Pablo Moriano

Contact information	Oak Ridge National Laboratory PO Box 2008, MS6015 Oak Ridge, TN 37831-6015, USA	*Mobile:* +1 (812) 219-6057 *E-mail:* moriano@ornl.gov *Web:* pmoriano.com

Research interests: Data Science, Machine Learning, Network Science, Cybersecurity

Education

Indiana University, Bloomington, IN

Ph.D., Informatics — **May 2019**

- Dissertation: Anomaly Detection in Real-World Temporal Networks
- Committee: L. Jean Camp, Yong-Yeol Ahn, Filippo Radicchi, Raquel Hill
- Minor in Statistical Science
- GPA: 3.94/4.00

M.S., Informatics — **October 2017**

- GPA: 3.88/4.00

Pontificia Universidad Javeriana, Colombia

M.S., Electrical Engineering — **October 2011**

- Master thesis: Heavy-tailed distributions from local decision-making strategies
- Advisor: Jorge Finke
- *Summa cum laude*, with highest distinction
- Ranked top 1%, GPA: 4.74/5.00

B.S., Electrical Engineering — **May 2008**

- *Summa cum laude*, with highest distinction
- Ranked top 1%, GPA: 4.45/5.00

Highlights

Selected Honors and Awards

- Research Gift. PI: Understanding Software Quality in Developer-Component Temporal Graphs, **Cisco Systems, Inc.**, ($87,000) 2018
- Best Paper Award, 9th ACM CCS International Workshop on Managing Insider Security Threats (**MIST**) 2017
- Science, Technology, and Innovation Scholar, **Minciencias** 2014
- Graduate Studies Scholarship, **Colfuturo** 2013
- Outstanding Lecturer, Department of Electrical Engineering and Computer Science, **Pontificia Universidad Javeriana** 2013
- Outstanding Young Researcher Award, **Minciencias**, ($10,000) 2010
- Dean's List, Department of Electrical Engineering and Computer Science, **Pontificia Universidad Javeriana** (top 1%) 2003–2007

Professional Experience

Oak Ridge National Laboratory, Oak Ridge, TN

Research & Development Associate Staff Member — **April 2020 to Present**

- Research scientist in the Computer Science and Mathematics Division working with the Discrete Computing Systems Group. The group uses artificial intelligence and supercomputing for modeling, computing, and analyzing advanced man-made systems and processes.

Indiana University, **Center for Security and Privacy in Informatics, Computing, and Engineering**, Bloomington, IN

Postdoctoral Research Associate **May 2019 to March 2020**

- Conducted research on analysis of BGP routing updates for early identification of man-in-the-middle (MITM) attacks using statistical analysis and machine learning.
- Characterized groups and features of developers more prone to introduce vulnerable commits using network science and machine learning methods.
- Analyzed privacy-related survey data to understand differences between samples of individuals using unsupervised learning.

Research Assistant **June 2015 to April 2019**

- Analyzed a dataset of routing anomalies using unsupervised machine learning methods to understand country-based generation of those.
- Collected a dataset of BGP routing updates for time series analysis of hijacking events.
- Conducted network analysis on BGP updates and proposed a framework of early identification of large-scale network disruptions.
- Performed statistical analysis of large-scale computer security surveys to distinguish traits between experts and non-experts security practitioners.
- Published 3 first author research articles on data-driven security applied to routing anomaly detection.
- Devised projects while teaching and mentoring 1 undergraduate and 3 graduate students.

  PI: **L. Jean Camp**

Research Assistant **September 2013 to July 2014**

- Conducted Twitter data analysis to understand how scientific publications spread online and presented results at an international conference.

  PIs: **Filippo Menczer** and **Alessandro Flammini**

Cisco Systems, Inc., Knoxville, TN

Research Intern **Summers 2016, 2017, and 2018**

- Designed and implemented an anomaly detection method based on temporal network analysis for identifying suspicious commits in Cisco's IOS codebase.
- Established collaborations to conduct experiments requiring specific techniques.
- Published a first author research article on insider threat event detection in the 9th ACM CCS International Workshop on Managing Insider Security Threats (MIST), which results in best paper award.
- Presented results at an international conference attended by more than 500 scientists.
- Participated in additional research that lead to an accepted research proposal for investigating vulnerability prediction in Cisco's codebases for over $60,000.
- Reported progress at regular meetings with the company SVP.

