **efficiency**. Second, systems intended for repeated or extended use need enough **flexibility** and autonomy to revise how they collect data as their knowledge, environment, and objectives change. I study these problems mainly from a Bayesian perspective, through Bayesian inference and Bayesian experimental design, while also drawing on ideas from control, continual learning, and reinforcement learning. Where possible, I seek convergence or performance guarantees under explicit assumptions, so that **reliability** is not assessed only empirically.

This programme builds directly on my **background** in sequential and online Bayesian inference for dynamical systems. During my PhD, I developed expertise in sequential Monte Carlo and, more generally, in filtering methods for updating uncertainty about unknown states and parameters as observations arrive. I later expanded my work towards Bayesian experimental design, where inference is only one part of the problem: one must also optimise which observation to obtain next. The resulting design objectives are often nested and analytically intractable, making Monte Carlo approximation central to their solution. My ICML 2026 paper on online Bayesian experimental design is an example of how I bring these strands together.

Active research directions

My first direction concerns **continual experimental design for long-running systems**. Many current policy-based methods are trained for a fixed number of experiments and then used without further adaptation. I want to develop design policies that continue to learn during deployment, so that they can operate over long or potentially unbounded horizons without repeatedly being retrained from scratch. This will draw on continual learning, where a central problem is how to adapt to new information without forgetting what remains useful from the past, and on reinforcement-learning formulations of sequential experimental design, where the value of a design also depends on how it affects future data-collection decisions.

My second direction concerns **experimental design when the system, or the model used to describe it, changes over time**. I will consider both gradual parameter drift and abrupt regime changes, and study how uncertainty about these changes should affect online inference and the choice of the next design. When the form of the change can be modelled, I will use dynamic and regime-switching models together with sequential inference. When a sufficiently reliable likelihood model cannot be maintained, a complementary approach is to use generalised Bayesian updates based on losses or predictive discrepancies. The aim is to develop design methods that remain useful under delayed detection of change and persistent model misspecification, and to understand when explicit modelling or a more robust posterior update is the appropriate response.

My third direction concerns **the objective used to decide which data are valuable**. Information-gain objectives are natural when the main aim is to learn unknown model parameters, but in many applications the relevant information instead **depends on a downstream decision, a user's preferences, or operational costs** that are not fully known in advance. I am currently studying the preference elicitation case, in which this objective is unknown but fixed, developing methods that decide whether to collect another observation about the system or query the user about what should be optimised.

At **Manchester**, this programme would connect particularly closely with Samuel Kaski's work on experimental design and human-AI collaboration, Mauricio Álvarez's probabilistic modelling of dynamical systems, and Mingfei Sun's research on reinforcement learning and policy optimisation. I would complement these strengths with a strong computational-statistical background, particularly in Monte Carlo methods, filtering, and online Bayesian inference; contributing collaborative projects and doctoral training through the Centre for AI Fundamentals and the AI CDT in Decision Making for Complex Systems. I have already begun to establish the foundations of an independent research programme. I currently hold an independent HIIT fellowship, and my proposal to the MSCA Postdoctoral Fellowship programme received a Seal of Excellence, having passed the programme's quality threshold. I have also started to work in this research agenda while co-supervising an ELLIS doctoral researcher, with Arto Klami, who works on Bayesian experimental design and preference or prior elicitation. At Manchester, I would target the EPSRC New Investigator Award and ERC Starting Grant, expand doctoral supervision, and build a group in adaptive data acquisition and probabilistic sequential decision-making.

TEACHING EXPERIENCE AND FUTURE PLANS

My aim in teaching is to help students approach a new concept through multiple, connected entry points: the model, its mathematical basis, its computational implementation, and the conclusions that can be drawn from it. I have used this approach in undergraduate *Linear Systems* workshops, as a guest lecturer in *Stochastic Optimal Control* at Aalto University, and in short tutorials on Monte Carlo methods for MSc and PhD students. During my PhD at Universidad Carlos III de Madrid, I delivered more than 100 hours of undergraduate workshops as a teaching assistant, with anonymous evaluations averaging 4.1/5.

Undergraduate contribution. At undergraduate level, I could contribute broadly to the mathematical and probabilistic foundations of AI and machine learning. This includes probability and statistics, regression and classification, probabilistic modelling and uncertainty, and introductory methods for sequential or time-dependent data. At Manchester, I could contribute to units such as *Data Science*, *Introduction to AI*, *Machine Learning*, and *Mathematical Topics in Machine Learning*, as well as final-year project supervision. I would aim to help students understand not only how to apply a method, but also the assumptions under which its conclusions can be trusted.

Postgraduate contribution. At postgraduate level, I could offer particular depth in probabilistic machine learning and sequential decision-making. My strongest areas include Bayesian analysis and approximate inference, particularly importance sampling, sequential Monte Carlo, and variational methods; as well as state-space models, filtering, and smoothing. I could also contribute to Bayesian experimental design, active learning, stochastic control, and the probabilistic and model-based aspects of reinforcement learning. These topics fit especially well with *Reasoning and Learning under Uncertainty*. I could also contribute to *Reinforcement Learning*, broader machine-learning courses, and MSc project supervision. In the longer term, I would like to develop research-led material connecting online Bayesian inference with sequential decision-making, either within existing units or as a new course.

Teaching methods and assessment. I would introduce new concepts through connected mathematical, algorithmic, visual, and computational explanations. Students need enough theory to understand the assumptions behind a method and recognise when it may fail, while implementation and experiments make the derivations more concrete and tangible. In my stochastic control teaching, for example, I asked students to derive the observation mean and covariance matrix used by the Kalman filter before implementing the method. This provided a short hands-on exercise during the lecture and connected the derivation with the later implementation in the workshops. In my Monte Carlo tutorials, I paired concise theoretical explanations with Jupyter notebooks in which students compared empirical behaviour with theoretical expectations.

Because these approaches develop different forms of understanding, I would also use different forms of assessment. Written exercises and examinations can assess conceptual understanding and mathematical reasoning. Computational assignments can assess implementation and practical skills, as well as students' ability to interpret results and diagnose problems. Finally, project-based assessments can test whether students can combine these skills when confronted with a more open-ended problem. I would balance these forms of assessment according to the content and learning outcomes of each unit, and use in-class exercises as formative feedback to identify difficulties early and adjust the pace or supporting material.

Supervision experience and future plans. My supervision experience includes a BSc thesis on variational methods for Bayesian experimental design and the co-supervision of two doctoral students: an industrial PhD student, with Dominik Baumann, working on experimental design and control for prognostics; and an ELLIS PhD student, with Arto Klami, working on Bayesian experimental design and elicitation. At Manchester, I would supervise projects at BSc, MSc, and doctoral levels in probabilistic machine learning, approximate inference, experimental design, and sequential decision-making. Where appropriate, I would draw project questions from my research agenda while adapting their scope to the students' level, background, and interests.