Pauline Kergus

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Experience

From 2022 **Researcher**, *LAPLACE - CNRS*, Toulouse, France.
My research project revolves around developing data-driven and learning-based approaches for modeling, control and analysis of smart grids.

2020–2021 **Postdoctoral fellow**, *Automatic control department, LTH*, Lund, Sweden.
Postdoc position within the ERC project Scalable Control of Interconnected Systems with Prof. Anders Rantzer.
- Teaching: PhD class on control systems synthesis with Karl-Johan Åström.
- Co-supervision of Felix Agner (PhD student) with Anders Rantzer and Richard Pates
- Supervision of Lisa Korsell and Tuva Yden (master students) on the subject "Control Design for Energy-Sharing Module of Next-Generation Thermal Energy System ectogrid" in collaboration with E.ON
- Industrial collaborations: Carrier, E.ON, Noda, Modelon, Energy Opticon

2019–2020 **Research project**, *DEIB, Politecnico di Milano*, Milano, Italy.
Management of water resources in the Hoa Binh reservoir (Vietnam) in collaboration with Simone Formentin, Matteo Giuliani and Andrea Castelletti:
- Policy search through multi-objective optimisation and dynamic programming.
- Design of a data-driven controller using VRFT.
- Use of economic MPC as reference governor and for constraint enforcement.

2016–2019 **PhD thesis**, *ONERA*, Toulouse, France.
Supervision: Charles Poussot-Vassal and Fabrice Demourant.
Title: "*Data-driven model reference control in the frequency-domain: From model reference selection to controller validation.*"
Development of a data-driven control framework based on rational interpolation, covering data-driven stability analysis and the choice of achievable specifications from data.
Thesis available at tel-3084374
- 3-months mobility at Politecnico di Milano in 2017 with Simone Formentin.
- 2-months exchange at INRIA Sophia-Antipolis in 2018 with Martine Olivi.
- Supervision with Pierre Vuillemin of Basile Bouteau for the master thesis: *Optimization-based closed-loop stability enforcement for direct data-driven control*.

2016–2019 **Teaching assistant**, *ENSEEIHT*, Toulouse, France.

Education

2016–2019 **PhD in Automatic Control**, *ONERA*, Toulouse, France.
Supervision: Charles Poussot-Vassal and Fabrice Demourant.
Title: "*Data-driven model reference control in the frequency-domain: From model reference selection to controller validation.*"
Thesis available at tel-3084374

2015 **UNICAMP**, *State University of Campinas*, Campinas, Brazil.
Final master year as an exchange student at UNICAMP in electrical engineering: linear systems, identification and filtering, data modelling, optimal control, LMIs, neural networks, signal and image processing, pattern recognition.

2012–2015 **Ecole Centrale de Lyon**, Lyon, France.
Scientific core curriculum (3 semesters) and specialization : numerical analysis of differential equations, functional analysis, finite element analysis, sensors and image processing, mechatronics and automated production systems.

2012–2013 **UCBL**, *Claude Bernard Lyon 1 University*, Lyon, France.
L3 of mathematics at Lyon 1 University and graduation (bachelor level).

2010–2012 **MPSI-MP**, *Lycée Sainte Geneviève*, Versailles, France.
Preparation for the national competitive entry exam for the French engineering faculties.

Teaching activities

Class	Type	Institution and level	Year	Hours
Linear control	TP	ENSEEIHT	2016-2017	35 hours
		1st-year students	2017-2018	31.5 hours
			2017-2018	28 hours
EROS *(architecture and assembler language)*	TP	ENSEEIHT	2016-2017	21 hours
		1st-year students	2017-2018	21 hours
			2017-2018	19 hours
Control project in simulink (within *Linear control*)	BE	ENSEEIHT	2016-2017	4 hours
		1st-year students	2017-2018	4 hours
Phase plane method (within *Non-linear systems*)	BE	ENSEEIHT work-study program	2017-2018	4 hours
Estimation and filtering	CM	ENSEEIHT	2018-2019	2 hours
	BE	3rd-year students		14 hours
Control Systems Synthesis (with K.J. Åström)	lectures	Lund University	2020	18 hours
	exercises	PhD students		4 hours
	projects			2 hours

TP = laboratory sessions BE = project sessions CM = lectures

Supervising activities

2022– (ongoing) Co-supervision of Noé Rivier, PhD student at LAPLACE, on the topic "Optimal, predictive and adaptive control strategies for hybrid fuel cell vehicles" (with Christophe Turpin, Amine Jaafar, Jérémi Régnier and in collaboration with Vitesco Technologies).

2022 Supervision of Henrik Lidstrom and Emil Sundström (master students at Lund University) on the subject "Physics-enhanced machine learning of energy systems" in collaboration with Carrier.

