GUILLAUME ST-ONGE

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Mathematical Modeling | Computational Epidemiology | Complex Networks | Bayesian Inference

ACADEMIC POSITIONS

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

- Roux Institute Member
- Core faculty at the Network Science Institute

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

- Advisor: Alessandro Vespignani
- Leading research on the modeling of wastewater surveillance at airports
- Contributing to work on ensemble forecast of COVID-19 and Influenza in the US
- Assisting in the supervision of Ph.D. students

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 oral presentation, Fourth Northeast Regional Conference on Complex Systems 2021
- Concours d'expression scientifique Pierre Amiot[†] (3rd place), Université Laval 2017
- Student merit award–Direction mention, Université Laval 2015
- Pedagogue of the year, Physics Students Association, Université Laval 2014

TEACHING

- *Dynamical Processes in Complex Networks*, guest lecturer 2022, 2023
  Presentation title: Tutorial on probability generating functions
- *Statistical Physics*, teaching assistant 2016–2018, 2020
  Tasks: lectures and additional exercises, marking
- *Computational Physics*, teaching assistant 2016, 2018
  Tasks: guidance for student projects, marking
- *Mathematical Physics III*, teaching assistant 2014
  Tasks: lectures and additional exercises
- *Mathematical Physics I, II*, teaching assistant 2013
  Tasks: lectures and additional exercises
- **Book in preparation**: CoSMOS: Complex Systems Modeling Open Sourcebooks

PUBLICATIONS AND PATENTS

Articles published or accepted in a peer-reviewed journal

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 2023
    Proc. Natl. Acad. Sci. U.S.A. 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
    J. phys. Complex. 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
    R. Soc. Open Sci. 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
    Commun. Phys. 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
    Phys. Rev. Lett. 127, 158301

[†]Scientific communication prize

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

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

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

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

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

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

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

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

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

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

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

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

2. *Exact vectorial model for nonparaxial focusing by arbitrary axisymmetric surfaces* 2016
D. Panneton, **G. St-Onge**, M. Piché, S. Thibault
J. Opt. Soc. Am. 33, 801

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

Preprints and submitted manuscripts

- *Optimization and performance analytics of 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
medRxiv 2024.08.02.24311418

- *Adaptive hypergraphs and the characteristic scale of higher-order contagions using generalized approximate master equations*
G. Burgio, **G. St-Onge**, L. Hébert-Dufresne
arXiv:2307.11268

- *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*, C. Allen, S. Thibault, A. Talbot-Lanciault, P. Blais, **G. St-Onge**, P. Desaulniers CA Patent No. 2983656 — 2017

CONFERENCE CONTRIBUTIONS AND INVITED LECTURES

- *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 award)
- *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

SERVICE AND LEADERSHIP

Conferences and workshops

- Co-organizer: Epistorm Rt-Collabathon 2024
- School & Satellite co-chair: International School and Conference on Network Science (NetSci 2024) 2024
- Program committee: Northeast Regional Conference on Complex Systems (NERCCS) 2022
- Session chair: Networks 2021: A Joint Sunbelt and NetSci Conference, S14 – Epidemiology 2021
- Session chair: SIAM Conference on Applications of Dynamical Systems (DS21), CP4 – Dynamics 2021
- Projects liaison: Complex Networks Winter Workshop 2019

Reviewer

- Journals (15): Physical Review Letters, Physical Review X, Physical Review E, Science Advances, Nature Communications, PLOS Computational Biology, 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

Volunteering

- La Coupe de Science (youth science contest) 2016
- Festival de Sciences et Génies (science festival) 2015
- Les Jeux photoniques (youth science contest) 2012–2014

MEDIA COVERAGE

- *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

COMPUTER SKILLS AND SOFTWARE

Programming languages & tools: Python (Jupyter · Pybind11 · Geopandas · Numba), C++, SQL, Bash, LaTeX, Git

Selected packages (open-source):

- **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)