GUILLAUME ST-ONGE

Research Assistant Professor

Network Science Institute & Roux Institute

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Mathematical & Computational Modeling | Complex Networks | Data Science | Epidemiology

ACADEMIC POSITIONS

Research Assistant Professor | Department of Physics, Northeastern University 2024–present

- Core faculty at the Network Science Institute & Roux Institute
- Member of EPISTORM—*Center for Advanced Epidemic Analytics and Predictive Modeling Technology*

Postdoctoral Research Associate | Department of Physics, Northeastern University 2022–2024

- Advisor: Alessandro Vespignani
- FRQNT: Postdoctoral Fellow

EDUCATION

Ph.D. in Physics | Université Laval | Honour List of the Faculty of Graduate and Postdoctoral Studies 2018–2022

- Advisors: Antoine Allard and Laurent Hébert-Dufresne (co-advisor)
- Thesis title: *Contagion process on complex networks beyond pairwise interactions*

M.Sc. in Physics | Université Laval | Honour List of the Faculty of Graduate and Postdoctoral Studies 2015–2017

- Advisor: Louis J. Dubé
- Thesis title: *Propagation dynamics on random networks: characterization of the phase transition*

B.Sc. in Physics | Université Laval | Governor General's Academic Medal for Highest Academic Standing 2012–2015

FUNDING AND AWARDS

Postdoctoral research

- FRQNT: Postdoctoral Research Fellowship ($110 000) June 2022–June 2024

Graduate research

- NSERC: Doctoral Scholarship – Alexander Graham Bell Canada ($105 000) Jan. 2018–Dec. 2020
- FRQNT: Doctoral Scholarship* ($60 000) Jan. 2018–Dec. 2020
- NSERC: Master Scholarship – Alexander Graham Bell Canada ($17 500) Sept. 2015–Aug. 2016
- FRQNT: Master Scholarship ($30 000) Sept. 2015–Aug. 2017
- Desjardins Foundation: Master Scholarship* ($3 000) Oct. 2015

*Awarded but declined

Internship research

- FRQNT: International Internship Program ($7 500) 2020
- NSERC: Michael Smith Foreign Study Supplements ($6 000) 2019
- NSERC: Undergraduate Student Research Award ($4 500, Awarded 3 times) 2013, 2014, 2015

Awards

- Best presentation, Fourth Northeast Regional Conference on Complex Systems 2021
- Concours d'expression scientifique Pierre Amiot (science popularization, 3rd place), Université Laval 2017
- Student merit award, Physics Department, Université Laval 2015
- Pedagogue of the year, Physics Students Association, Université Laval 2014

TEACHING

- *Dynamical Processes in Complex Networks*, guest lecturer 2022–2025
  Presentation title: Branching process and probability generating functions in network science
- Teaching assistant:
  - *Statistical Physics*, teaching assistant 2016–2018, 2020
  - *Computational Physics*, teaching assistant 2016, 2018
  - *Mathematical Physics III*, teaching assistant 2014
  - *Mathematical Physics I, II*, teaching assistant 2013
- Book in preparation: CoSMOS: Complex Systems Modeling Open Sourcebooks

PUBLICATIONS AND PATENTS

Articles published or accepted in a peer-reviewed journal

23. *Pandemic monitoring with global aircraft-based wastewater surveillance networks*
G. St-Onge, J. T. Davis, L. Hébert-Dufresne, A. Allard, A. Urbinati, S. V. Scarpino, M. Chinazzi, A. Vespignani 2025
Nature Medicine. 31, 788–796

22. *Characteristic scales and adaptation in higher-order contagions*
G. Burgio, **G. St-Onge**, L. Hébert-Dufresne 2025
Nature Communications. 16, 4589

21. *One pathogen does not an epidemic make: A review of interacting contagions, diseases, beliefs, and stories*
L. Hébert-Dufresne, Y.-Y. Ahn, V. Colizza, A. Allard, J. W. Crothers, P. Sheridan Dodds, M. Galesic, F. Ghanbarnejad, D. Gravel, R. A. Hammond, K. Lerman, J. Lovato, J. J. Openshaw, S. Redner, S. V. Scarpino, 2025
G. St-Onge, T. R. Tangherlini, J.-G. Young
npj Complexity. 2, 26

20. *Ensemble^2: scenarios ensembling for communication and performance analysis*
C. Bay, **G. St-Onge**, J. T. Davis, M. Chinazzi, E. Howerton, J. Lessler, M. C. Runge, K. Shea, S. Truelove, C. Viboud, A. Vespignani 2024
Epidemics. 46, 100748