2021 Supervision of Caroline Cognot (1st-year master student from Ecole Centrale de Lyon) for a 3-months research intership on the subject "Data-driven modelling of building thermal behaviour" in collaboration with Noda.

2021 Supervision of Lisa Korsell and Tuva Yden (master students at Lund University) on the subject "Control Design for Energy-Sharing Module of Next-Generation Thermal Energy System ectogrid" in collaboration with E.ON.

2020– (ongoing) Co-supervision of Felix Agner, PhD student in the Automatic Control Department at Lund University, on the topic "Scalable Control of Interconnected Systems" (with Anders Rantzer and Richard Pates).

2019 Co-supervision of a master thesis with Pierre Vuillemin of Basile Bouteau, master student from KTH on the subject "*Optimization-based closed-loop stability enforcement for direct data-driven control*".

Scientific activities

International conferences

- *Rational interpolation and model order reduction for data-driven controller design*
  Invited talk given at the 8th European Congress of Mathematics (2021) in the minisymposium *Rational approximation for data-driven modeling and complexity reduction of linear and nonlinear dynamical systems*.
- *From reference model selection to controller validation: Application to Loewner Data-Driven Control*
  IEEE Conference on Decision and Control 2019, Nice, France
- *Data-driven control design in the Loewner framework: Dealing with stability and noise*
  European Control Conference 2018, Limassol, Cyprus
- *Identification of parametric models in the frequency-domain through the subspace framework under LMI constraints*
  European Control Conference 2018, Limassol, Cyprus
- *Frequency-domain data-driven control design in the Loewner framework*
  IFAC World Congress 2017, Toulouse, France

Seminars and workshops

- *Physics-informed learning for identification of a residential building's thermal behavior*
  AI Lund lunch seminar, December 2021 (slides).
- *Physics-informed learning for identification of a residential building's thermal behavior*
  Talk given at the 2021 European Research Network on System Identification (ERNSI) Workshop.
- *Hybrid Loewner Data-Driven Control*
  Talk given at the "Journées Automatique de la SAGIP", 2021.
- *Learning-based hierarchical control of water reservoir systems*
  Joint workshop CNRS-CNES on AI & Control, 2021.
- *Exploring flexibility in district heating networks through demand-side management*
  Advanced Network Science Initiative, Los Alamos National Laboratory, May 2021.
- *Contrôle et analyse de stabilité de systèmes de dimension infinie - Approches directes et indirectes par l'interpolation de Loewner*
  Journées Nationales d'Automatique de la SAGIP, 2020 (slides).
- *Data-driven stability analysis and enforcement for Loewner Data-Driven Control*
  Poster at the 2020 IPAM Workshop on Intersections between Learning, Control and Optimization, in Los Angeles.
- *Contrôle direct par approche fréquentielle*
  Interactive session at Journées nationales du GdR MACS, Bordeaux, 2019.
- *Data-driven control in the frequency-domain: From reference model selection to controller validation*
  Poster at the 2019 European Research Network on System Identification (ERNSI) Workshop in Maastricht.
- *A control application to matching theory: Sensitivity minimization*
  Poster at the 2018 European Research Network on System Identification (ERNSI) Workshop in Cambridge.

Software

Preparation of a Matlab toolbox for MOR-based control, bringing together my thesis contributions.

Grants

- *IPAM funding*, 2020: 1200 USD travel grant to attend the IPAM workshop "Intersections between Learning, Control and Optimization".
- *EDT mobility grant*, 2017: 1700 euros from Toulouse Federal University for my mobility at Politecnico di Milano during my PhD.

- *EDSYS mobility grant*, 2017: 1000 euros from the doctoral school for my mobility at Politecnico di Milano during my PhD.
- *Brafitec*, 2015: 1000 euros travel grant from the Brafitec program for my exchange at UNICAMP.
- *Explora Sup*, 2015: 3000 euros grant from the region Rhône-Alpes for my exchange at UNICAMP.

Reviewer activities

- **Journals:** Automatica, Transactions on Automatic Control, Control Systems Letters
- **Conferences:** IFAC World Congress (2020), European Control Conference (ECC, 2019, 2020, 2021), American Control Conference (ACC, 2021), Conference on Decision and Control (CDC, 2020, 2021), Learning for Dynamical systems and Control (L4DC, 2021), IFAC Symposium on System Identification (SYSid, 2021).

Organization of scientific events

- International Program Committee member for the 2nd IFAC Workshop on Control Methods for Water Resource Systems (CMWRS 2022).
- Member of the organization committee of the EDSYS congress in 2017 for the PhD students of the doctoral school.
- President of the organization committee of the "Journées Des Doctorants" 2017 for the ONERA PhD students

Others

- Scientific popularization with 9-10 years old children for the 9th Children Congress, organized by Cité de l'Espace and the federal university of Toulouse (2018).
- PhD representative for the doctoral school EDSYS from 2017 to 2019.
- Volunteer for the IFAC World Congress in Toulouse in 2017.