  Mentor: **Steven Rich**

Pontificia Universidad Javeriana, Colombia

Research Assistant **February 2009 to July 2013**

- Developed software for constructing models of networks that have both heavy-tail degree distributions and high degrees of clustering.
- Participated in additional research that lead to an accepted research proposal with Colombian's National Science Department for investigating methods for anomaly detection in networks for $10,000.
- Published 3 first author research articles on mechanisms of network formation.
- Presented results at 3 international conferences in control systems.

  PI: **Jorge Finke**

Teaching Experience

Indiana University, Bloomington, IN
Associate Instructor **August 2014 to May 2015**

- Assisted in teaching 2 undergraduate courses ranging in size from 20-80 students on topics including: Discrete mathematics, programming in Python, and statistics.
- Led weekly laboratory and/or problem-solving and discussion sections for groups of 5-10 students.
- Supervised students in final projects, graded exams and weekly homework.

Pontificia Universidad Javeriana, Colombia
Lecturer **July 2011 to July 2013**

- Recognized as an outstanding lecturer while teaching an undergraduate introduction to programming class of about 30 students.
- Prepared course material including laboratory experiments, lectures, exams, homework, and practice problems.

Publications

Peer Reviewed Journals

[J8] **P. Moriano**, R. Hill, and L. J. Camp. **Early Detection of BGP Routing Anomalies From Bursty Announcements**. *Under review*, arXiv:1905.05835, 2019.
[J7] **P. Moriano**, J. Finke, and Y.-Y. Ahn. **Community-Based Event Detection in Temporal Networks**. *Scientific Reports*, vol. 9, no. 1, p. 4358, 2019.
[J6] **P. Moriano**, J. Pendleton, S. Rich, and L. J. Camp. **Stopping the Insider at the Gates: Protecting Organizational Assets Through Graph Mining**. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications*, vol. 9, no. 1, pp. 4–29, 2018.
[J5] **P. Moriano**, S. Achar, and L. J. Camp. **Incompetents, criminals, or spies: Macroeconomic analysis of routing anomalies**. *Computers & Security*, vol. 70, pp. 319–334, 2017.
[J4] P. Rajivan, **P. Moriano**, T. Kelley, and L. J. Camp. **Factors in an end user security expertise instrument**. *Information and Computer Security*, vol. 25, no. 2, pp. 190–205, 2017.
[J3] **P. Moriano** and J. Finke. **On the formation of structure in growing networks**. *Journal of Statistical Mechanics: Theory and Experiment*, 2013 (06), P06010.
[J2] **P. Moriano** and J. Finke. **Power-law weighted networks from local attachments**. *Europhysics Letters*, vol. 99, no. 1, p.18002(6), 2012.
[J1] **P. Moriano** and F. Naranjo. **Modelado y control de un nuevo sistema bola viga con levitación magnética**. *Revista Iberoamericana de Automática e Informática Industrial*, vol. 9, no. 3, pp. 249–258, 2012.

Peer Reviewed Conferences

[C6] J. Dev, **P. Moriano**, and L. J. Camp. **Lessons Learnt from Comparing WhatsApp Privacy Concerns Across Saudi and Indian Populations**. In Proceedings of the *Sixteenth Usenix Symposium on Usable Privacy and Security (SOUPS)*, pp. 81–97, Virtual Conference, August 2020.
[C5] P. Rajivan, **P. Moriano**, T. Kelley, and L. J. Camp. **What Can Johnny Do? – Factors in an End-User Expertise Instrument**. In Proceedings of the *Tenth International Symposium on Human Aspects of Information Security & Assurance (HAISA)*, pp. 199–208, Frankfurt, Germany, July 2016.
[C4] **P. Moriano** and J. Finke. **Model-based fraud detection in growing networks**. In Proceedings of the *IEEE Conference on Decision and Control (CDC)*, pp. 6068–6073, Los Angeles, CA, USA, December 2014.