19. *Nonlinear bias toward complex contagion in uncertain transmission settings*
G. St-Onge, L. Hébert-Dufresne, A. Allard 2024
Proceedings of the National Academy of Sciences of the United States of America. 121, e2312202121

18. *Hierarchical team structure and multidimensional localization (or siloing) on networks*
L. Hébert-Dufresne, **G. St-Onge**, J. Meluso, J. Bagrow, A. Allard 2023
Journal of Physics: Complexity. 4, 035002

17. *Source-sink behavioural dynamics limit institutional evolution in a group-structured society*
L. Hébert-Dufresne, T. M. Waring, **G. St-Onge**, M. T. Niles, L. K. Corlew, M. P. Dube, S. J. Miller, N. J. Gotelli, B. J. McGill 2022
Royal Society Open Science. 9, 211743

16. *Influential groups for seeding and sustaining nonlinear contagion in heterogeneous hypergraphs*
G. St-Onge, I. Iacopini, V. Latora, A. Barrat, G. Petri, A. Allard, L. Hébert-Dufresne 2022
Communications Physics. 5, 25

15. *Universal Nonlinear Infection Kernel from Heterogeneous Exposure on Higher-Order Networks*
G. St-Onge, H. Sun, A. Allard, L. Hébert-Dufresne, G. Bianconi 2021
Physical Review Letters. 127, 158301

14. *Social Confinement and Mesoscopic Localization of Epidemics on Networks*
G. St-Onge, V. Thibeault, A. Allard, L. J. Dubé, L. Hébert-Dufresne 2021
Physical Review Letters. 126, 098301

13. *Inference, Model Selection, and the Combinatorics of Growing Trees*
G. T. Cantwell, **G. St-Onge**, J.-G. Young 2021
Physical Review Letters. 126, 038301

12. *Master equation analysis of mesoscopic localization in contagion dynamics on higher-order networks*
G. St-Onge, V. Thibeault, A. Allard, L. J. Dubé, L. Hébert-Dufresne 2021
Physical Review E. 103, 032301

11. *Localization, epidemic transitions, and unpredictability of multistrain epidemics with an underlying genotype network*
B. J. M. Blake, **G. St-Onge**, L. Hébert-Dufresne 2021
PLOS Computational Biology. 17, e1008606

10. *Threefold way to the dimension reduction of dynamics on networks: an application to synchronization*
V. Thibeault, **G. St-Onge**, L. J. Dubé, P. Desrosiers 2020
Physical Review Research. 2, 043215

9. *Network comparison and the within-ensemble graph distance*
H. Hartle, B. Klein, S. McCabe, A. Daniels, **G. St-Onge**, C. Murphy, L. Hébert-Dufresne 2020
Proceedings of the Royal Society A. 476, 20190744

8. *Thresholding normally distributed data creates complex networks*
G. T. Cantwell, Y. Liu, B. F. Maier, A. C. Schwarze, C. A. Serván, J. Snyder, **G. St-Onge** 2020
Physical Review E. 101, 062302

7. *Phase transition in the recoverability of network history*
J.-G. Young, **G. St-Onge**, E. Laurence, C. Murphy, L. Hébert-Dufresne, P. Desrosiers 2019
Physical Review X. 9, 041056

6. *Efficient sampling of spreading processes on complex networks using a composition and rejection algorithm*
G. St-Onge, J.-G. Young, L. Hébert-Dufresne, L. J. Dubé 2019
Computer Physics Communications. 240, 30

5. *Universality of the stochastic block model*
J.-G. Young, **G. St-Onge**, P. Desrosiers, L. J. Dubé 2018
Physical Review E. 98, 032309

4. *Phase transition of the susceptible-infected-susceptible dynamics on time-varying configuration model networks*
G. St-Onge, J.-G. Young, E. Laurence, C. Murphy, L. J. Dubé 2018
Physical Review E. 97, 022305

3. *Geometric evolution of complex networks with degree correlations*
C. Murphy, A. Allard, E. Laurence, **G. St-Onge**, L. J. Dubé 2018
Physical Review E. 97, 032309

2. *Exact vectorial model for nonparaxial focusing by arbitrary axisymmetric surfaces*
D. Panneton, **G. St-Onge**, M. Piché, S. Thibault 2016
Journal of the Optical Society of America A. 33, 801

1. *Needles of light produced with a spherical mirror*
D. Panneton, **G. St-Onge**, M. Piché, S. Thibault 2015
Optics Letters. 4, 419

Preprints and submitted manuscripts

- *Evaluation of stochastic trajectory-based epidemic models using the energy score*
  C. Bay, K. Mu, **G. St-Onge**, M. Chinazzi, J. T. Davis, A. Vespignani
  medRxiv 2025.01.13.25320493.