Publications

Invited book chapter (peer-reviewed)

- *Interpolation-based infinite dimensional model control design and stability analysis*
  C. Poussot-Vassal, **P. Kergus**, P. Vuillemin
  Accepted for a Springer Festschrift in honor of A. Antoulas (to appear)
  arXiv:2012.01040.

Journal papers (peer-reviewed)

- *Learning-based hierarchical control of water reservoir systems*
  P. Kergus, S. Formentin, M. Giuliani and A. Castelletti
  IFAC Journal of Systems and Control
  DOI: 10.1016/j.ifacsc.2022.100185
  ScienceDirect, arXiv:2012.13224
- *Interpolatory-based data-driven pulsed fluidic actuator control design and experimental validation*
  C. Poussot-Vassal, **P. Kergus**, F. Kerhervé, D. Sipp and L. Cordier
  Transactions on Control Systems Technology, 2021
  DOI: 10.1109/TCST.2021.3070056
  IEEE*Xplore*, arXiv:2012.01061
- *Data-driven control of infinite dimensional systems: Application to a continuous crystallizer*
  P. Kergus
  IEEE Control Systems Letters, 2020
  DOI: 10.1109/LCSYS.2020.3045827
  Accepted for presentation at the American Control Conference 2021
  IEEE*Xplore*, arXiv:2012.09069

- *From reference model selection to controller validation: Application to Loewner Data-Driven Control*
  P. Kergus, M. Olivi, C. Poussot-Vassal, and F. Demourant
  IEEE Control Systems Letters, vol. 3, no. 4, pp. 1008-1013, Oct. 2019
  DOI:10.1109/LCSYS.2019.2920208
  Accepted for presentation at the IEEE Conference on Decision and Control 2019, Nice, France
  IEEE*Xplore*, hal-02181447
- *Identification of parametric models in the frequency-domain through the subspace framework under LMI constraints*
  P. Kergus, F. Demourant and C. Poussot-Vassal
  International Journal of Control, 2018, 93:8, 1879-1890
  DOI: 10.1080/00207179.2018.1535717
  TaF*Online*, hal-02061484

Conference papers (peer-reviewed)

- *Loewner-based Data-driven Iterative Structured Control Design*
  B. Bouteau, **P. Kergus**, P.Vuillemin
  European Control Conference, 2021
  DOI:10.23919/ECC54610.2021.9655099
  IEEE*Xplore*, arXiv:1910.12632
- *Hybrid Loewner Data Driven Control*
  P. Vuillemin, **P. Kergus** and C. Poussot-Vassal
  IFAC World Congress, Berlin, 2020
  DOI: 10.1016/j.ifacol.2020.12.1574
  IFAC-PapersOnline, arXiv:1909.02231
- *Data-driven control design in the Loewner framework: Dealing with stability and noise*
  P. Kergus, S. Formentin, C. Poussot-Vassal and F. Demourant
  2018 European Control Conference (ECC), Limassol, 2018, pp. 1704-1709
  DOI: 10.23919/ECC.2018.8550216
  IEEE*Xplore*, hal-02099590
- *Identification of parametric models in the frequency-domain through the subspace framework under LMI constraints*
  P. Kergus, F. Demourant and C. Poussot-Vassal
  2018 European Control Conference (ECC), Limassol, 2018, pp. 2873-2878
  DOI: 10.23919/ECC.2018.8550180e
  IEEE*Xplore*
- *Frequency-domain data-driven control design in the Loewner framework*
  P. Kergus, C. Poussot-Vassal, F. Demourant and S. Formentin, IFAC World Congress 2017, Toulouse, IFAC-PapersOnLine, vol. 50, no 1, p. 2095-2100.
  DOI: 10.1016/j.ifacol.2017.08.531
  IFAC-PapersOnline, hal-01850582

In preparation

- *Fair heat distribution under deficits in district heating networks*
  F. Agner, **P. Kergus**, R. Pates and A. Rantzer.
  Submitted
  arXiv:2103.02300
- *Data-driven approximation and reduction from noisy data in matrix pencil frameworks*
  P. Kergus and IV. Gosea.
  Submitted
  arXiv:2202.09568

Skills

Languages French (native), English (fluent), Portuguese (fluent), Spanish (basics), Swedish (beginner).

Informatics Matlab, Simulink, Python, OpenCV, C/C++, Git, Latex

References

- Anders Rantzer, anders.rantzer@control.lth.se
- Martine Olivi, martine.olivi@inria.fr
- Simone Formentin, simone.formentin@polimi.it
- Charles Poussot-Vassal, charles.poussot-vassal@onera.fr