Nicolas Gast

Associate researcher at Inria

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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

2020 **HDR (Habilitation)**, *University of Grenoble*, Grenoble, France.

2010 **PhD in Computer Science**, *University of Grenoble*, Grenoble, France, 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 (Élève fonctionnaire stagiaire) at ENS Paris (Ulm)**, *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.

Supervision

6 PostDocs **Guillaume Massonnet** (2014-2016), **Josu Doncel** (2015-2016), **Carmen Higuerra** (2016-2017), **Takai Kennouche** (2018-2019), **Mouhcine Mendil** (2018-2019), **Henry-Joseph Audeoud** (2020-2022).

8 PhD students **Benoit Vinot** (2015-2018), **Vitalii Emelianov** (2018-2022), **Chen Yan** (2019-now), **Thomas Barzola** (2019-now), **Kimang Khun** (2019-now), **Sebastian Allmeier** (2020-now), **Romain Cravic** (2021-now), **Mathieu Molina** (2022-now).

Awards and Honors

PEDR Prime d'encadrement doctoral et de recherche. Awarded for 2015 – 2023.

Best paper ACM SIGMETRICS 2018 [12, 31], ACM CoNext 2012 [41]

Best student paper ValueTools 2009 [44].

Grants and Project

Current projects I am PI of the ANR project "REFINO" (ANR-JCJC), funded from 2019 to 2024 (250k euros). Two grants from Enedis (total 150k) to study PLC-G3.

Past projects I was 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 our group at Inria).

Professional Activities and Collective Responsabilities

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).

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

Program committee I served as a member of the technical program committee of various conferences, including ACM SIGMETRICS (2016,2017,2018,2019,2020), IFIP Performance (2016,2017,2019), NeurIPS (2020), ICML (2020), ICLR (2021), ITC (2017), ACM E-Energy (2014,2016,2017), ValueTools (2012,2013,2014,2020).

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 served as a reviewer for the PhD of Santiago Duran (Toulouse, 2020). 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).

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:

- Patrick Loiseau (Inria) on the impact of fairness policies in selection problems [25, 27, 2, 29].
- Benny Van Houdt (Univ Antwerp) on the development of stochastic method to study caching algorithms. [16, 34, 36]
- Jean-Yves Le Boudec (EPFL), Dan-Crisitian Tomozei (Cisco), Alexandre Proutière (KTH) and Pierre Pinson (DTU) on smart-grids and electricity markets[14, 17, 37, 38, 40].
- Ramin Khalili (Deutsche Telecom/TU Berlin), Jean-Yves Le Boudec (EPFL) for my work on MP-TCP [18, 41, 51, 50].
- Bruno Gaujal (Inria) and Jean-Yves Le Boudec (EPFL) for mean-field optimal control [20, 19, 23, 42, 44, 60]
- Christine Fricker (Inria), Mirco Tribastone (IMT) and Guillaume Massonnet (Univ. Nantes) on bike-sharing modeling [15, 35, 39].
- Francois Baccelli (Inria / Austin) and Nick Bambos (Stanford) on power control algorithms for wireless networks [22, 49].
- Denis Trystram (Grenoble University) and Marc Tchiboukdjian (Criteo) on distributed scheduling algorithms [21, 43].

Teaching

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), 3rd year of 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 : 23 (google scholar). 2000+ citations. Authors of 40+ conference and journal papers.
Selected publications: [12, 15, 35, 37, 41]

In general, authors are in alphabetic order. This is not the case for [29, 8, 14, 17, 18, 21, 41, 43, 40, 51, 50]. Google scholar profile: `http://scholar.google.ch/citations?user=KbEN-HoAAAAJ&hl=en&oi=ao`.

Peer-reviewed journal articles

[1] S. Allmeier and N. Gast. "Mean Field and Refined Mean Field Approximations for Heterogeneous Systems: It Works!" In: *Proceedings of the ACM on Measurement and Analysis of Computing Systems* 6.1 (Feb. 2022), pp. 1–43. DOI: 10.1145/3508033. URL: https://hal.inria.fr/hal-03600672.

