Pierre-Jean Meyer

Current position: Research Fellow at the ESTAS lab of Université Gustave Eiffel, Lille, France

Personal information

Date of birth: 1988-06-30
Nationality: French

Contact information
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Education

2012-2015	**PhD thesis in Automatic Control**, Université Grenoble Alpes, France *Supervisors*: Antoine Girard (LJK), Emmanuel Witrant (GIPSA-lab) *Title*: Invariance and symbolic control of cooperative systems for temperature regulation in intelligent buildings
2010 (1 semester)	**Chalmers University of Technology**, Göteborg, Sweden Humanoid robotics, Introduction to discrete event systems, Simulation of production systems, Programming paradigms.
2008-2011	**Engineering school: ENSEEIHT**, INP Toulouse, France Master degree in Electrical Engineering and Automation (2011), rank 2/76
2006-2008	Two-year intensive course in Mathematics, Physics and Engineering Sciences to prepare competitive entrance to engineering schools. Saint-Etienne, France.

Professional experience

since 2021	**Research Fellow**, ESTAS, Université Gustave Eiffel, Lille, France *Topic* : Safety evaluation and control for autonomous vehicles
2017-2020	**Postdoc**, University of California, Berkeley, USA *Supervisor* : Murat Arcak *Title* : Reachability analysis for abstraction-based control synthesis
2015-2017	**Postdoc**, KTH Royal Institute of Technology, Stockholm, Sweden *Supervisor* : Dimos Dimarogonas *Title* : Formal methods for collaborative control of multi-robot systems
2017	**Guest lecturer**, Hybrid and Embedded Control Systems, KTH, Stockholm, Sweden One lecture on bisimulation and verification of hybrid systems, Master level
2012-2015	**PhD thesis in Automatic control**, Université Grenoble Alpes, France *Supervisors*: Antoine Girard (LJK), Emmanuel Witrant (GIPSA-lab) *Title*: Invariance and symbolic control of cooperative systems for temperature regulation in intelligent buildings
2013-2015	**Teaching assistant**, Université Grenoble Alpes, France Labs and exercise sessions in automatic control, French and English, ∼130 hours

2014 (2 weeks)	**Visiting scholar**, Automatic Control Department, KTH, Stockholm In the team of Karl Henrik Johansson. Exchanges on experimental smart building testbeds and discussions for the application of the methods of my PhD to collision avoidance in multi-vehicle systems.
2011 (6 months)	**Master thesis**, LAAS-CNRS, Toulouse, France *Supervisors*: Yannick Pencolé, Elodie Chanthery (team DISCO) *Title*: Anytime diagnosis on discrete event systems

Academic activities (since 2012)

Research interests

- Hybrid control, symbolic control, formal methods
- Abstraction-based synthesis: compositional abstraction, abstraction refinement, specification revision
- Reachability analysis, monotone systems, mixed monotonicity
- Safety verification of neural networks and artificial intelligence
- Applications: thermal control in buildings, multi-agent systems, medical robotics, ship control, autonomous vehicles

Project participation

Name	**Chaire "Sécurité des systèmes ferroviaires"**
Dates	2022-2027
Funding	CERTIFER Association, GAPAVE
Coordinator	Paola Pellegrini (Université Gustave Eiffel, France)
Size	National (6 normalization and industrial partners)
Personal role	Leader of one work package, scientific contributor

Name	**PRISSMA (Plateforme de Recherche et d'Investissement pour la Sûreté et la Sécurité de la Mobilité Autonome)**
Dates	2021-2024
Funding	Grand Défi du Conseil de l'Innovation
Coordinators	Université Gustave Eiffel, UTAC CERAM (France)
Size	National (6 academic partners, 15 industrial partners)
Personal role	Leader of one task, scientific contributor

Name	**Autonomous Docking for Marine Vessels**
Dates	2019-2021
Funding	Peder Sather Center for Advanced Study
Coordinator	Murat Arcak (UC Berkeley, USA) and Asgeir Sørensen (NTNU, Trondheim, Norway)
Size	International (2 academic partners)
Personal role	Main scientific contributor

Name	**Scalable Symbolic Control**
Dates	2019-2021
Funding	National Science Foundation
Coordinator	Murat Arcak, University of California, Berkeley, USA
Size	Local (group of Murat Arcak)
Personal role	Writing of the proposal

