Manuel Sebastian Mariani

Personal Data

Place and Date of Birth:	Roma, Italy | 25.12.1990
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Current positions

- Sep 2017–present: **Research Associate Professor in Physics** at the Institute of Fundamental and Frontier Sciences, **University of Electronic Science and Technology of China (UESTC)**, Chengdu, China

Topics: Quantitative analysis of scientific and technological innovation, spreading processes and diffusion in networks, models of network growth, network-based ranking.

Previous positions

- Dec 2013–Oct 2017: **PhD Candidate in Physics** at the **University of Fribourg**, Switzerland

Thesis: "The temporal dimension of ranking in complex networks: algorithms, models, and applications"
Supervisor: Prof. Yi-Cheng Zhang

Thesis summary. In my thesis, I analyzed data from large real networks and growing network models to extensively study the *temporal bias* and the *performance* of network centrality metrics such as degree and PageRank. In particular, I used growing network models to understand how network formation mechanisms make the ranking by static centrality metrics biased by node age. I showed that this temporal bias can be suppressed by a suitable rescaling procedure of the original scores, which leads to a time-balanced metric called *rescaled PageRank*. As a consequence of its lack of time bias, rescaled PageRank can identify expert-selected seminal publications in papers' citation networks and expert-selected significant patents in patents' citation networks much earlier than the original PageRank metric and significantly better than (variants of) citation count. A comparison with a novel dynamic random graph model shows that the obtained results cannot be explained by the individual citation dynamics, which calls for new modeling paradigms for papers' and patents' citation networks.

- Sep 2014–Oct 2017: **Teaching assistant** at the Physics Department, **University of Fribourg**, Switzerland

Courses: Thermodynamics, Computational Physics Atelier, Quantum Statistical Mechanics, Theoretical Physics Atelier on Economic Complexity, Advanced Physics Labs, "Travaux pratiques" (laboratory program).

- Sep 2016–Jun 2017: **Visiting senior researcher** at the Guangdong Province Key Laboratory of Popular High Performance Computers, College of Computer Science and Software Engineering, **Shenzhen University**, China

Tasks: Writing the review article [Physics Reports 689: 1-54 (2017)].

Education

- Sep 2011–Jul 2013: Master of Science in Physics, **University La Sapienza, Rome**

Final mark: 110/110 *cum laude*
Topics: Theoretical physics, high-energy physics, statistical mechanics, condensed matter physics, dynamical systems.

Thesis: "Effects of density variations in out-of-equilibrium glasses"
Supervisor: Prof. Giorgio Parisi
Thesis summary. In this thesis, I studied numerically and analytically a mean-field model of hard spheres, called Mari-Kurchan model. The model is interesting because it is simple enough to be analytically solved with the replica formalism and, at the same time, it displays a dynamic glass transition at finite density. The results obtained in this thesis led to *Proc. Natl. Acad. Sci. USA 112.8: 2361-2366 (2015)*.

- Sep 2008–Sep 2011: Bachelor of Science in Physics, **University La Sapienza, Rome**

Final mark: 110/110 *cum laude*

Thesis: "Quantum Entanglement: consequences and applications"
Supervisor: Prof. Massimo Testa
Thesis summary. In this thesis, I started from Bell's inequalities and discussed how quantum theory rules out the possibility of superluminal information transmission. Classical and quantum information compression theorems were also discussed together with a few simple applications.

Fellowships and Awards

- Jun 2017: **EPS Young Researcher Grant** to participate to the SigmaPhi 2017 conference [link]
- Dec 2013 - Sep 2017 **PhD fellowship** at Physics Department, **University of Fribourg**, Switzerland
- Jul 2013: **Excellence program diploma** for outstanding M. Sc. physics student at University of Rome La Sapienza. The award was motivated by academic marks and master thesis work, and consisted in tax reimbursement.
- Sep 2011: **Excellence program diploma** for outstanding B. Sc. physics student at University of Rome La Sapienza. The award was motivated by academic marks and reports on advanced physics lectures, and consisted in tax reimbursement.

Contribution to funded projects

Submitted

- 2017 *Unveiling network nestedness: Characterisation, assemblage and modelling* , submitted to the Swiss National Science Foundation.
  My contributions: Contribution to proposal writing.
  Proposal currently under review.