[2] V. Emelianov, N. Gast, K. P. Gummadi, and P. Loiseau. "On fair selection in the presence of implicit and differential variance". In: *Artificial Intelligence* 302 (Oct. 2021), pp. 1–20. DOI: 10.1016/j.artint.2021.103609. URL: https://hal.inria.fr/hal-03398739.

[3] N. Gast, M. Khatiri, D. Trystram, and F. Wagner. "Analysis of Work Stealing with latency". In: *Journal of Parallel and Distributed Computing* 153 (July 2021), pp. 119–129. DOI: 10.1016/j.jpdc.2021.03.010. URL: https://hal.inria.fr/hal-03356234.

[4] G. Casale and N. Gast. "Performance analysis methods for list-based caches with non-uniform access". In: *IEEE/ACM Transactions on Networking* (Dec. 2020), pp. 1–18. DOI: 10.1109/TNET.2020.3042869. URL: https://hal.inria.fr/hal-03102188.

[5] J. Doncel, N. Gast, and B. Gaujal. "A Mean Field Game Analysis of SIR Dynamics with Vaccination". In: *Probability in the Engineering and Informational Sciences* (Dec. 2020), pp. 1–18. DOI: 10.1017/S0269964820000522. URL: https://hal.inria.fr/hal-01496885.

[6] N. Gast, S. Ioannidis, P. Loiseau, and B. Roussillon. "Linear regression from strategic data sources". In: *ACM Transactions on Economics and Computation (TEAC)* 8.2 (2020), pp. 1–24.

[7] J. Doncel, N. Gast, and B. Gaujal. "Discrete mean field games: Existence of equilibria and convergence". In: *Journal of Dynamics & Games* (2019), pp. 269–316.

[8] N. Gast, L. Bortolussi, and M. Tribastone. "Size Expansions of Mean Field Approximation: Transient and Steady-State Analysis." In: *Performance Evaluation* (2018).

[9] N. Gast, D. Latella, and M. Massink. "A refined mean field approximation of synchronous discrete-time population models". In: *Performance Evaluation* 126 (2018), pp. 1–21. ISSN: 0166-5316. DOI: https://doi.org/10.1016/j.peva.2018.05.002.

[10] N. Gast. "Expected Values Estimated via Mean-Field Approximation Are 1/N-Accurate". In: *Proc. ACM Meas. Anal. Comput. Syst.* 1.1 (June 2017), 17:1–17:26. ISSN: 2476-1249. DOI: 10.1145/3084454. URL: http://doi.acm.org/10.1145/3084454.

[11] N. Gast and B. Gaujal. "Computing absorbing times via fluid approximations". In: *Advances in Applied Probability* 49.3 (2017), pp. 768–790. DOI: 10.1017/apr.2017.21.

[12] N. Gast and B. Van Houdt. "A Refined Mean Field Approximation". In: *Proc. ACM Meas. Anal. Comput. Syst.* 1.2 (Dec. 2017), 33:1–33:28. ISSN: 2476-1249. DOI: 10.1145/3154491. URL: http://doi.acm.org/10.1145/3154491.

[13] N. Gast and B. Van Houdt. "TTL approximations of the cache replacement algorithms LRU(m) and h-LRU". In: *Performance Evaluation* 117 (2017), pp. 33–57. ISSN: 0166-5316. DOI: https://doi.org/10.1016/j.peva.2017.09.002. URL: http://www.sciencedirect.com/science/article/pii/S0166531617300688.

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

[15] C. Fricker and N. Gast. "Incentives and redistribution in homogeneous bike-sharing systems with stations of finite capacity". In: *Euro journal on transportation and logistics* 5.3 (2016), pp. 261–291.

[16] N. Gast and B. Van Houdt. "Transient and steady-state regime of a family of list-based cache replacement algorithms". In: *Queueing Systems* 83.3-4 (2016), pp. 293–328.

