✉ melvyn.tyloo@gmail.com
Swiss
OrcID: 0000-0003-1761-4095
ResearcherID: T-7054-2017
Google Scholar ID: Melvyn Tyloo
website: melvyntyloo.com

Melvyn Tyloo

My research focuses on complex network-coupled dynamical systems. Such systems are usually defined as individual agents with their own internal dynamics, coupled together through a complex network. Depending of the coupling characteristics, collective behaviors (e.g synchronization, consensus) might exist, with different properties. Some questions I investigated until now are (i) what are the vulnerabilities or how robust are such collective states against external perturbations (e.g in the coupling network or in the internal parameters); (ii) how does the system response to perturbations relates to the coupling network and the dynamical parameters; (iii) can we recover the coupling network from time series of the agents' degrees of freedom; (iv) can we detect and identify a faulty or attacked element in a large networked system. These coupled dynamical systems commonly have nonlinear coupling functions, leading to multi-stability. Therefore, within noisy conditions or due to external perturbations, the system can undergo transition between different basins of attraction. I recently work on trying to predict such transitions using learning methods such as reservoir computing.

Education

Oct.2016–Feb.2020 **PhD in Physics**, *Swiss Federal Institute of Technology in Lausanne - EPFL*.
Local Vulnerabilities and Global Robustness of Coupled Dynamical Systems on Complex Networks.
[https://infoscience.epfl.ch/record/274264]
Supervisors: Profs. Philippe Jacquod and Frédéric Mila.
Private defense: December 16, 2019.
Public defense: February 6, 2020.
Experts: Profs. Mauricio Barahona, Enrique Mallada, Paolo De Los Rios.
President: Prof. Henrik Rønnow

Sep.2014–Jul.2016 **Master of Science in Physics**, *Swiss Federal Institute of Technology in Lausanne - EPFL*.
Specialisation in theoretical physics (RQFT, Relativity and Cosmology, Statistical, Solid-state physics, Doctoral quantum class, Information Theory). Completed 96/90 ETCS.
Thesis at the Chair of Condensed Matter Theory: *Quantum Monte Carlo simulation of $SU(N)$ antiferromagnetic Heisenberg chain in the fully symmetric/antisymmetric representations*.
Supervisor: Prof. Frédéric Mila

Sep.2011–Jul.2014 **Bachelor of Science in Physics**, *Swiss Federal Institute of Technology in Lausanne - EPFL*.
Emphasis on theoretical courses (Statistical, Solid-state, Quantum, Computational, Plasma physics).

Employement History

Feb.2022–present **Director's Postdoc Fellow**, *Theoretical Division, T-4/T-5, Los Alamos National Laboratory (LANL)*.
Advisors: Dr. Marc Vuffray and Dr. Andrey Lokhov.

Apr.2021–Oct.2021 **Postdoctoral researcher**, *University of Geneva (UNIGE), Department of Quantum Matter Physics (DQMP)*.

Feb.2020–Mar.2021 **Postdoctoral researcher**, *University of Applied Sciences of Western Switzerland, HES-SO Valais/Wallis*.
Advisor: Prof. Philippe Jacquod.

Jul.-Aug.2019 **Invited researcher**, *Center for Nonlinear Studies, Los Alamos National Laboratory - LANL.* Advisors: Dr. Andrey Lokhov and Dr. Marc Vuffray.

Teaching activities

2020-2022 PhD student supervision, Julian Fritzsch, *Interarea oscillations in coupled oscillator networks and power grids*.

2016-2021 Substitute lecturer for the course of general physics at the University of Applied Sciences of Western Switzerland, HES-SO Valais/Wallis.

2011-2016 Tutoring for physics, maths, chemistry, probability and programming given to bachelor, master and doctoral students at EPFL and UNIL.

Prizes, awards, fellowships

Mar.2022 Los Alamos National Laboratory Director's Postdoc Fellowship.

Feb.2020 PhD thesis nominated for the Asea Brown Boveri Ltd. (ABB) Award and the EPFL Doctorate Award.

