Timothée Schmoderer

Doctorate 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 – 2022

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

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

2015 – 2018

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

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

2017 – 2018

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

- Master thesis title: *Transport Optimal: Théorie et Applications*, supervised by Carole Le Guyader (Professor at INSA 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, *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 (Professor, LMI INSA Rouen Normandie) et Emmanuel Trélat (Professor, 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 (Assistant professor at Université Clermont Auvergne).
- Non-convex and non-smooth optimisation
- Parsimony
- Dictionary based learning
- MRI Reconstruction

Mar–Sep 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

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

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

Publications

Journal papers

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". *In preparation.*

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

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., Debroux, N., Bousquet-Melou, P., Quesnel, E., Rouxelin, N., **Schmoderer, T.**, Gout, C., Antoine, R., Fauchard, C., Jouin, D., (2018). "A second order nonlocal variational model for crack detection on bituminous surfacing". *Curves and surfaces 2018 (Arcachon).*

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 committee	Member of evaluation committee for two engineering schools. Reviewer specialised on research and students policies.
Elected member at PhD school council	Grant attribution decisions, PhD students well-being policies.
Elected member at the Laboratory council	Representation of the PhD students for the Laboratory of Mathematics of INSA Rouen.

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-projects using those tools
OS	Linux (Debian, Fedora)	

Soft skills

Autonomy, Commitment, Creativity, Rigour	PhD thesis work during 4 years. Get state of the art knowledge in geometric control theory. Look for solutions for the problems of the thesis project and try to make those ideas work. Submit solutions to the judgement of the scientific community.
Scientific curiosity	Three different master degrees in mathematics to discover and learn new topics.
Written and oral communication	Multiple scientific communications in international journals and at international conferences.
Project management and task planning	Tasks organisations during PhD thesis, order ideas to get new results. Organise the research of the thesis between the two projects lead by the two advisors.
Team work	Multiple associative experiences as a volunteer with different level of responsibilities (treasurer and president of student association, child supervisions for scouts troups)