[17] N. Gast, D.-C. Tomozei, and J. Le Boudec. "Optimal generation and storage scheduling in the presence of renewable forecast uncertainties". In: *IEEE Transactions on Smart Grid* 5.3 (2014), pp. 1328–1339.

[18] R. Khalili, N. Gast, M. Popovic, and J. Le Boudec. "MPTCP is not pareto-optimal: performance issues and a possible solution". In: *IEEE/ACM Transactions on Networking (TON)* 21.5 (2013), pp. 1651–1665.

[19] N. Gast and B. Gaujal. "Markov chains with discontinuous drifts have differential inclusion limits". In: *Performance Evaluation* (2012).

[20] N. Gast, B. Gaujal, and J. Le Boudec. "Mean field for Markov decision processes: from discrete to continuous optimization". In: *IEEE Transactions on Automatic Control* 57.9 (2012), pp. 2266–2280.

[21] M. Tchiboukdjian, N. Gast, and D. Trystram. "Decentralized list scheduling". In: *Annals of Operations Research* (2012), pp. 1–23.

[22] F. Baccelli, N. Bambos, and N. Gast. "Distributed Delay-Power Control Algorithms for Bandwidth Sharing in Wireless Networks". In: *IEEE/ACM Transactions on Networking* 99 (2011).

[23] N. Gast and B. Gaujal. "A mean field approach for optimization in discrete time". In: *Discrete Event Dynamic Systems* (2011). ISSN: 0924-6703.

[24] N. Gast and B. Gaujal. "Infinite labeled trees: From rational to Sturmian trees". In: *Theoretical Computer Science* (2009).

Peer-reviewed international conferences

[25] V. Emelianov, N. Gast, and P. Loiseau. "Fairness in Selection Problems with Strategic Candidates". In: *EC 2022 - ACM Conference on Economics and Computation*. Boulder, Colorado, United States: ACM, July 2022, pp. 1–29. DOI: 10.1145/3490486.3538287. URL: https://hal.inria.fr/hal-03677966.

[26] B. Roussillon, N. Gast, P. Loiseau, and P. Mertikopoulos. "Asymptotic Degradation of Linear Regression Estimates with Strategic Data Sources". In: *ALT 2022 - 33rd International Conference on Algorithmic Learning Theory*. Paris, France, Mar. 2022, pp. 1–31. URL: https://hal.univ-grenoble-alpes.fr/hal-03593516.

[27] V. Emelianov, N. Gast, K. P. Gummadi, and P. Loiseau. "On Fair Selection in the Presence of Implicit Variance". In: *The Twenty-First ACM Conference on Economics and Computation (EC'20)*. 27 pages, 10 figures. Budapest, Hungary, July 2020. DOI: 10.1145/3391403.3399482. URL: https://hal.inria.fr/hal-02880578.

[28] J. Doncel, N. Gast, M. Tribastone, M. Tschaikowski, and A. Vandin. "UTOPIC: Under-Approximation Through Optimal Control". In: *QEST 2019*. Glasgow, United Kingdom, Sept. 2019, pp. 277–291. URL: https://hal.inria.fr/hal-02283189.

[29] V. Emelianov, G. Arvanitakis, N. Gast, K. Gummadi, and P. Loiseau. "The Price of Local Fairness in Multistage Selection". In: *Proceedings of the Twenty-Eighth International Joint Conference on Artificial Intelligence, IJCAI-19*. International Joint Conferences on Artificial Intelligence Organization, July 2019, pp. 5836–5842. DOI: 10.24963/ijcai.2019/809. URL: https://doi.org/10.24963/ijcai.2019/809.

[30] T.-E. Kennouche, F. Cadoux, N. Gast, and B. Vinot. "ASGriDS: Asynchronous Smart-Grids Distributed Simulator". In: *APPEEC 2019 - 11th IEEE PES Asia-Pacific Power and Energy Engineering Conference*. Macao, Macau SAR China: IEEE, Dec. 2019, pp. 1–5. URL: https://hal.archives-ouvertes.fr/hal-02384051.