Name	**SpaceBots (Collaborative Robots for Microgravity Environments)**
Dates	submitted in April 2017
Funding	European Union's Horizon 2020 Research and Innovation Programme
Coordinator	Rodrigo Ventura, IST-ID, Lisbon, Portugal
Size	European (3 academic partners, 1 industrial partner and the French Center for Space Studies (CNES))
Personal role	Co-PI, writing of the proposal

Name	**EnviroLens (In-situ Observation System for Smart Environmental Monitoring and Improved Prediction utilising Advanced Pervasive Sensing, Data Analytics and Modeling)**
Dates	submitted in March 2017
Funding	European Union's Horizon 2020 Research and Innovation Programme
Coordinator	George Athanasiou, ICCS-NTUA, Athens, Greece
Size	European (7 academic partners, 6 industrial partners and 3 local administrations)
Personal role	Co-PI, writing of the proposal

Name	**Co4Robots (Achieving Complex Collaborative Missions via Decentralized Control and Coordination of Interacting Robots)**
Dates	2017-2020
Funding	European Union's Horizon 2020 Research and Innovation Programme
Coordinator	Dimos Dimarogonas, KTH, Stockholm, Sweden
Size	European (4 academic partners and 2 industrial partners)
Personal role	Co-PI, writing of the proposal in the coordinator's team

Name	**COIN (Co-adaptive human-robot interactive systems)**
Dates	2016-2021
Funding	SSF (Swedish Foundation for Strategic Research) Smart Systems
Coordinator	Dimos Dimarogonas, KTH, Stockholm, Sweden
Size	National (4 departments in 2 Swedish universities)
Personal role	Co-management of the project in the coordinator's team

Name	**BUCOPHSYS (Bottom-up hybrid control and planning synthesis with application to multi-robot multi-human coordination)**
Dates	2015-2020
Funding	European Union's Horizon 2020 ERC Starting Grant
Coordinator	Dimos Dimarogonas, KTH, Stockholm, Sweden
Size	Local (group of Dimos Dimarogonas)
Personal role	Scientific contributor

Name	**AEROWORKS (Collaborative Aerial Robotic Workers)**
Dates	2015-2017
Funding	European Union's Horizon 2020 Research and Innovation Programme
Coordinator	George Nikolakopoulos, LTU, Luleå, Sweden
Size	European (6 academic partners and 4 industrial partners)
Personal role	Co-PI, full project management for the partner KTH in Stockholm

Name	**CoHyBa (Hybrid Control for Green Buildings)**
Dates	2012-2015
Funding	CIBLE, Région Rhône-Alpes, France
Coordinator	Antoine Girard, Laboratoire Jean Kuntzmann, Grenoble, France
Size	Local (4 persons)
Personal role	Co-PI, writing of reports, main scientific contributor

Supervision

PhD thesis

- Fateh Boudardara, Université Gustave Eiffel, Lille, France, since 2021 (main supervisors: Mohamed Ghazel, Abderraouf Boussif)
- He Yin, University of California, Berkeley, USA, 2019-2020 (main supervisors: Andrew Packard, Murat Arcak)
- Alex Devonport, University of California, Berkeley, USA, 2018-2020 (main supervisor: Murat Arcak)
- Octavio Narváez-Aroche, *Robust Control of the Sit-To-Stand Movement for Powered Lower Limb Orthoses*, University of California, Berkeley, USA, 2017-2019 (main supervisors: Andrew Packard, Murat Arcak)
- Sofie Ahlberg, KTH, Stockholm, Sweden, 2016-2017 (main supervisor: Dimos Dimarogonas)

Master thesis

- Abdelrahman Ibrahim, *Bridging discrete and continuous neural network models*, Université Gustave Eiffel, Lille, France, 2023
- Matthias Hirche, *Tuning iterative learning control parameters with reinforcement learning for human-machine shared control*, University of California, Berkeley, USA, 2018
- Paul Rousse, *Multi-agent control with LTL specifications and abstraction with input memories*, KTH, Stockholm, Sweden, 2016
- Hosein Nazarpour, *Modeling, identification and control of an experimental platform for energy management in intelligent buildings*, LJK, Université Grenoble Alpes, France, 2014

Bachelor student

- Neelay Junnarkar, *Further development and improvement of the Matlab toolbox TIRA: Toolbox for Interval Reachability Analysis*, University of California, Berkeley, USA, 2020-2021