- *Detecting structural perturbations from time series with deep learning*
  E. Laurence, C. Murphy, **G. St-Onge**, X. Roy-Pomerleau, V. Thibeault
  arXiv:2006.05232.

Patents

- *Hybrid nanocomposite materials, laser scanning system and use thereof in volumetric image projection*, 2017
  C. Allen, S. Thibault, A. Talbot-Lanciault, P. Blais, **G. St-Onge**, P. Desaulniers
  CA Patent No. 2983656

TALKS AND INVITED PRESENTATIONS

- *Modeling Platform for Travel-Based Genomic and Wastewater Outbreak Surveillance* 2025
  - InsightNet Annual Meeting, Salt Lake City (UT), USA
  - Epistorm Annual Meeting, Boston (MA), USA
- *The Unreasonable Effectiveness of Branching Processes for Outbreak Analytics* 2025
  Network Science Research Symposium (keynote presentation), Boston (MA), USA
- *L'efficacité hors norme des fonctions génératrices pour modéliser les épidémies* 2025
  Centre Interdisciplinaire en Modélisation Mathématique de l'Université Laval, Québec (QC), Canada
- *Statistical physics of epidemics with applications to global biosurveillance* 2025
  PHYS 7210 - Introduction to Research in Physics (seminar), Northeastern University, Boston (MA), USA
- *Generating function methodology for metapopulation epidemics with applications to global biosurveillance* 2024
  Quantitative Methods for Dynamics on Networks, Los Alamos (NM), USA
- *Optimization of a global wastewater surveillance network at airports for emerging pathogens* 2024
  International School and Conference on Network Science, Québec (QC), Canada
- *Establishing a wastewater global surveillance network at airports for early detection of emerging pathogens: A modeling study* 2023
  Epidemics: 9th International Conference on Infectious Disease Dynamics, Bologna, Italy
- *Wastewater environmental Surveillance for Pandemic Preparedness (Roundtable discussion)* 2023
  Grand Challenges Annual Meeting, Dakar, Senegal
- *Probability generating functions for epidemics on metapopulation networks* 2023
  - Contagion on Complex Social Systems (CCSS), Burlington (VT), USA
  - International School and Conference on Network Science, Vienna, Austria
- *Quantifying population dynamics of complex contagions* 2023
  International School and Conference on Network Science, Vienna, Austria
- *Navigating wastewater surveillance at airports with probability generating functions* 2023
  NetPLACE, (virtual)
- *Indistinguishability of simple and complex contagions when transmission settings matter* 2023
  Mathematical Institute, University of Oxford, Oxford, UK (virtual)
- *Confounders of interacting diseases* 2023
  Dynamics of Interacting Contagions, Santa Fe (NM),USA
- *Reconstruction Of Product-Diffusion Cascades* 2022
  Workshop on Network Dynamics and Choice Theory, Burlington (VT), USA
- *Nonlinear infection rate to compress mechanistic epidemic models* 2022
  Fourth Northeast Regional Conference on Complex Systems, Buffalo (NY), USA

- *Influential groups in hypergraph contagions* 2022
  Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
- *Bursty exposure on higher-order networks leads to nonlinear infection kernels* 2021
  - Networks 2021: A Joint Sunbelt and NetSci Conference, Bloomington (IN), USA
  - SIAM Conference on Applications of Dynamical Systems (DS21), Portland (OR), USA
  - Fourth Northeast Regional Conference on Complex Systems, Buffalo (NY), USA 🏆 (*best talk*)
- *Influence maximization in simplicial contagion* 2020
  International School and Conference on Network Science, Rome, Italy
- *Localization, bistability and optimal seeding of contagions on higher-order networks* 2020
  Artificial Life Conference, Montreal (QC), Canada
- *Mesoscopic localization of spreading processes on networks* 2019
  International School and Conference on Network Science, Burlington (VT), USA
- *SIS dynamics on time-varying random networks* 2017
  Institute for Disease Modeling, Seattle (WA), USA
- *Susceptible-infected-susceptible dynamics on the rewired configuration model* 2017
  International School and Conference on Network Science, Indianapolis (IN), USA
- *Co-evolution of Growth and Dynamics on Network* 2016
  International School and Conference on Network Science, Seoul, Republic of Korea
- *Modeling ultra-sharp needles of light using vector diffraction theory* 2014
  50th Canadian Undergraduate Physics Conference, Kingston (ON), Canada