Funded

- 2014-2017 *Node heterogeneity and temporal patterns in growing complex networks* (Swiss National Science Foundation, Grant No. 200020-156188).
  My contribution: Contribution to proposal writing, performing research on the proposals' tasks.
- 2013-2016 *GROWTHCOM* EU FET-Open Grant No. 611272.
  My contributions: Contribution to project reports writing, performing research on the proposals' tasks. Participation to project meetings, to the project's summer school (Lipary, Italy, September 2015), to the project's final conference "Social and Economic Change as a Complex Dynamical System 2016" (satellite of the 2016 Conference on Complex Systems, Amsterdam, Netherlands).

Publications

(*) marks the papers for which I am corresponding author.

Working papers

- M. S. Mariani, Z.-M. Ren, C. J. Tessone, *Nestedness in complex networks*, proposal to be submitted to Physics Reports.
- F. Iannelli, M. S. Mariani, I. Sokolov, *Network centrality based on reaction-diffusion dynamics reveals influential spreaders*, in preparation, to be submitted to Nature Communications.
- A. Sole-Ribalta, C. J. Tessone, M. S. Mariani, J. Borge-Hoefstader, *Revaling In-Block Nestedness: a pervasive structural pattern in networks*, to be submitted to Proceedings of the National Academy of Sciences.
- (*) Z.-M. Ren, M. S. Mariani, M. Medo, Y.-C. Zhang, *"A time-respecting null model for growing networks"*, to be submitted to Physical Review E, pre-print: https://arxiv.org/abs/1703.07656.

Submitted

- (*) M. S. Mariani, M. Medo, F. Lafond, *Early identification of important patents through network centrality*, submitted to Technological Forecasting and Social Change, pre-print: https://arxiv.org/abs/1710.09182.

Published

8. (*) H. Liao, M. S. Mariani, M. Medo, Y.-C. Zhang, M.-Y. Zhou, *"Ranking in evolving complex networks"*, Physics Reports 689: 1-54 (2017) [doi].
7. (*) G. Vaccario, M. Medo, N. Wider, M. S. Mariani, *"Quantifying and suppressing ranking bias in a large citation network"*, Journal of Informetrics, 11: 766-782 (2017).
6. (*) M. S. Mariani, M. Medo, Y.-C. Zhang, *"Identification of milestone papers through time-balanced network centrality"*, Journal of Informetrics 10: 1207-1223 (2016).
5. M. Medo, M. S. Mariani, A. Zeng, Y.-C. Zhang, *"Identification and impact of discoverers in online social systems"*, Scientific Reports 6: 34218 (2016).
4. (*) R.-J. Wu, G.-Y. Shi, Y.-C. Zhang, M. S. Mariani, *"The mathematics of non-linear metrics for nested networks"*, Physica A 460: 254-269 (2016).
3. (*) M. S. Mariani, M. Medo, and Y.-C. Zhang, *"Ranking nodes in growing networks: When PageRank fails"*, Scientific Reports 5:16181 (2015).
2. (*) M. S. Mariani, A. Vidmer, M. Medo, Y.-C. Zhang, *"Measuring economic complexity of countries and products: which metric to use?"*, European Physical Journal B 88.11: 1-9 (2015).
1. M. S. Mariani, G. Parisi, and C. Rainone. *"Calorimetric glass transition in a mean-field theory approach"* Proceedings of the National Academy of Sciences 112.8: 2361-2366 (2015).

Talks, lectures and posters

Conferences

- July 2017: **Contributed talk** at the SigmaPhi 2017 conference, Corfu, Greece. Title of the talk: *A time-respecting null model to explore the structure of growing networks.*
- July 2017: **Contributed talk** at the SigmaPhi 2017 conference, Corfu, Greece. Title of the talk: *Early-identification of significant nodes in growing networks.*
- September 2016: **Contributed talk** at the 2016 Conference on Complex Systems, Amsterdam, Netherlands. Title of the talk: *Early identification of milestone papers.*
- September 2016: **Invited talk** at the conference "Social and Economic Change as a Complex Dynamical System 2016", satellite of the 2016 Conference on Complex Systems, Amsterdam, Netherlands. Title of the talk: *The essential role of time in information filtering.*
- July 2016: **Contributed talk** at the conference "Complex Networks", Marseille, France. Title of the talk: *Early identification of milestone papers.*
- October 2015: **Poster** at the conference "Challenges in Data Science: a complex systems perspective", Turin, Italy. Title of the poster: *Quantifying scientific impact: how (not) to use Google's PageRank.*

Workshops and schools

- September 2017: **Invited talk** at the workshop "Complex networks: from socio-economic systems to biology and brain", Lipari, Italy: *Identification of significant papers and patents in citation networks: citation count or PageRank?*.
- September 2015: **Invited lecture** at the Growthcom Summer School on Socio-Economic Complex Systems, Lipari, Italy. Title of the lecture: *An analytic computation of country fitness*.