Student group project

- *Robust MIMO control for temperature regulation in a building*, M2 MiSCIT, Université Grenoble Alpes, France, 2014
- *Control through a wireless network for temperature regulation*, M2 MiSCIT, Université Grenoble Alpes, France, 2014
- *Efficient implementation for symbolic abstraction and the synthesis of a symbolic controller*, L3 IMA, Université Grenoble Alpes, France, 2014

Teaching

Guest lecturer **KTH, Stockholm, Sweden**

- *Hybrid and Embedded Control Systems* (EL2450), Electrical Engineering School, 2017

Teaching assistant **Université Grenoble Alpes, France**

- *Continuous control systems*, L3 GE, 2015
- *SISO Feedback control*, M1 EEATS, 2014-2015
- *State-space representation*, M1,EEATS, 2013-2014
- *Modeling and identification for control*, M2 MiSCIT, 2013
- *Introduction to applied mathematics*, L1 DLST, 2013

Administration

2013-2015 **Elected representative of PhD students** in the council of the Laboratoire Jean Kuntzmann (LJK), Université Grenoble Alpes, France

Scientific animation

2015-2017 Organization of a reading group on *Hybrid Systems and Formal Methods*, Automatic Control Department, KTH, Stockholm

2014 Organization and animation of a day to welcome new PhD students and provide information to Master students interested in doing a PhD, Université Grenoble Alpes, France

2013 Animation at the French *Fête de la science* (one week national science fair for scientific popularization), Grenoble, France

Reviewing

Journals. Nonlinear Analysis: Hybrid Systems (NAHS), IEEE Transactions on Automation Science and Engineering (T-ASE), IEEE Transactions on Automatic Control (TAC), Systems & Control Letters (SCL), Automatica, IEEE Control Systems Letters (L-CSS), IEEE Transactions on Neural Networks and Learning Systems (TNNLS).

Conferences. IEEE Multi-conference on Systems and Control (MSC), American Control Conference (ACC), International Conference on Hybrid Systems: Computation and Control (HSCC), IEEE Conference on Decision and Control (CDC), European Control Conference (ECC), IFAC Workshop on Distributed Estimation and Control in Networked Systems (NecSys).

Invited seminar talks

June 2023	*Mixed-monotonicity reachability analysis of uncertain neural networks* Invited speaker and panelist in the workshop *Formal methods for data-driven control systems* at the 21^{st} European Control Conference, Bucharest, Romania
Sept. 2022	*Interval Reachability Analysis and its applications* Department of Marine Technology, NTNU, Trondheim, Norway
April 2022	*Reachability analysis of neural networks using mixed monotonicity* Group of Murat Arcak, University of California, Berkeley, USA
June 2021	*Interval reachability analysis* International Online Seminar on Interval Methods in Control Engineering
Dec. 2020	*Sampled-data reachability analysis using sensitivity and mixed-monotonicity* Invited talk in the Tutorial session *Monotone Systems Theory for Reachability and Safety* at the 59^{th} Conference on Decision and Control (Virtual), Jeju Island, South Korea
March 2020	*Reachability analysis and decompositions for abstraction-based control synthesis* Inria Saclay, France
Sept. 2019	*Reachability analysis and decompositions for abstraction-based control synthesis* Verimag, Grenoble, France
May 2019	*Hierarchical decomposition of LTL synthesis problem for nonlinear control systems* Joint seminar of French working groups on Verification and Synthesis of Cyber-Physical Systems (VS-CPS in GdR MACS) and Control Architecture for Robotics (GT4 of GdR ROB), Paris, France
April 2018	*Sampled-data reachability analysis using sensitivity and mixed-monotonicity* CITRIS/CPAR Control Theory and Automation Symposium, University of California, Santa Cruz, USA
March 2018	*Abstraction-based synthesis: some recent results* Joint seminar "Semiautonomous" in the groups of Claire Tomlin and Shankar Sastry, University of California, Berkeley, USA
Nov. 2017	*Abstraction-based synthesis* LAAS-CNRS, Toulouse, France

