

# NICOLÒ PAGAN, Ph.D. ETH



## ABOUT ME

I am a computational data science engineer with a multi-disciplinary background in the social, economic, behavioural, and network sciences.

## RESEARCH INTERESTS

I have a strong passion for mathematical modelling of real-world problems using **numerical simulations** and **generative AI**. My primary research interests lie in the area of **algorithmic fairness**, where I explore the complex interplay between **AI** and **human decision-making** so that I can design effective long-term interventions that foster social well-being.

## KEYWORDS

Algorithmic Fairness, Generative AI, Complex Systems, Human/AI decision-making, Social Networks

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## EXPERIENCE

### ACADEMIC

01 / 2022 - Present

**Research Fellow**, NCCR Automation (Swiss National Science Foundation)

05 / 2021 - Present

**Postdoctoral Researcher**, Social Computing Group, Department of Informatics, University of Zurich

*Mentor:* Prof. Dr. Anikó Hannák

05 / 2021 - 11 / 2021

**Postdoctoral Researcher**, Social Networks Lab, Department of Humanities, Social and Political Sciences, ETH Zurich

*Mentor:* Prof. Dr. Christoph Stadtfeld

02 / 2021 - 05 / 2021

**Lecturer**, Social Computing Group, Department of Informatics, University of Zurich

### PROFESSIONAL

05 / 2013 - 12 / 2015

**Software Engineer** and **Research Consultant** in Computational Fluid-Dynamics (CFD). Ascomp AG (Zürich, Switzerland).

07 / 2012 - 08 / 2012

**Software Engineer Intern** at FLUXiM AG (Winterthur, Switzerland)

## EDUCATION

2016 - 2021

**Ph.D.**, Automatic Control Laboratory, Department of Information Technology and Electrical Engineering, ETH Zurich

*Thesis:* Modeling, analysis, and inference in social network formation

*Advisor:* Prof. Dr. Florian Dörfler

2011 - 2013

**M.Sc. in Computational Science and Engineering** (5.45/6), EPF Lausanne

*Thesis:* Coupling 1D system code OLGA with TransAT CFD

*Advisors:* Prof. Dr. François Gallaire, Dr. Sylvain Reboux

2007 - 2010

**B.Sc. in Mathematical Engineering** (110/110 cum Laude), Politecnico di Torino

*Thesis:* Analysis of the car behaviour while transiting on an active speed bump

*Advisor:* Prof. Dr. Luigi Preziosi

## PUBLICATIONS

### SELECTED

- 2023 **N. Pagan\***, J. Baumann\*, E. Elokda, G. De Pasquale, S. Bolognani, and A. Hannák: A Classification of Feedback Loops and Their Relation to Biases in Automated Decision-Making Systems. 3<sup>rd</sup> ACM Conference on Equity and Access in Algorithms, Mechanisms, and Optimization (EAAMO '23).
- 2021 **N. Pagan**, W. Mei, C. Li, and F. Dörfler. A meritocratic network formation model for the rise of social media influencers. *Nature Communications* 12, 6865 (2021).
- 2019 **N. Pagan**, and F. Dörfler. Game theoretical inference of human behavior in social networks. *Nature Communications* 10, 5507 (2019).

## GRANTS

- 01 / 2022 - 12 / 2023 *Ethical Auditing of Control Systems Methods*, Swiss National Science Foundation (SNSF). Grant #180545. CHF 192'000.

## HONORS AND AWARDS

- 2020 Featured in the Top 50 Physics Articles in Nature Communications
- 2019 Invited by the Department of Mathematical Sciences at Politecnico di Torino during the *Department of Excellence 2018-2022* program: awarded a scholarship
- 2011 Erasmus program at EPF Lausanne. Awarded a scholarship
- 2010 Admitted to the 7<sup>th</sup> cycle of *Alta Scuola Politecnica* Educational program
- 2007 Rank 1<sup>st</sup> at the Engineering admission test at Politecnico di Torino: awarded a scholarship
- 2007 High School Diploma: awarded with special distinction and a scholarship