Oct.2018 Best presentation Award at the International School on Informatics and Dynamics in Complex Networks, University of Catania, Italy.

Grants

2022

- **LDRD/ER Seedlings**, *Co-PI, Los Alamos National Laboratory (LANL).*
- **LDRD/PRD**, *Director's Postdoc Fellow, Los Alamos National Laboratory (LANL) + additional M&S funding.*

Personal skills

Languages French (native), English (fluent), German (intermediate).

Programming C++, Matlab, Julia.

Research interests

Complex networks, dynamical systems, inference, reservoir computing.

Reviewer

SIADS (SIAM Applied Dynamical Systems); Physica A (Elsevier); EPL (Europhysics Letters); IEEE TNSE (Transactions on Network Science and Engineering); Chaos, Solitons and Fractals; Patterns; IEEE TPS (Transactions on Power Systems); Nature Communications Physics.

Publications in peer-reviewed scientific journals

All publications can be found on my personal website (`melvyntyloo.com`).

- **M. Tyloo**, R. Delabays, P. Jacquod, *Reconstructing network structures from partial measurements*, *Chaos* **31**, 103117 (2021). `[Link]`.

- L. Pagnier, R. Delabays, **M. Tyloo**, *Locating line and node disturbances in networks of diffusively coupled dynamical agents*, *New J. Phys.* **23**, 043037 (2021). [Link].
- **M. Tyloo**, R. Delabays, *System Size Identification from Sinusoidal Probing in Diffusive Complex Networks* , *J. Phys. Complex.* **2**, 025016 (2021). [Link].
- F. Baumann, I.M. Sokolov, **M. Tyloo**, *Periodic Coupling inhibits Second-order Consensus on Networks* , *Phys. Rev. E* **102**, 052313 (2020). [Link]
- F. Baumann, I. M. Sokolov, **M. Tyloo**, *A Laplacian approach to stubborn agents and their role in opinion formation on influence networks*, *Phys. A* **557**, 124869 (2020). [Link]
- **M. Tyloo**, P. Jacquod, *Primary Control Effort in Realistic High-Voltage Power Networks*, *IEEE Control Systems Letters*, **5** (3), (2020). [Link]
- **M. Tyloo**, L. Pagnier, P. Jacquod, *The key player problem in complex oscillator networks and electric power grids: resistance centralities identify local vulnerabilities*, *Sci. Adv.* **5** (11), eaaw8359 (2019). [Link]
- R. Delabays, **M. Tyloo**, P. Jacquod, *Rate of change of frequency under line contingencies in high voltage electric power networks with uncertainties*, *Chaos* **29**, 103130 (2019). Focus Issue on the Dynamics of Modern Power Grids [Link]
- **M. Tyloo**, P. Jacquod, *Global robustness versus local vulnerabilities in complex synchronous networks*, *Phys. Rev. E* **100**, 032303 (2019). [Link]
- **M. Tyloo**, R. Delabays, P. Jacquod, *Noise-induced desynchronization and stochastic escape from equilibrium in complex networks*, *Phys. Rev. E* **99**, 062213 (2019). [[Link]
- **M. Tyloo**, T. Coletta, P. Jacquod, *Robustness of synchrony in complex networks and generalized Kirchhoff indices*, *Phys. Rev. Lett.* **120**, 084101 (2018). [[Link]
- R. Delabays, **M. Tyloo**, P. Jacquod, *The size of the sync basin revisited*, *Chaos* **27**, 103109 (2017). [Link]