October 2017	*Abstraction-based synthesis* CRAN, Université de Lorraine, Nancy, France
April 2017	*Abstraction-based synthesis* GIPSA-lab, Université Grenoble Alpes, France
Sept. 2015	*Invariance and symbolic control of cooperative systems for temperature regulation in intelligent buildings* Automatic Control Department, KTH, Stockholm, Sweden
June 2015	*Safety control with performance guarantees of cooperative systems using compositional abstractions* Joint seminar of French working groups on Hybrid Dynamical Systems (SDH) and Non-linear Model Predictive Control (CPNL), Paris, France
June 2014	*Invariance and symbolic control on monotone systems, application to intelligent buildings* GIPSA-lab, Université Grenoble Alpes, France
May 2014	*Invariance and symbolic control on monotone systems, application to intelligent buildings* Laboratoire Jean Kuntzmann, Université Grenoble Alpes, France
March 2014	*Invariance and symbolic control on monotone systems, application to intelligent buildings* Joint seminar of French working groups on Hybrid Dynamical Systems (SDH) and Robustness Analysis and Synthesis (MOSAR), Nancy, France
January 2014	*Invariance and symbolic control on monotone systems, application to intelligent buildings* Automatic Control Department, KTH, Stockholm, Sweden

Publications

Google Scholar page

Books

(B1) P.-J. Meyer, A. Devonport and M. Arcak, **Interval Reachability Analysis: Bounding trajectories of uncertain systems with boxes for control and verification**. *Springer Briefs in Control, Automation and Robotics*, 2021.

Journal paper

(J9) F. Boudardara, A. Boussif, P.-J. Meyer and M. Ghazel, **INNAbstract: an INN-based abstraction method for large-scale neural network verification**. Submitted to *IEEE Transactions on Neural Networks and Learning Systems*, 2022

(J8) F. Boudardara, A. Boussif, P.-J. Meyer and M. Ghazel, **A review of abstraction methods towards verifying neural networks**. Submitted to *ACM Transactions on Embedded Computing Systems*, 2022

(J7) P.-J. Meyer, **Reachability analysis of neural networks using mixed monotonicity**. *IEEE Control Systems Letters*, v. 6, pp. 3068-3073, 2022. Work also presented at 61^{st} *IEEE Conference on Decision and Control*, Cancun, Mexico, 2022.

(J6) O. Narvaez Aroche, P.-J. Meyer, S. Tu, A. Packard and M. Arcak, **Robust Control of the Sit-to-Stand Movement for a Powered Lower Limb Orthosis**. *IEEE Transactions on Control Systems Technology*, v. 28, n. 6, pp. 2390-2403, 2019.

(J5) P.-J. Meyer and D. V. Dimarogonas, **Hierarchical decomposition of LTL synthesis problem for nonlinear control systems**. *IEEE Transactions on Automatic Control*, v. 64, n. 11, pp. 4676-4683, 2019.

(J4) P.-J. Meyer, S. Coogan and M. Arcak, **Sampled-data reachability analysis using sensitivity and mixed-monotonicity**. *IEEE Control Systems Letters*, v. 2, n. 4, pp. 761-766, 2018. Work also presented at 57^{th} *IEEE Conference on Decision and Control*, Miami, USA, 2018.

(J3) P.-J. Meyer, A. Girard and E. Witrant, **Compositional abstraction and safety synthesis using overlapping symbolic models**. *IEEE Transactions on Automatic Control*, v. 63, n. 6, pp. 1835-1841, 2018.

(J2) P.-J. Meyer and D. V. Dimarogonas, **Compositional abstraction refinement for control synthesis**. *Nonlinear Analysis: Hybrid Systems*, v. 27, pp. 437-451, 2018.

(J1) P.-J. Meyer, A. Girard and E. Witrant, **Robust controlled invariance for monotone systems: application to ventilation regulation in buildings**. *Automatica*, v. 70, pp. 14-20, 2016.

International conference

(C16) F. Boudardara, A. Boussif, P.-J. Meyer and M. Ghazel, **Monitoring of Neural Network Classifiers using Neuron Activation Paths**. Submitted to the 26^{th} *European Conference on Artificial Intelligence*, Krakow, Poland, 2023

(C15) P.-J. Meyer, **Reachability Analysis of Neural Networks with Uncertain Parameters**. 22^{nd} *IFAC World Congress*, Yokohama, Japan, 2023.

(C14) F. Boudardara, A. Boussif, P.-J. Meyer and M. Ghazel, **Interval weight-based abstraction for neural network verification**. 5^{th} *International Workshop on Artificial Intelligence Safety Engineering*, Munich, Germany, pp. 330-342, 2022.