## INVITED TALKS

- 03 / 04 / 2023 *Strategic Interactions among Social Media Content Creators*, Workshop on Games on Networks, National University of Singapore.
- 28 / 02 / 2023 *Social Computing: Bridging the Gap Between Technology and Human Interaction*, Digital Society Initiative (DSI) Professors Presentations, Zürich.
- 01 / 09 / 2022 *The Interplay Between Content Quality and Recommender Systems in Social Network Dynamics*. **Keynote** at the Media Consumption Habits of Young People workshop, European Alliance of News Agencies (EANA), Zürich.
- 15 / 07 / 2021 *A meritocratic network formation model for the rise of social media influencers* Doctoral course on Mining knowledge from complex network, Torino (online)
- 12 / 12 / 2020 *A meritocratic network formation model for the rise of social media influencers* Dynamics in Social and Economic Networks, CDC, South Korea (online)
- 21 / 09 / 2020 *Game Theoretical Inference of Human Behaviour in Social Networks*, Autonomy Talk, IDSC, ETH Zurich (online).
- 09 / 06 / 2020 *Game Theoretical Inference of Human Behaviour in Social Networks*, Intelligent Control Seminar, Peking University (online).
- 28 / 11 / 2019 *Game Theoretical Inference of Human Behaviour in Social Networks*, Workshop on Networks Dynamics in the Social, Economic, and Financial Sciences, Torino.

## TEACHING

2022	<b>Examiner</b> of <i>Fundamentals of People Oriented Computing</i> , Department of Informatics, University of Zurich
2021	<b>Lecturer</b> of <i>Social Computing</i> , Department of Informatics, University of Zurich
2019 - 2020	<b>Head Teaching Assistant</b> of <i>Game Theory and Control</i> , Department of Information Technology and Electrical Engineering, ETH Zurich
2016 - 2019	<b>Head Teaching Assistant</b> of <i>Linear Systems Theory</i> , Department of Information Technology and Electrical Engineering, ETH Zurich
2017 - 2018	<b>Head Teaching Assistant</b> of <i>Non-linear Systems and Control</i> , Department of Information Technology and Electrical Engineering, ETH Zurich
2012	<b>Teaching Assistant</b> of Informatics 2, Department of Informatics, EPF Lausanne

## SUPERVISING

10 / 2023 - present	Jiaqi Zhang, University of Zurich. Master Thesis: <i>Using generative AI for modelling large-scale human behaviour for health notification interventions</i>
03 / 2023 - 08 / 2023	Michael Blum, University of Zurich. Independent Study: <i>How Specialization Shapes Pattern Recognition: Empirical Evidence from the Domain of Chess</i> .
05 / 2022 - 05 / 2023	Maria Helena Margareta Pelli and Andrianos Michail, University of Zurich. Master Project: <i>A longitudinal study of emotions on Twitter chains of re-tweets</i>
03 / 2022 - 07 / 2022	Jules Authier, ETH Zurich. Semester Project: <i>Analysis of the Closed-Loop between Recommender Systems and Opinion Dynamics</i>
06 / 2021 - 11 / 2021	Michael Blum, University of Zurich. Bachelor Thesis: <i>Learning and success in chess: the role of openings patterns</i>
09 / 2020 - 04 / 2021	Anna M. Maddux, ETH Zurich. Master Thesis: <i>Behavior estimation in dynamic games</i>
05 / 2020 - 12 / 2020	Cheng Li, ETH Zurich. Master Thesis: <i>Data-driven analysis of the ranking-quality network formation model</i>
05 / 2017 - 08 / 2018	Marco Buob, ETH Zurich. Semester Project: <i>Dynamics of cooperative agents in social network formation: theory and simulation</i>
10 / 2017 - 02 / 2018	Tomer Gidron, ETH Zurich. Semester Project: <i>Centrality games in social and economic networks</i>
02 / 2015 - 08 / 2015	Jiadong Bao, ETH Zurich. Master Thesis at Ascomp AG: <i>Cathare-TransAT Coupling for the Prediction of Boron Dilution in the ROCOM Test Facility</i>
02 / 2014 - 08 / 2014	Hassan Bahramian, Politecnico di Milano. Master Thesis at ASCOMP AG: <i>Coupling 1D System Code with TransAT CFD</i>

## REVIEW ACTIVITY

Journals	Nature Communications, Artificial Intelligence Reviews, Automatica, Chaos, Journal of Complex Networks, VLDB, IEEE Transactions on Control of Network Systems
Conferences	The Web Conference, International Conference on Computational Social Science (IC2S2), ACM Conference on Fairness, Accountability, and Transparency (FAccT), Network Science Conference (NetSci), Complex Networks Conference, European and American Control Conferences (ECC, ACC), IFAC World Congress
Conference Organizer	IC2S2 2022