Peer-reviewed conference proceedings

- P. Jacquod, **M. Tyloo**, *Propagation of non-Gaussian voltage angle fluctuations in high-voltage power grids*, *Paper accepted to Necsys'22, Zürich, Switzerland, July 5-7, 2022.*
- R. Delabays, L. Pagnier, **M. Tyloo**, *Locating high-frequency line disturbances with the frequency mismatch*, *arXiv:2202.08317* (2022), *Paper accepted to Necsys'22, Zürich, Switzerland, July 5-7, 2022.* [Link]
- J. Fritzsch, **M. Tyloo**, P. Jacquod, *Matrix Perturbation Theory of Inter-Area Oscillations*, *Paper accepted to the 60th IEEE Conference on Decision and Control (CDC)*, (2021). [Link]
- R. Delabays, **M. Tyloo**, *Network inference using sinusoidal probing*, IFAC-PapersOnLine **54** (9), 696-700, *24th International Symposium on Mathematical Theory of Networks and Systems MTNS 2020: Cambridge United Kingdom*, (2021). [Link]
- **M. Tyloo**, P. Jacquod, *Primary Control Effort in Realistic High-Voltage Power Networks*, *Proceedings of the 59th IEEE Conference on Decision and Control 2020*, (2020). [Link]

Organization of international conferences

2021

Oct. 27 Data-based Diagnosis of Networked Dynamical Systems, CCS2021 Satellite Symposium, Lyon, France. **Organisation**. [Site] [Link]

Guest Editor

2022

- Journal of Physics: Complexity – Focus on Monitoring and Control of Complex Supply Systems

Invited speaker to international conferences and seminars

Presentations can be found on my personal website (melvyntyloo.com).

2022

Apr. 11 BLABS Seminar, T-4, Los Alamos National Laboratory, Los Alamos NM, USA. **Invited Speaker**. *Fault detection and inference in networks of diffusively coupled dynamical agents*. [Link]

Mar. 16 CNLS Seminar, Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos NM, USA. **Invited Speaker**. *Local vulnerabilities and global robustness of equilibrium in network-coupled systems*. [Link]

2021

Oct. 4-8 PhysCon2021, The 10th International Scientific Conference on Physics and Control, Fudan University, Shanghai, China. **Invited Speaker**. *Fault detection and probing in high-voltage power networks*. [Link]

May 30-Jun.3 The 11th International Conference on Smart Grids, Green Communications and IT Energy-aware Technologies ENERGY 2021, Special Track on Modelling Dynamics of Power Grids (MoDyPoG). **Invited Speaker**. *Power grids: Small Signal Stability vs. Dynamical Parameters*. [Link]

2019

Oct.17 Institute of Physics, Humboldt University, Berlin. **Invited speaker for the seminar talk**. *Near Equilibrium Dynamics and Transitions in Complex Network-Coupled Systems*. [Link]

Sep.2-6 Dynamics Days Europe 2019, Rostock, Germany. **Invited speaker in the Power Grid minisymposium**. *The Key Player Problem in Realistic Large-Scale Power Grids*. [Link]

Aug.26-27 Whiting School of Engineering, Johns Hopkins University, Baltimore, MD, USA. **Invited speaker for the group seminar** (Profs. D. Gayme and E. Mallada). *Quantifying Vulnerabilities of Complex Oscillatory Networks*. [Link]

Jan.14 National Renewable Energy Laboratory (NREL), Golden CO, USA. **Invited speaker of the Brown Bag Talk**. *Quantifying Fragility of Network-Coupled Oscillators and Electric Power Grids with Resistance Distances*. [Link]

Visits in international research groups

2019

Sep.6-11 Statistical Physics and Nonlinear Dynamics & Stochastic Processes Group, Humboldt University, Berlin. **Visiting researcher** (Dr. F. Baumann, Prof. I.M. Sokolov).

Aug.26-27 Whiting School of Engineering, Johns Hopkins University, Baltimore, MD, USA. **Visiting researcher** (Profs. D. Gayme and E. Mallada).

Jul.-Aug. Los Alamos National Laboratory (LANL), Theory Division T-5, Los Alamos, NM, USA. **Invited researcher**.

Jan.16-18 Center for Control, Dynamical Systems and Computation, University of California, Santa Barbara (UCSB). **Visiting researcher** (Prof. F. Bullo).

Jan.14-15 National Renewable Energy Laboratory (NREL), Golden, CO, USA. **Visiting researcher** (Dr. M. Colombino).

Contributions to international conferences (oral presentations, posters, participation)

Posters and presentations can be found on my personal website (`melvyntyloo.com`).

