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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

Education

- Oct.2016– **PhD in Physics**, *Swiss Federal Institute of Technology in Lausanne - EPFL*.
Feb.2020 *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– **Master of Science in Physics**, *Swiss Federal Institute of Technology in Lausanne - EPFL*.
Jul.2016 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– **Bachelor of Science in Physics**, *Swiss Federal Institute of Technology in Lausanne - EPFL*.
Jul.2014 *EPFL*.
Emphasis on theoretical courses (Statistical, Solid-state, Quantum, Computational, Plasma physics).

Employment History

- Feb.2022– **Director's Postdoc Fellow**, *Theoretical Division, T-4/T-5, Los Alamos National Laboratory (LANL)*.
present
Advisors: Dr. Marc Vuffray and Dr. Andrey Lokhov.
- Apr.2021– **Postdoctoral researcher**, *University of Geneva (UNIGE), Department of Quantum Matter*
Oct.2021 *Physics (DQMP)*.
- Feb.2020– **Postdoctoral researcher**, *University of Applied Sciences of Western Switzerland, HES-SO*
Mar.2021 *Valais/Wallis*.
Advisor: Prof. Philippe Jacquod.

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

Teaching activities

- 2020-2022 PhD student supervision, Julian Fritzsche, *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

- Aug.2022 Los Alamos National Laboratory SPOT Award.
- 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, graphical models.

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).

- R. Delabays, **M. Tyloo**, *Heavy-tailed distribution of the number of papers within scientific journals*, *Quantitative Science Studies* 1–17 (2022). [[Link](#)].

- **M. Tyloo**, *Layered complex networks as fluctuations amplifiers*, *J. Phys. Complex.* **3**, 03LT01 (2022). [Link].
- **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*, *IFAC-PapersOnLine* **55-13** (2022) 67-72, *Necsys 22, Zürich, Switzerland, July 5-7, 2022*. [Link]
- R. Delabays, L. Pagnier, **M. Tyloo**, *Locating fast-varying line disturbances with the frequency mismatch*, *IFAC-PapersOnLine* **55-13** (2022) 270-275, *Necsys 22, Zürich, Switzerland, July 5-7, 2022*. [Link]
- J. Fritzsche, **M. Tyloo**, P. Jacquod, *Matrix Perturbation Theory of Inter-Area Oscillations*, *2021 60th IEEE Conference on Decision and Control (CDC)*, 3507-3512. [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 (melvynityloo.com).

2022

- Aug. 18 CNLS Postdoc Seminar, Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos NM, USA. **Invited Speaker.** *More complexity for richer network dynamics.* [Link]
- 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 (melvynty100.com).

2022

- Jul.13-15 5th Workshop on Autonomous Energy Systems, NREL, Golden, CO, USA. Poster. *Primary control effort and noise propagation in high-voltage power grids*. [[Link](#)]
- Dec.5-7 Necsys 22, Zürich, Switzerland. **Paper presentation**. *Propagation of non-Gaussian voltage angle fluctuations in high-voltage power grids*. [[Link](#)]
- Dec.5-7 Necsys 22, Zürich, Switzerland. **Paper presentation**. *Locating high-frequency line disturbances with the frequency mismatch*. [[Link](#)]

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**, J. Hindes, P. Jacquod, *Finite-time Correlations Boost Large Voltage-Angle Fluctuations in Electric Power Grids*, *arXiv:2203.00590* (2022). [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

Judge representing T-4, for LANL Summer students lightning talks 2022.

Cycling → [Link]

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