Seminars

- June 2017: **Invited talk** at Alibaba Business College, Hangzhou, China. Title of the talk: *The temporal dimension of ranking in growing networks*.
- April 2017: **Invited talk** at Shanghai University of Economics and Finance, Shanghai, China. Title of the talk: *The temporal dimension of complex networks and its application to ranking, null models and community detection*.
- April 2017: **Invited talk** at College of Computer Science and Software Engineering, Shenzhen University, Shenzhen, China. Title of the talk: *Understanding and improving the performance of PageRank in growing networks*.
- February 2016: **Invited talk** at the Network Seminars at University of Zurich, Zurich, Switzerland. Title of the talk: *Understanding and improving the performance of PageRank in growing networks*.

Teaching

- Sep 2014–present: Teaching assistant at Physics Department, **University of Fribourg**, Switzerland

In the last three years, I have gained teaching experience in experimental physics, theoretical physics, computational physics, and complex systems. I list below the courses for which I have been assistant.

- Spring 2017: **Thermodynamics** (undergraduate level; French; course held by Prof. Yi-Cheng Zhang). I solved the course's exercises in class and graded students' work.
- Spring 2017: **Computational Physics Atelier** (graduate level; French; program supervised by Prof. Matus Medo). I followed students' projects on numerical methods for the solution of ordinary differential equations. I corrected the students' reports.
- Fall 2016: **Quantum Statistical Mechanics** (graduate level; French; course held by Prof. Yi-Cheng Zhang). I solved the course's exercises in class and graded students' work. I also gave a two-hour lecture on Bose-Einstein condensation.
- Spring 2015: **Theoretical Physics Atelier** (graduate level; English; program supervised by Prof. Matus Medo). I gave a series of lectures on complex networks and the recent economic complexity approach.
- 2015, Spring 2016: **Advanced Physics Labs** (undergraduate level; 2015, French; laboratory program supervised by Dr. Victor Lebedev). I was assistant for physics experiments for first year Bachelor students in physics, chemistry, biology and mathematics. I supervised the students' laboratory work and graded their reports.
- Fall 2014: **"Travaux pratiques"** (undergraduate level; French; laboratory program supervised by Dr. Veronique Trappe). I was assistant of physics experiments for first year Bachelor students in medicine and biomedicine. I supervised the students' laboratory work.

Computer Skills

Operating system:	Linux
Programming languages:	C++, C, Python
Network packages:	networkx, igraph.
Text editors:	Kile, Emacs, Geany.
Text editing languages:	Latex.

Languages

Italian:	Mother tongue
English:	Fluent
French:	Fluent
German:	Beginner

Online resources

- **Quantifying ranking bias:** To allow other researcher to easily implement the statistical test for ranking bias introduced in [https://arxiv.org/abs/1703.08071], my co-authors and I made the respective code publicly available at [https://github.com/giava90/quantifying-ranking-bias] together with a quick tutorial on how to use it at [https://www.sg.ethz.ch/team/people/gvaccario/quantifying-ranking-bias/].
- **Sciencenow.info:** I am one of the developers of the website http://sciencenow.info/, where it is possible to search physics papers with the rescaled PageRank metric, introduced in [*J. Informetr. 10: 1207-1223 (2016)*]. The main idea is that with our website, scholars can easily discover not only old influential papers, but also *recent* papers that are highly relevant for current lines of research.

Other informations

- **Reviewer activity:** Reviewer for *Journal of Informetrics, Scientific Reports, EPJ Data Science, Journal of Computational and Applied Mathematics*.
- **Event organization:** I coordinated the organization of the Fribourg Physics Department's summer event (apero, dinner and after-dinner for the Department's staff) in 2014 and 2015.
- **Personal interests:** Sport (running, cycling, swimming), reading, languages, differences and analogies between different cultures.