Nicolas Gast

Associate researcher at Inria

4 rue des marronniers, 38610 Gieres, France
nicolas.gast@inria.fr
polaris.imag.fr/nicolas.gast/

My research focuses on the development and the use of stochastic models and optimization methods for the design of control algorithms in large-scale systems. I am interested both on theoretical problems (related to optimization and mathematical modeling) and on the application of these methods to practical problems.
In my research, I focus on various applications: communication networks, distributed computing systems, transport systems and energy management. Currently, my main application area concerns the management of electrical storage systems. Specifically, I am interested in centralized and distributed algorithms for the mangement of energy storage systems. These algorithms aim at compensating for the volatility associated with renewable energy.

Education

2010 **PhD in Computer Science**, *University of Grenoble*, France, Title: Optimization and Control of Large Systems: Fighting the curse of Dimensionality. Advisor: Bruno Gaujal..

2007 **Agrégation de Mathématiques**.

2006 **Master of Computer Science (MPRI)**, *École Normale Supérieure*, Paris, France.

2006 **MMFAI**, *École Normale Supérieure*, Paris, France, Magistère de Méthématiques Fondamentales et Appliquées et d'Informatique.

2003–2007 **Student at École Normale Supérieure**, *Paris*, France.

Professional Experience

2014–current **Research associate**, *Inria*, Grenoble, France, (in french: *chargé de recherche*).

2010–2014 **Post-doctoral fellow**, *EPFL, Lausanne, Suisse*.

2007–2010 **PhD candidate and teaching assistant**, *Grenoble University and Inria*, France.

2003–2007 **Student at École Normale Supérieure**, *Paris, France*.

Supervision

5 PostDocs **Guillaume Massonnet** (2014-2016), **Josu Doncel** (2015-2016), **Carmen Higuerra** (2016-2017), **Takai Kennouche** (2018-now), **Mouhcine Mendil** (2018-now)

5 PhD Benoit Vinot (2015-2018), Vitalii Emelianov (2018-now), Chen Yan (2019-now), Thomas Barzolla (2019-now), Kimang Khun (2019-now)

Awards and Honors

PEDR Prime d'encadrement doctoral et de recherche. Awarded for 2015 – 2019.

Best paper ACM SIGMETRICS 2018 [4, 21], ACM CoNext 2012 [29]

Best student paper ValueTools 2009 [33].

Professional Activities

Program committee member I served as a member of the technical program committee of the following conferences: ACM SIGMETRICS (2016,2017,2018,2019,2020), IFIP Performance (2016,2017,2019), ITC 2017, ACM E-Energy (2014,2016,2017), ValueTools (2012, 2013, 2014,2020).

Editorship Associate editor of the journals "Performance Evaluation" and of "Stochastic models"

Reviewer I served as a reviewer for journals and conferences, including IEEE Infocom, IEEE Transaction on Automatic Control, American Conference on Control, IEEE/ACM Transaction on Networking, IEEE Transactions on Information Theory.

PhD committee I have been invited to be member of the PhD jury of Eyal Castiel (Toulouse, 2019), Céline Comte (Telecom-Paris, 2019), Fabio Cecchi (Eindhoven, 2018).

Responsibilities I am also co-responsible for the PhD program in Computer Science at the University Grenoble-Alpes (ED MSTII). I am an elected member of the "conseil de laboratoire" of the Laboratoire d'informatique de Grenoble (LIG).

Project I am PI of the ANR project "REFINO" (ANR-JCJC), funded from 2019 to 2024 (250k euros). I am PI of the project "Flex-MS" (IRS-project from IDEX-Grenoble), funded from 2018 to 2019 (100k euros). I was PI for Inria of the European FP7 project Quanticol. I participated to the elaboration of the research plan of the project. Funded from 2013 to 2017 (2.5M euros, 400k for Inria).

Conferences I co-organized the *winter school on energy system*, YEQT XI at TU-Eindhoven, Dec 2017.