[31] N. Gast and B. Van Houdt. "A Refined Mean Field Approximation". In: *Abstracts of the 2018 ACM International Conference on Measurement and Modeling of Computer Systems*. SIGMETRICS '18. Irvine, CA, USA: ACM, 2018, pp. 113–113. ISBN: 978-1-4503-5846-0. DOI: 10.1145/3219617.3219663. URL: http://doi.acm.org/10.1145/3219617.3219663.

[32] N. 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. Urbana-Champaign, Illinois, USA: ACM, 2017, pp. 50–50. ISBN: 978-1-4503-5032-7. DOI: 10.1145/3078505.3078523. URL: http://doi.acm.org/10.1145/3078505.3078523.

[33] L. Bortolussi and N. Gast. "Mean Field Approximation of Uncertain Stochastic Models". In: *46th Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN 2016)*. 2016.

[34] N. Gast and B. Van Houdt. "Asymptotically Exact TTL-Approximations of the Cache Replacement Algorithms LRU(m) and h-LRU". In: *28th International Teletraffic Congress (ITC 28)*. 2016.

[35] 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.

[36] N. Gast and B. Van Houdt. "Transient and Steady-state Regime of a Family of List-based Cache Replacement Algorithms". In: *Proceedings of ACM SIGMETRICS*. ACM, 2015.

[37] N. Gast, J. Le Boudec, and D. Tomozei. "Impact of Demand-Response on the Efficiency and Prices in Real-Time Electricity Markets". In: *Proceedings of ACM E-ENERGY*. 2014.

[38] N. Gast, J. Le Boudec, A. Proutière, and D. Tomozei. "Impact of Storage on the Efficiency and Prices in Real-Time Electricity Markets". In: *Proceedings of ACM E-ENERGY*. 2013.

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

[40] N. Gast, D. Tomozei, and J. Le Boudec. "Optimal Storage Policies with Wind Forecast Uncertainties". In: *ACM Greenmetrics 2012, London, UK* (2012).

[41] R. Khalili, N. Gast, M. Popovic, U. Upadhyay, and J. 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*. Best paper award. ACM. 2012, pp. 1–12.

[42] N. Gast and B. Gaujal. "A Mean Field Model of Work Stealing in Large-Scale Systems". In: *ACM SIGMETRICS* (2010).

[43] M. Tchiboukdjian, N. Gast, D. Trystram, J.-L. Roch, and J. Bernard. "A Tighter Analysis of Work Stealing". In: *ISAAC* (2010).

[44] N. Gast and B. Gaujal. "A Mean Field Approach for Optimization in Particle Systems and Applications". In: *Fourth International Conference on Performance Evaluation Methodologies and Tools, ValueTools* (2009). Best Student Paper Award.

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

[46] F. de Dinechin, A. Ershov, and N. Gast. "Towards the Post-Ultimate libm". In: *Proceedings of the 17th IEEE Symposium on Computer Arithmetic*. IEEE Computer Society. 2005, pp. 288–295. ISBN: 0769523668.

Other publications

Book Chapter

[47] L. Bortolussi and N. Gast. "Mean-field limits beyond ordinary differential equations". In: *Formal Methods for the Quantitative Evaluation of Collective Adaptive Systems*. Springer, 2016, pp. 61–82.

Patent

[48] B. Vinot, N. Gast, F. Cadoux, and R. Heliot. "Method for monitoring and controlling an electrical network". US Patent App. 16/125,106. Mar. 2019.

[49] F. Baccelli, N. Bambos, and N. Gast. *Scalable delay-power control algorithm for bandwidth sharing in wireless networks*. US Patent 8,320,269. Nov. 2012. URL: `http://www.google.com.na/patents/US8320269`.