2021

Aug.23-27 Dynamics Days Europe, Nice, France. Talk. *Reconstructing Network Structures from Partial Measurements*. [Link]

Jun.21-Jul.10 Networks 2021: A Joint Sunbelt and NetSci Conference. Talk. *Periodic coupling inhibits second-order consensus on networks*. [Link]

2020

Dec.14-18 59th IEEE Conference on Decision and Control, online conference. **Paper presentation**. *Primary Control Effort in Realistic High-Voltage Power Networks*.

Dec.7-11 Conference on Complex Systems 2020 (CCS2020), online conference. Talk. *The key player problem in complex oscillator networks*. [Video (->16:59)]

Dec.9-10 Complexity in Energy Systems satellite of Conference on Complex Systems 2020 (CCS2020), online conference. Talk. *The Key Player Problem in High-Voltage Power Networks*. [Video]

Aug.22-27 Digital Dynamics Days 2020 (DDD2020), online conference. Talk. *A Laplacian approach to stubborn agents and their role in opinion formation on influence networks*. [Video]

Feb.2-5 Geometry of Complex Webs International Minicourse and Exploratory Workshop (GeoCow), Les Diablerets. Poster. *Coupled Oscillators vs. Opinion Formation*. [Link]

2019

Dec.16 PhD Defense, EPFL Lausanne, Switzerland. Oral presentation. *Local Vulnerabilities and Global Robustness of Coupled Dynamical Systems on Complex Networks*. [Link]

Feb.3-8 Future Electric Power Systems and the Energy Transition, 2nd International conference in Champéry, Switzerland. Oral presentation. *Resistance Centralities Identify Local Vulnerabilities in Electric Power Grids*. [Link]

Jan.7-11 2019 Grid Science Winter School & Conference, Santa Fe NM, USA. Poster. *Robustness of Synchrony in Complex Networks, Generalized Kirchhoff Indices and Resistance Centralities*. [Link]

2018

Oct.15-19 International School on Informatics and Dynamics in Complex Networks, University of Catania, Italy. Oral presentation. *Robustness of Synchrony in Complex Networks and Generalized Kirchhoff Indices*. **Best Presentation Award**. [Link]

Sep.3-7 Dynamics Days Europe 2018, Loughborough, England.

Jan.29-31 661. WE-Heraeus-Seminar: Nonlinear Dynamics, Optimization and Control of Distributed Energy Systems, Physikzentrum Bad Honnef, Germany. Poster. *Robustness of Synchrony in Electrical Grids and Generalized Kirchhoff Indices*. [Link]

2017

Feb.5-9 Future Electric Power Systems and the Energy Transition, International conference in Champéry, Switzerland. Poster. *Numerical method to determine different power flow solutions*.

Submitted but not yet accepted/published publications

- **M. Tyloo**, *Layered Complex Networks as Fluctuation Amplifiers*, *arXiv:2204.10251* (2022). [Link]
- **M. Tyloo**, J. Hindes, P. Jacquod, *Finite-time Correlations Boost Large Voltage-Angle Fluctuations in Electric Power Grids*, *arXiv:2203.00590* (2022). [Link]
- R. Delabays, **M. Tyloo**, *Heavy-tailed distribution of the number of publications within scientific journals* , *arXiv:2011.05703* (2020). [Link]

Ongoing collaborations

- A. Lokhov, M. Vuffray, Center for Nonlinear Studies (CNLS), Los Alamos National Laboratory (LANL), NM, USA.
- F. Baumann, Humboldt-Universität zu Berlin, Max Planck Institute for Human Development, Berlin, Germany.
- L. Pagnier, Program in Applied Mathematics, University of Arizona, Tucson, USA.
- R. Delabays, Center for Control, Dynamical Systems and Computation, UC Santa Barbara, Santa Barbara, CA, USA.
- J. Hindes, US Naval Research Laboratory, Washington DC.

Seminar organizations

2021-2022 Bi-monthly seminar talks, University of Applied Science of Western Switzerland.

Other activities

Cycling → [Link]

Appearance in media → [Link] (bottom of the page)