## INDEPENDENT COURSES

10 / 2021	AI + X Summit Workshop, Zürich
06 / 2020	Data Science in Techno-Socio-Economic Systems Workshop, ETH Zurich and NYU Courant (online)
11 / 2019	Network Dynamics in the Social, Economic, and Financial Sciences Workshop, Politecnico di Torino
06 / 2018	Summer School on Economic Networks, Oxford
10 / 2017	Autonomous Decision-Making Workshop, ETH Risk Center, Zürich

## IT SKILLS

Software

### Foundational

MacOS-Unix  
Windows OS  
MS Office  
iWork

### Programming

C / C++  
Bash  
Fortran  
Git

### Data Science

Python/R  
SQL/Pandas  
TensorFlow  
Tableau

### Web Tools

HTML  
CSS

## LANGUAGES

Mother Tongue  
Other Languages

Italian  
English C2 | French B1 | German A2

## APPENDIX

Full list of publications  
List of conference talks

## REFERENCES

**Prof. Dr. Anikó Hannák**, Assistant Professor, Social Computing Group,  
Department of Informatics, University of Zurich  
[hannak@ifi.uzh.ch](mailto:hannak@ifi.uzh.ch)

**Prof. Dr. Florian Dörfler**, Associate Professor, Automatic Control Laboratory,  
Department of Information Technology and Electrical Engineering, ETH Zurich  
[dorfler@ethz.ch](mailto:dorfler@ethz.ch)

## PERSONAL INFO

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20.12.1988, Italy  
C Permit (CH)  
B Driving License, own auto

## FULL LIST OF PUBLICATIONS

## Journal Articles

- [J3] S. Ioneuscu, A. Hannák, and **N. Pagan**: The Role of Luck in the Success of Social Media Influencers, *Applied Network Science* (2023).
- [J2] **N. Pagan**, W. Mei, C. Li, and F. Dörfler: A meritocratic network formation model for the rise of social media influencers, *Nature Communications* 12, 6865 (2021).
- [J1] **N. Pagan** and F. Dörfler: Game theoretical inference of human behavior in social networks, *Nature Communications* 10, 5507 (2019).

## Conference Articles

- [C9] A. Bouleimen, **N. Pagan**, S. Cresci, A. Urman, G. Nogara, and S. Giordano. *Dynamics of toxic behavior in the Covid-19 vaccination debate*. Forthcoming at the 12<sup>th</sup> International Conference on Complex Networks and their Applications (2023).
- [C8] **N. Pagan\***, J. Baumann\*, E. Elokda, G. De Pasquale, S. Bolognani, and A. Hannák: A Classification of Feedback Loops and Their Relation to Biases in Automated Decision-Making Systems, 3<sup>rd</sup> ACM Conference on Equity and Access in Algorithms, Mechanisms, and Optimization (EAAMO '23), Manuscript available upon request.
- [C7] S. Ionescu, A. Hannák, and **N. Pagan**: Group Fairness for Content Creators: the Role of Human and Algorithmic Biases under Popularity-based Recommendations, 17<sup>th</sup> ACM Conference on Recommender Systems 2023. Manuscript available upon request.
- [C6] N. Lanzetti, F. Dörfler, and **N. Pagan**: The Impact of Recommendation Systems on Opinion Dynamics: Microscopic versus Macroscopic Effects, 62<sup>nd</sup> IEEE Conference on Decision and Control (CDC) (2023). Manuscript available upon request.
- [C5] A. Maddux, **N. Pagan**, G. Belgioioso, and F. Dörfler: Data-Driven Behaviour Estimation in Parametric Games, 22<sup>nd</sup> World Congress of the International Federation of Automatic Control (2023).
- [C4] S. Ionescu, **N. Pagan**, and A. Hannák: Individual Fairness for Social Media Influencers, The 11<sup>th</sup> International Conference on Complex Networks and their Applications (2022).
- [C3] J. Bao, S. Reboux, **N. Pagan**, and D. Lakehal: *Cathare-TransAT Coupling for the Prediction of Boron Dilution in the ROCOM Test Facility*, 16<sup>th</sup> International Topical Meeting on Nuclear Reactor Thermal Hydraulics, (2015).
- [C2] Labois, M., **N. Pagan**, D. Lakehal, and C. Narayanan: *Computational modelling of subsea hydrate formation and associated risks and impact on flow assurance*, In Proceeding of 10<sup>th</sup> International Conference on CFD in the Minerals and Process Industries. (2014)

[C1] S. Altazin, B. Perucco, **N. Pagan**, K. Lapagna, T. Lanz, R. Knaack, E. Knapp, B. Ruhstaller: *Multi-scale modeling of organic light-emitting devices*, SID Symposium Digest of Technical Papers (2013).