International collaborations

My work covers various application area for which I collaborated with a number of people, including:

- Benny Van Houdt (Univ Antwerp) on the development of stochastic method to study caching algorithms. [8, 24, 25]
- Jean-Yves Le Boudec (EPFL), Dan-Crisitian Tomozei (Cisco), Alexandre Proutière (KTH) and Pierre Pinson (DTU) on smart-grids and electricity markets[7, 10, 27, 28, 45].
- Ramin Khalili (Deutsche Telecom/TU Berlin), Jean-Yves Le Boudec (EPFL) for my work on MP-TCP [11, 29, 38, 39].
- Bruno Gaujal (Inria) and Jean-Yves Le Boudec (EPFL) for mean-field optimal control [12, 14, 16, 32, 33, 46]
- Christine Fricker (Inria), Mirco Tribastone (IMT) and Guillaume Massonnet (Univ. Nantes) on bike-sharing modeling [9, 26, 30].
- Francois Baccelli (Inria / Austin) and Nick Bambos (Stanford) on power control algorithms for wireless networks [15, 37].
- Denis Trystram (Grenoble University) and Marc Tchiboukdjian (Exatec) on distributed scheduling algorithms [13, 31].

Teaching

I usually teach one of two classes per year. Currently, I am responsible of two courses:

- Optimization under Uncertainties (Master 2 ORCO – [Operations Research], Univ. Grenoble Alpes)
- Informatique et aléatoire (Randomness in Computer Science), Bachelor, Univ. Grenoble Alpes

In the past, I participated to many classes (as professor or teaching assistant), including

- Performance evaluation and stochastic modeling (Master, and Bachelor, Univ. Grenoble-Alpes)

- Algorithms design and analysis: 3rd year of Bachelor, Univ. Grenoble-Alpes.
- Preparation to the french civil service competitive examination for future high-school teachers (CAPES and Agrégation).
- Performance evaluation and TCP-IP networking (Master), Information and coding theory (Bachelor) at EPFL

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Dissemination of non-technical content

During my PhD, I animated in a project in which we presented during six sessions basic algorithms to mid-school students (our example was the minimax algorithm). `http://mathsamodeler.ujf-grenoble.fr/`

At EPFL, I organized practical sessions to present some mechanisms of computer networks to high-school students (the course was called "demystify internet" `http://bachelor.epfl.ch/journees-visite`).

Publications

H-index : 19 (google scholar). 1300+ citations. Authors of 30+ conference and journal papers.
Selected publications: [4, 9, 26, 27, 29]

In general, authors are in alphabetic order. This is not the case for [19, 20, 7, 10, 11, 13, 29, 31, 45, 38, 39].
Google scholar profile: `http://scholar.google.ch/citations?user=KbEN-HoAAAAJ&hl=en&oi=ao`.

Peer-reviewed journal articles

[1] Josu Doncel, Nicolas Gast, and Bruno Gaujal. Discrete mean field games: Existence of equilibria and convergence. *Journal of Dynamics & Games*, pages 269–316, 2019

[2] Nicolas Gast, Diego Latella, and Mieke Massink. A refined mean field approximation of synchronous discrete-time population models. *Performance Evaluation*, 126:1 – 21, 2018

[3] Nicolas Gast and Benny Van Houdt. TTL approximations of the cache replacement algorithms LRU(m) and h-LRU. *Performance Evaluation*, 117:33 – 57, 2017

[4] Nicolas Gast and Benny Van Houdt. A refined mean field approximation. *Proc. ACM Meas. Anal. Comput. Syst.*, 1(2):33:1–33:28, December 2017

[5] Nicolas Gast. Expected values estimated via mean-field approximation are 1/n-accurate. *Proc. ACM Meas. Anal. Comput. Syst.*, 1(1):17:1–17:26, June 2017

[6] Nicolas Gast and Bruno Gaujal. Computing absorbing times via fluid approximations. *Advances in Applied Probability*, 49(3):768–790, 2017

[7] F. Bona, N. Gast, J.-Y. Le Boudec, P. Pinson, and D.-C. Tomozei. Attribution mechanisms for ancillary service costs induced by variability in power delivery. *IEEE Transactions on Power Systems*, 2016

[8] Nicolas Gast and Benny Van Houdt. Transient and steady-state regime of a family of list-based cache replacement algorithms. *Queueing Systems*, 83(3-4):293–328, 2016

