Guillaume St-Onge

Postdoctoral Research Associate

Network Science Institute

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Research interests: Mathematical & Computational Modeling, Contagion Dynamics, Networks, Bayesian inference

Academic positions

Postdoctoral Research Associate, Northeastern University — 2022–present

Education

Degrees

Ph.D. in Physics, Université Laval — 2018–2022

- Advisors: Antoine Allard and Laurent Hébert-Dufresne (co-advisor)
- Thesis title: *Contagion process on complex networks beyond pairwise interactions*
- The thesis is part of the **Honour List of the Faculty of Graduate and Postdoctoral Studies**

M.Sc. in Physics, Université Laval — 2015–2017

- Advisor: Louis J. Dubé
- Thesis title: *Propagation dynamics on random networks: characterization of the phase transition*
- The thesis is part of the **Honour List of the Faculty of Graduate and Postdoctoral Studies**

B.Sc. in Physics, Theoretical physics concentration, Université Laval — 2012–2015

- **Governor General's Academic Medal** for **Highest Academic Standing** — 2016

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

Scholarships and honors

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

Other awards

- Scholarship to attend the Summer Institute in Statistics and Modeling in Infectious Diseases 2022
- Prize to highlight publications by students, CIMMUL 2021
- 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

Publications and patents

Articles published or accepted in a peer-reviewed journal

17. *Source-sink behavioural dynamics limit institutional evolution in a group-structured society* 2022
L. Hébert-Dufresne, T. M. Waring, **G. St-Onge**, *et al.*
R. Soc. Open Sci. **9**, 211743

16. *Influential groups for seeding and sustaining nonlinear contagion in heterogeneous hypergraphs* 2021
G. St-Onge, I. Iacopini, V. Latora, A. Barrat, G. Petri, A. Allard, L. Hébert-Dufresne
Commun. Phys. **5**, 25

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

14. *Social Confinement and Mesoscopic Localization of Epidemics on Networks* (CIMMUL) 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

[†]Scientific communication prize

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
Comput. Phys. Commun. **240**, 30

5. *Universality of the stochastic block model*
J.-G. Young, **G. St-Onge**, P. Desrosiers, L. J. Dubé 2018
Phys. Rev. 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
Phys. Rev. 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
Phys. Rev. E **97**, 032309

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

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

Preprints

- *Heterogeneous transmission in groups induces a superlinear force of infection*
G. St-Onge, L. Hébert-Dufresne, A. Allard
arXiv:2302.13358

- *Hierarchical team structure and multidimensional localization (or siloing) on networks*
L. Hébert-Dufresne, **G. St-Onge**, J. Meluso, J. Bagrow, A. Allard
arXiv:2203.00745

- *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 2017
CA Patent No. 2983656

Other research 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*

Working groups

- *Detecting structural perturbations from time series*, Université Laval, Québec (QC), Canada 2019
- *Network Reconstruction & Graph Distances*, Northeastern University, Boston (MA), USA 2019
- *Network Archaeology*, Université Laval, Québec (QC), Canada 2016

Teaching

- PHY-3500: *Computational Physics*, teaching assistant 2016, 2018
  Tasks: guidance for student projects, marking
- PHY-3000: *Statistical Physics*, teaching assistant 2016–2018, 2020
  Tasks: lectures, marking

Conference contributions and invited lectures

- *Indistinguishability of simple and complex contagions when transmission settings matter* 2023
  Mathematical Institute, University of Oxford, Oxford, UK
- *Confounders of interacting diseases* 2023
  Dynamics of Interacting Contagions, Santa Fe (NM),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
  14th 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
  14th 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
  12th International School and Conference on Network Science, Indianapolis (IN), USA
- *Co-evolution of Growth and Dynamics on Network* 2016
  11th 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

Service and leadership

Conferences and workshops

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

Mentoring

- Internship mentor for an undergraduate student research 2018
- Mentor for Physique mathématique III (undergraduate course) 2014
- Mentor for Physique mathématique I, II (undergraduate courses) 2013

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

Miscellaneous

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

Programming languages and tools: C++, Python, Bash, CSS, HTML, LaTeX, Linux, Git, Jupyter Notebook, Pybind11

Selected packages (open-source):

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

Languages

- French–native speaker
- English–fluent (spoken and written); $117/120$ on the TOEFL test
- German–elementary