Internet Draft

[50] R. Khalili, N. Gast, M. Popovic, and J. Le Boudec. "Opportunistic Linked-Increases Congestion Control Algorithm for MPTCP". In: *INTERNET-DRAFT* (2013). draft-khalili-OLIA-00.

[51] R. Khalili, N. Gast, M. Popovic, and J. Le Boudec. "Performance Issues with MPTCP". In: *INTERNET-DRAFT* (2012). draft-khalili-mptcp-performance-issues-01.

Workshops

[52] T. Barzola, V.-D. Cung, N. Gast, and V. Jost. "Experiments in Operations Research are Hardly Reproducible: A Bike-Sharing Case-Study." In: *23ème congrès annuel de la Société Française de Recherche Opérationnelle et d'Aide à la Décision*. INSA Lyon. Villeurbanne - Lyon, France, Feb. 2022. URL: `https://hal.archives-ouvertes.fr/hal-03595289`.

[53] S. Allmeier and N. Gast. "rmftool - A library to Compute (Refined) Mean Field Approximation(s)". In: *TOSME 2021*. Online conference, France, Nov. 2021. URL: `https://hal.inria.fr/hal-03485044`.

[54] M. Mendil, N. Gast, and H.-J. Audéoud. "Collisions groupées lors du mécanisme d'évitement de collisions de CPL-G3". In: *Rencontres Francophones sur la Conception de Protocoles, l'Évaluation de Performance et l'Expérimentation des Réseaux de Communication*. Lyon, France, Sept. 2020. URL: `https://hal.archives-ouvertes.fr/hal-02879294`.

[55] N. Gast, D. Latella, and M. Massink. "A Refined Mean Field Approximation for Synchronous Population Processes". In: vol. 46. 2. ACM, 2019, pp. 30–32.

[56] B. Vinot, F. Cadoux, and N. Gast. "Congestion Avoidance in Low-Voltage Networks by using the Advanced Metering Infrastructure". In: vol. 46. 3. ACM, 2019, pp. 89–91.

[57] J. Doncel, N. Gast, and B. Gaujal. "Are mean-field games the limits of finite stochastic games?" In: *The 18th Workshop on MAthematical performance Modeling and Analysis (MAMA)*. 2016.

[58] N. Gast. "Construction of Lyapunov functions via relative entropy with application to caching". In: *The 18th Workshop on MAthematical performance Modeling and Analysis (MAMA)*. 2016.

[59] N. Gast. "The Power of Two Choices on Graphs: the Pair-Approximation is Accurate". In: *ACM SIGMETRICS Performance Evaluation Review* (2015).

[60] N. Gast and B. Gaujal. "Mean field limit of non-smooth systems and differential inclusions". In: *ACM SIGMETRICS Performance Evaluation Review* 38.2 (2010), pp. 30–32.

Working Papers

[61] N. Gast, B. Gaujal, and C. Yan. "LP-based policies for restless bandits: necessary and sufficient conditions for (exponentially fast) asymptotic optimality". working paper or preprint. May 2022. URL: https://hal.inria.fr/hal-03262307.

[62] N. Gast, B. Gaujal, and K. Khun. "Reinforcement Learning for Markovian Bandits: Is Posterior Sampling more Scalable than Optimism?" working paper or preprint. June 2021. URL: https://hal.inria.fr/hal-03262006.

[63] N. Gast, B. Gaujal, and C. Yan. "Exponential Convergence Rate for the Asymptotic Optimality of Whittle Index Policy". working paper or preprint. Dec. 2020. URL: https://hal.inria.fr/hal-03041176.

Thesis

[64] N. Gast. "Refinements of Mean Field Approximation". Habilitation à diriger des recherches. Université Grenoble Alpes, Jan. 2020. URL: https://tel.archives-ouvertes.fr/tel-02509756.

[65] N. Gast. "Optimization and Control of Large Systems: Fighting the Curse of Dimensionality". PhD thesis. Université Grenoble Alpes, Sept. 2010. URL: https://tel.archives-ouvertes.fr/tel-01875211.