Timothée Schmoderer

PhD student in Mathematics

Laboratoire de Mathématiques de l'INSA
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Research interests

- Geometric control theory
- Lie algebra of symmetries
- Optimal control theory
- Feedback classification
- Differential geometry
- Motion planning

Academic background

2018

PhD in Mathematics, *Laboratoire de Mathématique de l'INSA Rouen*

- Thesis title: *Study of control systems under quadratic nonholonomic constraints. Motion planning, introduction to the regularised continuation method.*
- Advisors : Witold Respondek (Senior Lecturer, LMI INSA Rouen Normandie) et Emmanuel Trélat (Senior Lecturer, LJLL Sorbonne Université).
- Keywords: Nonlinear control systems, Feedback classification, Normal forms, Differential geometry, Motion planning, Continuation method.
- PhD defense June, 21st 2022.
- Jury composition:
  - Ugo Boscain, Research Director, CNRS (examiner)
  - Yacine Chitour Chabassier, Senior Lecturer, CentraleSupélec (reviewer)
  - Frédéric Jean, Senior Lecturer, ENSTA Paris (reviewer)
  - Jean-Baptiste Pomet, Research Director, INRIA Sophia Antipolis (examiner)
  - Hasnaa Zidani, Senior Lecturer, INSA Rouen Normandie (examiner)
- Funding: French ministry of research grant.

2015 – 2018

Engineer degree specialising in "Applied mathematics", *INSA de Rouen*

- Speciality : Mathematics modelling and numerical simulations.
- Functional analysis
- Numerical analysis
- Linear and nonlinear automatic
- Optimisation
- Operational research
- Probability & Data Analysis
- Algorithmic
- Programming & object based modeling

2017 – 2018

Master of Research in Mathematics and Applications, *Université de Rouen*

- Master thesis title: *Transport Optimal: Théorie et Applications*, supervised by Carole Le Guyader (Senior Lecturer INSA de Rouen) and Vincent Duval (Researcher INRIA - Mokaplan).
- HPC implementation of optimal transport algorithms .
- Markov chains and processes
- Sobolev spaces
- Geometric control
- Nonlinear PDEs

2016 – 2018

Master of Research in Mathematics and Applications, *Université Sorbonne Université*

- Speciality: "Mathematics of modelling".
- Galois Theory
- Group Theory
- Lie Algebras
- Differential Geometry
- Theory for PDEs
- Numerical methods
- Optimal transport
- Optimal control

Experiences

2018 – 2022

PhD, *Laboratory of Mathematics of INSA Rouen Normandie (FR)*

- Title: Study of control systems under quadratic nonholonomic constraints. Motion planning, introduction to the regularised continuation method.
- Advisors: Witold Respondek (Senior Lecturer, LMI INSA Rouen Normandie) et Emmanuel Trélat (Senior Lecturer, LJLL Sorbonne Université).
- Autonomy and scientific curiosity
- Development of a new theory for control systems
- Several scientific articles and talks in English
- Implementation of an algorithm for the motion planning problem

Summer 2019 – 2019

Research internship, *Department of Pure Mathematics and Mathematical Statistics, University of Cambridge, (UK)*

- Subject: Learning optical flow for fast MRI reconstruction.
- Advisors: A. I. Aviles-Rivero (Senior Research Associate, DAMTP University of Cambridge) and N. Debroux (Lecturer at Université Clermont Auvergne).
- Non-convex and non-smooth optimisation
- Parsimony
- Dictionary based learning
- MRI Reconstruction

Mar–Sep 2018 – 2018

Research internship, *Institut de Biologie de l'ENS (IBENS)*

- Subject: Modelling the transformation of snow into ice in a global warming context.
- Advisor: David Holcman (DR IBENS).

June–Sep 2017 – 2017

Research internship, *Mathematical Institute of Cologne, (GER)*

- Subject: Second Order Method for the Euler's Gas Equation on Non Regular Grid.
- Advisor: Gregor Gassner (Senior Lecturer).