(C13) P. Tajvar, P.-J. Meyer and J. Tumova, **Closed-loop incremental stability for efficient symbolic control of non-linear systems**. 7^{th} *IFAC Conference on Analysis and Design of Hybrid Systems*, Brussel, Belgium, v. 54, n. 5, pp. 121-126, 2021.

(C12) P.-J. Meyer, H. Yin, A. H. Brodtkorb, M. Arcak and A. J. Sørensen, **Continuous and discrete abstractions for planning, applied to ship docking**. 21^{st} *IFAC World Congress (Virtual)*, Berlin, Germany, pp. 1857-1862, 2020.

(C11) P.-J. Meyer and M. Arcak, **Interval Reachability Analysis using Second-Order Sensitivity**. 21^{st} *IFAC World Congress (Virtual)*, Berlin, Germany, pp. 1851-1856, 2020.

(C10) P.-J. Meyer, A. Devonport and M. Arcak, **TIRA: Toolbox for Interval Reachability Analysis**. 22^{nd} *ACM International Conference on Hybrid Systems: Computation and Control*, Montreal, Canada, pp. 224-229, 2019.

(C9) O. Narvaez Aroche, P.-J. Meyer, M. Arcak and A. Packard, **Reachability Analysis for Robustness Evaluation of the Sit-to-Stand Movement for Powered Lower Limb Orthoses**. *ASME Dynamic Systems and Control Conference*, Atlanta, USA, 2018.

(C8) P.-J. Meyer and D. V. Dimarogonas, **Abstraction refinement and plan revision for control synthesis under high level specifications**. 20^{th} *IFAC World Congress*, Toulouse, France, pp. 9664-9669, 2017.

(C7) P. Rousse, P.-J. Meyer and D. V. Dimarogonas, **Using progress sets on non-deterministic transition systems for multiple UAV motion planning**. 20^{th} *IFAC World Congress*, Toulouse, France, pp. 16547-16552, 2017.

(C6) P.-J. Meyer and D. V. Dimarogonas, **Compositional abstraction refinement for control synthesis under lasso-shaped specifications**. *American Control Conference*, Seattle, USA, pp. 523-528, 2017.

(C5) P.-J. Meyer, A. Girard and E. Witrant, **Safety control with performance guarantees of cooperative systems using compositional abstractions**. 5^{th} *IFAC Conference on Analysis and Design of Hybrid Systems*, Atlanta, USA, pp. 317-322, 2015.

(C4) P.-J. Meyer, A. Girard and E. Witrant, **Poster: Symbolic Control of Monotone Systems, Application to Ventilation Regulation in Buildings**. 18^{th} *ACM International Conference on Hybrid Systems: Computation and Control*, Seattle, USA, pp. 281-282, 2015.

(C3) P.-J. Meyer, H. Nazarpour, A. Girard and E. Witrant, **Experimental Implementation of UFAD Regulation based on Robust Controlled Invariance**. 13^{th} *European Control Conference*, Strasbourg, France, pp. 1468-1473, 2014.

(C2) P.-J. Meyer, A. Girard and E. Witrant, **Controllability and invariance of monotone systems for robust ventilation automation in buildings**. 52^{nd} *IEEE Conference on Decision and Control*, Florence, Italy, pp. 1289-1294, 2013.

(C1) P.-J. Meyer, H. Nazarpour, A. Girard and E. Witrant, **Poster abstract: Robust Controlled Invariance for UFAD Regulation**. 5^{th} *ACM Workshop on Embedded Systems For Energy-Efficient Buildings (BuildSys)*, Rome, Italy, pp. 1-2, 2013.

National conference

(CN2) F. Boudardara, A. Boussif, M. Ghazel, and P.-J. Meyer, **Deep Neural Networks Abstraction using An Interval Weights Based Approach**. *Confiance.ai Days 2022*, Saclay, France, 2022.

(CN1) P. Tajvar, P.-J. Meyer and J. Tumova, **Abstraction Refinement for Control Synthesis: A Discrete-Time Hybridization Approach**. *Swedish Control Conference (Reglermöte)*, Stockholm, Sweden, 2018.

Tool and software

(T2) P.-J. Meyer, **MMRANN: Mixed-Monotonicity Reachability Analysis of Neural Networks**. https://gitlab.com/pj_meyer/MMRANN

(T1) P.-J. Meyer, A. Devonport and M. Arcak, **TIRA: Toolbox for Interval Reachability Analysis**. https://gitlab.com/pj_meyer/TIRA