Conference Articles - Under Review

[C10] A. Michail\*, M. H. M. Pelli\*, A. M. Günster, and **N. Pagan**: *Emotions and Opinion Biases on Social Media: The Case of Abortion on Twitter*. Under review at The Web Conference 2024. Manuscript available upon request.

Manuscripts in Preparation

[J5] **N. Pagan** and J. Baumann: *Feedback loops in Automated Decision-Making Systems: a review*. Manuscript available upon request.

[J4] M. Blum and **N. Pagan**: *How Specialization Shapes Pattern Recognition: Empirical Evidence from the Domain of Chess*. Manuscript available upon request.

Extended Abstracts

[[EA6] **N. Pagan\***, J. Baumann\*, E. Elokda, G. De Pasquale, S. Bolognani, and A. Hannák: Closing the Loop: Feedback Loops and Biases in Automated Decision-Making Systems, 2<sup>nd</sup> European Workshop on Algorithmic Fairness (EWAf'23).

[EA5] **N. Pagan\***, J. Baumann\*, E. Elokda, G. De Pasquale, S. Bolognani, and A. Hannák: Closing the Loop: Feedback Loops and Biases in Automated Decision-Making Systems, 9<sup>th</sup> International Conference on Computational Social Science (IC2S2) 2023.

[EA4] A. Bouleimen, **N. Pagan**, S. Cresci, A. Urman, G. Nogara, and S. Giordano: User's Reaction Patterns in Online Social Network Communities, the International School and Conference on Network Science (NetSci) (2023).

[EA3] S. Ionescu, A. Hannák, and **N. Pagan**: The impact of users' homophily and recommendation biases on social network inequalities, the International School and Conference on Network Science (NetSci) (2023).

[EA2] **N. Pagan**, W. Mei, and F. Dörfler: Emergence of Zipf's law among social networks influencers, IFAC Conference on Networked Systems (NecSys) (2022).

[EA1] **N. Pagan** and F. Dörfler: *Learning strategic behavior in social and economic networks*, The 7<sup>th</sup> International Conference on Complex Networks and Their Applications: book of abstracts, p.207-209 (2018).

Monograph

[Th1] **N. Pagan**: Modeling, analysis, and inference in social network formation, ETH Zurich Research Collection (2021).

Media Coverage

[M3] Mathematics: Investigating how social media influencers arise, In: NatureAsia (2021).

[M2] What influences the rise of influencers?, In: Phys.org (2021).

[M1] **N. Pagan** Can social network structure reveal human behavior?, Behind the paper blog post at Behavioural and Social Sciences - Nature Research (2019).

## LIST OF CONFERENCE TALKS

- 01 / 11 / 2023    *A Classification of Feedback Loops and Their Relation to Biases in Automated Decision-Making Systems,*  
The 3<sup>rd</sup> ACM conference on Equity and Access in Algorithms, Mechanisms, and Optimization (EAAMO'23), Boston (USA).
- 08 / 11 / 2022    *Individual Fairness for Social Media Influencers,*  
11<sup>th</sup> International Conference on Complex Networks and their Applications, Palermo (Italy)
- 08 / 09 / 2021    *A meritocratic network formation model for User-Generated Content based platforms,*  
5<sup>th</sup> European Conference on Social Networks, Naples (Italy)
- 12 / 12 / 2018    *Learning strategic behavior in social and economic networks,*  
7<sup>th</sup> International Conference on Complex Networks, Cambridge (UK)
- 12 / 06 / 2018    *Social network formation: from individual incentives to systemic stability,*  
GameNet at NETSCI, Paris (France)
- 14 / 02 / 2018    *From individuals decisions to emerging social structure,*  
Infrastructure Resilience Conference, Zürich (Switzerland)