OTHER RELEVANT EXPERIENCES

Internships

Vermont Complex System Center, Burlington (VT), USA

- Visiting graduate student | group of Prof. Laurent Hébert-Dufresne 2019-2020
  Project: *Temporal reconstruction of networks with message-passing*

Université Laval, Québec (QC), Canada

- Undergraduate research assistant | group of Prof. Louis J. Dubé 2015
  Project: *Statistical physics of complex networks*
- Undergraduate research assistant | group of Prof. Michel Piché 2014
  Project: *Highly focused laser beam modeling*
- Undergraduate research assistant | group of Prof. Claudine Allen 2013
  Project: *Development of an optical system for biodetection*

Summer and winter schools

- Summer Institute in Statistics and Modeling in Infectious Diseases, (virtual) 2022
- Complex Systems Summer School, Santa Fe (NM), USA 2018
- Complex Networks Winter Workshop, Québec (QC), Canada 2018

LEADERSHIP AND SERVICE

Conferences and workshops

- Co-organizer: The Art of Epidemics: Data Storytelling through Effective Visualizations 2025

  - Special session at Epidemics 10: 10th International Conference on Infectious Disease Dynamics
- School & Satellite chair: International School and Conference on Network Science (NetSci) 2024
  - Flagship conference of the Network Science Society
  - Elected *Scientific Event of the Year* by the Cercle des ambassadeurs de Québec 🏆
- Co-organizer: Epistorm Rt-Collabathon 2024
  - Collaborative event to build community around real-time estimation of the effective reproduction number
  - Supported by the CDC's Center for Forecasting and Outbreak Analytics Insight Net initiative
- Program committees:
  - Conference on Complex Systems (CCS) 2024-2025
  - Northeast Regional Conference on Complex Systems (NERCCS) 2022
- Session chair:
  - Networks 2021: A Joint Sunbelt and NetSci Conference, S14 – Epidemiology 2021
  - SIAM Conference on Applications of Dynamical Systems (DS21), CP4 – Dynamics 2021
- Projects liaison: Complex Networks Winter Workshop 2019

Faculty committee

- Member: Full Time Non-Tenure Track Faculty Committee, College of Science, Northeastern University 2024–present
- Member: PhD Admission Committee, Network Science, Northeastern University 2025

Reviewer

- Journals (17): Science Advances, Nature Communications, Physical Review Letters, Physical Review X, Physical Review E, PLOS Computational Biology, npj Complexity PNAS Nexus, Journal of The Royal Society Interface, Journal of Complex Networks, Communications Physics, Scientific Reports, Chaos: An Interdisciplinary Journal of Nonlinear Science, New Journal of Physics, IMA Journal of Applied Mathematics, Advances in Complex Systems, PLOS One
- Triage grading for The Interdisciplinary Contest in Modeling (ICM) 2022

MEDIA COVERAGE

- Selection of media coverage on our *Nature Medicine* article about aircraft wastewater surveillance: 2025
  - Thinking globally for pandemic early warning systems, *Nature News and Views*
  - Wastewater sampling could be key to early warning of new disease outbreaks, *The Guardian*
  - Waste surveillance at just 20 airports could spot the next pandemic, *NewScientist*
  - How monitoring wastewater from international flights can serve as an early warning system for the next pandemic, *Northeastern Global News*
- Other media coverage of my research:
  - *Mathematical model offers new insights into spread of epidemics*, *phys.org* 2021
  - *To find the right network model, compare all possible histories*, *phys.org* 2021
  - *How large a gathering is too large during the coronavirus pandemic?*, *Science News* 2020

SELECTED OPEN-SOURCE SOFTWARE

- **pgfgleam**: efficient solution of stochastic metapopulation epidemics for global biosurveillance (Python)
- **SamplableSet**: implementation of sets which can be randomly sampled efficiently (C++/Python)
- **fasttr**: uniform sampler for the temporal reconstruction of growing trees (C++/Python)
- **spreading_CR**: stochastic simulation algorithm for contagion processes (C++/Python)