[9] Christine Fricker and Nicolas Gast. Incentives and redistribution in homogeneous bike-sharing systems with stations of finite capacity. *EURO Journal on Transportation and Logistics*, pages 1–31, 2014

[10] N. Gast, D-C Tomozei, and J-Y Le Boudec. Optimal generation and storage scheduling in the presence of renewable forecast uncertainties. *IEEE Transactions on Smart Grid*, 5(3):1328–1339, 2014

[11] R. Khalili, N. Gast, M. Popovic, and J-Y Le Boudec. MPTCP is not pareto-optimal: performance issues and a possible solution. *IEEE/ACM Transactions on Networking (TON)*, 21(5):1651–1665, 2013

[12] N. Gast, B. Gaujal, and J.Y. Le Boudec. Mean field for Markov decision processes: from discrete to continuous optimization. *IEEE Transactions on Automatic Control*, 57(9):2266–2280, 2012

[13] M. Tchiboukdjian, N. Gast, and D. Trystram. Decentralized list scheduling. *Annals of Operations Research*, pages 1–23, 2012

[14] N. Gast and B. Gaujal. Markov chains with discontinuous drifts have differential inclusion limits. *Performance Evaluation*, 2012

[15] F. Baccelli, N. Bambos, and N. Gast. Distributed delay-power control algorithms for bandwidth sharing in wireless networks. *IEEE/ACM Transactions on Networking*, 99, 2011

[16] N. Gast and B. Gaujal. A mean field approach for optimization in discrete time. *Discrete Event Dynamic Systems*, 2011

[17] N. Gast and B. Gaujal. Infinite labeled trees: From rational to Sturmian trees. *Theoretical Computer Science*, 2009

Peer-reviewed conferences

[18] Josu Doncel, Nicolas Gast, Mirco Tribastone, Max Tschaikowski, and Andrea Vandin. UTOPIC: Under-Approximation Through Optimal Control. In *QEST 2019*, pages 277–291, Glasgow, United Kingdom, September 2019

[19] Vitalii Emelianov, George Arvanitakis, Nicolas Gast, Krishna Gummadi, and Patrick Loiseau. The price of local fairness in multistage selection. In *Proceedings of the Twenty-Eighth International Joint Conference on Artificial Intelligence, IJCAI-19*, pages 5836–5842. International Joint Conferences on Artificial Intelligence Organization, 7 2019

[20] Nicolas Gast, Luca Bortolussi, and Mirco Tribastone. Size expansions of mean field approximation: Transient and steady-state analysis. *Performance Evaluation*, 2018

[21] Nicolas Gast and Benny Van Houdt. A refined mean field approximation. In *Abstracts of the 2018 ACM International Conference on Measurement and Modeling of Computer Systems*, SIGMETRICS '18, pages 113–113, New York, NY, USA, 2018. ACM

[22] Nicolas Gast. Expected values estimated via mean-field approximation are 1/n-accurate: Extended abstract. In *Proceedings of the 2017 ACM SIGMETRICS / International Conference on Measurement and Modeling of Computer Systems*, SIGMETRICS '17 Abstracts, pages 50–50, New York, NY, USA, 2017. ACM

[23] Luca Bortolussi and Nicolas Gast. Mean field approximation of uncertain stochastic models. In *46th Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN 2016)*, 2016

[24] Nicolas Gast and Benny Van Houdt. Asymptotically exact TTL-approximations of the cache replacement algorithms LRU(m) and h-LRU. In *28th International Teletraffic Congress (ITC 28)*, 2016

[25] Benny Van Houdt Nicolas Gast. Transient and steady-state regime of a family of list-based cache replacement algorithms. In *Proceedings of ACM SIGMETRICS*. ACM, 2015

[26] N. Gast, G. Massonnet, D. Reijsbergen, and M. Tribastone. Probabilistic forecasts of bike-sharing systems for journey planning. In *Proceeding of the 24th ACM International Conference on Information and Knowledge Management (CIKM'15)*. ACM, 2015

[27] N. Gast, J.Y. Le Boudec, and D.C. Tomozei. Impact of demand-response on the efficiency and prices in real-time electricity markets. In *Proceedings of ACM E-ENERGY*, 2014