Publications

Journal paper

Schmoderer, T., Aviles-Rivero, A. I., Corona, V., Debroux, N., Schönlieb, C.-B., (2021). "Learning Optical Flow for Fast MRI Reconstruction". *Inverse Problems* 37.9. DOI: 10.1088/1361-6420/ac164a.

Submitted papers

Schmoderer, T., Respondek, W., (2022). "Null-forms of conic systems in $\mathbb{R}^3$ are determined by their symmetries". *Submitted to: Systems & Control Letters*. URL: https://arxiv.org/abs/2205.12170.

Schmoderer, T., Respondek, W., (2021). "Conic nonholonomic constraints on surfaces and control systems". *Submitted to: Journal of Dynamical and Control Systems*. URL: https://arxiv.org/abs/2106.08635.

Papers in preparation

Schmoderer, T., Respondek, W., (2022). "Characterisation and classification of control systems with paraboloid nonholonomic constraints in any dimension". *En préparation.*

Schmoderer, T., Respondek, W., (2022). "Trivialisable control-affine systems revisited". *En préparation.*

Talks

Schmoderer, T. (2022). "Control systems with paraboloid nonholonomic constraints". *Workshop on "Optimal Control Theory" (Rouen).*

Schmoderer, T., Respondek, W., (2021). "Conic nonholonomic constraints on surfaces and control systems". *13e journée de la Fédération Normandie-Mathématiques (Rouen).*

Schmoderer, T., Trélat, E., (2021). "Motion Planning with a Regularized Continuation Method". *Conférence des Jeunes Chercheurs en Mathématiques Appliquées (École polytechnique).*

Schmoderer, T., Aviles-Rivero, A. I., Corona, V., Debroux, N., Schönlieb, C.-B., (2020). "Learning Optical Flow for Fast MRI Reconstruction". *SIAM Imaging Science 2020 - Mini-Symposium: The Power of Variational and Hybrid Multi-task Models for Image Analysis (en ligne).*

Schmoderer, T., Respondek, W., (2020). "Introduction to the equivalence and classification of quadratic submanifolds in $T\mathbb{R}^2$". *12e journée de la Fédération Normandie-Mathématiques (en ligne).*

Le Guyader, C., Rouxelin, N., **Schmoderer, T.**, Quesnel, E., Bousquet-Melou, P., Debroux, N., (2018). "A second order free discontinuity model for bituminous surfacing crack recovery, analysis of a nonlocal version of it and MPI implementation". *SIAM Conference on Imaging Science (Bologna).*

Teaching

Teaching assignment and Temporary teaching assistant at INSA de Rouen Normandie (271h)

2019–2021 **Sequences and real functions analysis** (215h - TD) *1st year INSA*

- Introduction to logic
- Sets theory
- Sequences
- Real functions analysis

2021–2022 **Numerical analysis** (14h - CM + 42h - TD) *3rd year INSA*

- Linear algebra
- Direct and iterative methods for linear equations
- Methods for nonlinear equations
- Python practical exercices

Temporary teaching at Polytech Sorbonne (64h)

2018–2019 **Computer Science** (64h) *2nd year course Electronics - Computer Science course Embedded Systems course*

Responsabilities

Member HCERES comity	Evaluation of research policy of two engineer schools
Elected member at PhD school council	Grant attribution decisions, PhD student well-being policy
Elected member at the Laboratory council	Representation of the PhD students for the laboratory

Skills

Languages

French	Native language	
English	Spoken, Written, Reading (*TOEIC 935/990*)	Multiple scientific articles written in English, multiple conferences in English
German	B2 Level (Common European Framework of References for Languages)	Several immersion stays, a scientific internship in Germany

Technical skills

Informatics	C/C++, Matlab, Fortran, Python, Git	Several school-project using those tools
OS	Linux (Debian, Fedora)	

Soft skills

Autonomy and Commitment	PhD thesis work during 4 years
Scientific curiosity	Several master in mathematics to discover new topics
Team work	Multiple associative experiences as a volunteer with different level of responsibilities (treasurer, president, child supervisions)