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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 worked on correlated noise that might be more efficient in driving the system out of synchrony. Another ongoing project is about the reconstruction of graphical models from finite samples.

## 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  
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 Lkhov.
- 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 Valais/Wallis*.  
Mar.2021  
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

Scientific Reports; Chaos; 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](http://melvyntyloo.com)).

- R. Delabays, **M. Tyloo**, *Heavy-tailed distribution of the number of papers within scientific journals*, *Quantitative Science Studies* **3** (3), 776-792 (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](#)].

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## 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. Fritsch, **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](#)]

### 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](#)]
- **M. Tyloo**, *Faster network disruption from layered oscillatory dynamics*, *arXiv:2210.01180* (2022). [[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 ([melvynntyloo.com](http://melvynntyloo.com)).

#### 2022

- Nov. 14 Prof. De Lellis group seminar, University of Naples Federico II, Naples, Italy. **Invited Speaker**. *Noise transmission and disruption in layered complex networks*. [[Link](#)]
- Oct. 20 CNLS Postdoc Seminar, Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos NM, USA. **Invited Speaker**. *Heavy-tailed distribution of the number of papers within scientific journals*. [[Link](#)]
- 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]

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## Visits in international research groups

### 2022

Nov.14-15 Department of Electrical Engineering and Information Technology, University of Naples Federico II, Naples, Italy. **Visiting researcher** (Prof. De Lellis).

### 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).

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

Posters and presentations can be found on my personal website ([melvynty100.com](http://melvynty100.com)).

### 2022

- Nov.8-10 Complex Networks 2022, The 11th International Conference on Complex Networks and their Applications, Palermo, Italy. Oral presentation. *Noise transmission in layered complex networks*. [Link]
- 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]
- Jul.5-7 Necsys 22, Zürich, Switzerland. **Paper presentation**. *Propagation of non-Gaussian voltage angle fluctuations in high-voltage power grids*. [Link]

Jul.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.*

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## Ongoing collaborations

- A. Likhov, M. Vuffray, T-4, T-5, Center for Nonlinear Studies (CNLS), Los Alamos National Laboratory (LANL), NM, USA.

- F. Caravelli, M. Saccone, T-4, 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)