Pauline Kergus

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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.

Experience

2020– (ongoing) **Postdoctoral position**, *Automatic control department, LTH*, Lund, Sweden.
Postdoc position within the ERC project Scalable Control of Interconnected Systems with Prof. Anders Rantzer.
- Modelling of a district heating network and identifying the control problems through which it would be possible to explore the flexibility of the network and provide services to the power grid.
- Teaching: PhD class on control systems synthesis with Karl-Johan Åström (taught in September-October 2020).
- 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 collobaration with E.ON
- Industrial collaborations: E.ON, Noda, Modelon, Energy Opticon

2019– (ongoing) **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: looking for an ideal behaviour to be tracked 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 the method proposed during the master thesis. in particular by exploiting the properties of the used identification techniques, studying data-driven stability and building 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.
- Participation to summer schools: control of saturated systems (Toulouse, 2016), data-driven system identification (Nancy, 2017), optimal control (Toulouse, 2018).
- Supervision with Pierre Vuillemin of Basile Bouteau for the master thesis: *Optimization-based closed-loop stability enforcement for direct data-driven control*.
- Qualification in CNU Section 61 (computer engineering, automatic control and signal processing): requirement to take many of the assistant professor competitions in France.

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

Practical sessions of linear control, assembler language and computer architecture for bachelor students. Sessions of non-linear control, estimation and Kalman filtering for master students.

2016 **Master thesis**, *ONERA*, Toulouse,France.

6-months internship.
Development of a direct data-driven control method using frequency-domain data to identify a controller through the Loewner framework or the subspace approach.

2014 **Research internship**, *CEA*, Saclay, France.

6-months internship.
Development of an algorithm to detect and classify welds' defects on the basis of TOFD images (ultrasonic technique of non-destructive control).

2013–2014 **Research project**, *Ecole Centrale de Lyon (ECL)*.

Student project in the laboratory Ampère concerning non-linear systems and contactless energy transmission: design of a controller for an artificial heart, analytic method of validation and experimental validation.

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*	TP	ENSEEIHT	2016-2017	21 hours
and assembler language)		1st-year students	2017-2018	21 hours
			2017-2018	19 hours
Control project in simulink	BE	ENSEEIHT	2016-2017	4 hours
(within *Linear control*)		1st-year students	2017-2018	4 hours
Phase plane method	BE	ENSEEIHT	2017-2018	4 hours
(within *Non-linear systems*)		work-study program		
Estimation and filtering	CM	ENSEEIHT	2018-2019	2 hours
	BE	3rd-year students		14 hours
Control Systems Synthesis	lectures	Lund University	2020-2021	18 hours
	exercises	PhD students		4 hours
	projects			2 hours

TP = laboratory sessions BE = project sessions CM = lectures

Supervising activities

2020 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)

2020 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 collobaration with E.ON

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*
  Talk to be given at the 2020 European Congress of Mathematics (postponed to 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

- *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.

Organization of scientific events

- 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)

- *Interpolatory-based data-driven pulsed fluidic actuator control design and experimental validation*
  C. Poussot-Vassal, **P. Kergus**, F. Kerhervé, D. Sipp and L. Cordier
  Accepted on 04/01/2021 (pending minor revisions) in *Transactions on Control Systems Technology*
  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
  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)

- *Hybrid Loewner Data Driven Control*
  P. Vuillemin, **P. Kergus** and C. Poussot-Vassal
  IFAC World Congress, Berlin, 2020
  Proceedings are not published yet
  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

- *Loewner-based Data-driven Iterative Structured Control Design*
  B. Bouteau, **P. Kergus**, P.Vuillemin
  Submitted to 2021 *European Control Conference*
  arXiv:1910.12632
- *Real-time control of water reservoir operations : a learning-based hierarchical approach*
  P. Kergus, S. Formentin, M. Giuliani and A. Castelletti
  To be submitted
  arXiv:2012.13224
- *Exploring district heating networks flexibility through efficient building control*
  F. Agner, P. Kergus, R. Pates and A. Rantzer.
  In preparation

Skills

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

Hobbies

Yoga, self-defence, sewing.