[28] N. Gast, J.Y. Le Boudec, A. Proutière, and D.C. Tomozei. Impact of storage on the efficiency and prices in real-time electricity markets. In *Proceedings of ACM E-ENERGY*, 2013

[29] R. Khalili, N. Gast, M. Popovic, U. Upadhyay, and J.Y. Le Boudec. MPTCP is not pareto-optimal: performance issues and a possible solution. In *Proceedings of the 8th international conference on Emerging networking experiments and technologies*, pages 1–12. ACM, 2012. Best paper award

[30] C. Fricker, N. Gast, and A. Mohamed. Mean field analysis for inhomogeneous bike sharing systems. *AofA 2012, International Meeting on Probabilistic, Combinatorial and Asymptotic Methods for the Analysis of Algorithms*, 2012

[31] M. Tchiboukdjian, N. Gast, D. Trystram, J.-L. Roch, and J. Bernard. A tighter analysis of work stealing. *ISAAC*, 2010

[32] N. Gast and B. Gaujal. A Mean Field Model of Work Stealing in Large-Scale Systems. *ACM SIGMETRICS*, 2010

[33] N. Gast and B. Gaujal. A mean field approach for optimization in particle systems and applications. *Fourth International Conference on Performance Evaluation Methodologies and Tools, ValueTools*, 2009. Best Student Paper Award

[34] N. Gast and B. Gaujal. Balanced labeled trees: density, complexity and mechanicity. In *Words, 6th international conference on words*, Marseille, France, 2007

[35] F. de Dinechin, A.V. Ershov, and N. Gast. Towards the Post-Ultimate libm. In *Proceedings of the 17th IEEE Symposium on Computer Arithmetic*, pages 288–295. IEEE Computer Society, 2005

Other publications

- **Book Chapter**

  [36] Luca Bortolussi and Nicolas Gast. Mean-field limits beyond ordinary differential equations. In *Formal Methods for the Quantitative Evaluation of Collective Adaptive Systems*, pages 61–82. Springer, 2016

- **Patents**

  [37] F. Baccelli, N. Bambos, and N. Gast. Scalable delay-power control algorithm for bandwidth sharing in wireless networks, November 27 2012. US Patent 8,320,269

- **Internet Draft.**

  [38] R. Khalili, N. Gast, M. Popovic, and J.Y. Le Boudec. Performance issues with MPTCP. *INTERNET-DRAFT*, 2012. draft-khalili-mptcp-performance-issues-01

  [39] R. Khalili, N. Gast, M. Popovic, and J.Y. Le Boudec. Opportunistic linked-increases congestion control algorithm for MPTCP. *INTERNET-DRAFT*, 2013. draft-khalili-OLIA-00

- **Workshops**

  [40] Benoît Vinot, Florent Cadoux, and Nicolas Gast. Congestion avoidance in low-voltage networks by using the advanced metering infrastructure. volume 46, pages 89–91. ACM, 2019

[41] Nicolas Gast, Diego Latella, and Mieke Massink. A refined mean field approximation for synchronous population processes. volume 46, pages 30–32. ACM, 2019

[42] Nicolas Gast. Construction of lyapunov functions via relative entropy with application to caching. In *The 18th Workshop on MAthematical performance Modeling and Analysis (MAMA)*, 2016

[43] Josu Doncel, Nicolas Gast, and Bruno Gaujal. Are mean-field games the limits of finite stochastic games? In *The 18th Workshop on MAthematical performance Modeling and Analysis (MAMA)*, 2016

[44] Nicolas Gast. The power of two choices on graphs: the pair-approximation is accurate. *ACM SIGMETRICS Performance Evaluation Review*, 2015

[45] N. Gast, D.C. Tomozei, and J.Y. Le Boudec. Optimal storage policies with wind forecast uncertainties. *ACM Greenmetrics 2012, London, UK*, 2012

[46] N. Gast and B. Gaujal. Mean field limit of non-smooth systems and differential inclusions. *ACM SIGMETRICS Performance Evaluation Review*, 38(2):30–32, 2010