[C3] **P. Moriano** and J. Finke. **Characterizing the relationship between degree distributions and community structures**. In Proceedings of the *American Control Conference (ACC)*, pp. 2383–2388, Portland, OR, USA, June 2014.
[C2] **P. Moriano** and J. Finke. **Structure of growing networks with no preferential attachment**. In Proceedings of the *American Control Conference (ACC)*, pp. 1088–1093, Washington, DC, USA, June 2013.
[C1] **P. Moriano** and J. Finke. **Heavy-tailed weighted networks from local attachment strategies**. In Proceedings of the *50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC)*, pp. 5211–5216, Orlando, FL, USA, December 2011.

Referred Workshops

[W3] **P. Moriano**, J. Pendleton, S. Rich, and L. J. Camp. **Insider Threat Event Detection in User-System Interactions**. In Proceedings of the *9th ACM CCS International Workshop on Managing Insider Security Threats (MIST)*, pp. 1–12, Dallas, TX, USA, October 2017 (**Best paper award**).
[W2] **P. Moriano**, E. Ferrara, A. Flammini, and F. Menczer. **Dissemination of scholarly literature in social media**. In Proceedings of the *ACM Web of Science Conference Workshop Altmetrics*, Bloomington, IN, USA, June 2014.
[W1] **P. Moriano** and F. Naranjo. **Modelado de un nuevo sistema bola viga con levitación magnética**. In Proceedings of the *4th IEEE Colombian Workshop on Robotics and Automation*, Cali, Colombia, August 2008.

Referred Abstracts & **Posters**

[A5] **P. Moriano**, J. Finke, and Y.-Y. Ahn. **Community-Based Event Detection in Temporal Networks**. In *LatinX in AI Workshop at ICML*, Long Beach, CA, USA, June 2019.
[A4] **P. Moriano**, R. Hill, and L. J. Camp. **Hijacking Network Traffic: Temporal Analysis of Adverse Changes in the Internet Topology**. In *Conference on Complex Systems (CCS)*, Thessaloniki, Greece, September 2018.
[A3] C. McElroy, **P. Moriano**, and L. J. Camp. **On Predicting BGP Anomalous Incidents: A Bayesian Approach**. In *Network and Distributed Security Symposium (NDSS)*, San Diego, CA, USA, February 2018 (**Honorable mention**).
[A2] **P. Moriano**, J. Finke, and Y.-Y. Ahn. **Community-based anomalous event detection in temporal networks**. In *Conference on Complex Systems (CCS)*, Cancún, Mexico, September 2017.
[A1] **P. Moriano**, S. Achar, and L. J. Camp. **Macroeconomic Analysis of Routing Anomalies**. In *Telecommunications Policy Research Conference (TPRC)*, Arlington, VA, USA, October 2016 (**Honorable mention**).

Work in Progress

[WP2] **P. Moriano** and K. Perumalla. **Using Knowledge Graphs for Verifying Security Specifications in Cyber-Physical Systems**. In preparation.
[WP1] **P. Moriano**, C. McElroy, and L. J. Camp. **On predicting BGP hijacking incidents: A Bayesian approach**. In preparation.

Other Publications

[O1] **P. Moriano**. **Anomaly Detection in Real-World Temporal Networks**. Ph.D. Dissertation, Indiana University, 2019.

Awards

Gifts

- PI: Understanding Software Quality in Developer-Component Temporal Graphs, **Cisco Systems, Inc.**, ($87,000) 2018

Indiana University, Bloomington, IN
- Research and Teaching Assistantship 2013–2017

Minciencias, Colombia
- Science, Technology, and Innovation Scholar 2014
- Outstanding Young Researcher Award ($10,000) 2010

Colfuturo, Colombia
- Graduate Studies Scholarship 2013

Pontificia Universidad Javeriana, Colombia
- Outstanding Lecturer 2013
- Outstanding Master Thesis 2011
- M.S. Research Scholarship 2009–2011
- Outstanding Undergraduate Thesis 2008
- Dean's List 2003–2007

Travel Grants ($9,850 in total)
- CMD-IT Academic Careers Workshop (Virtual) 2020
- ACM Architectural Support for Programming Languages and Operating Systems (ASPLOS) ($1,600) 2020
- ACM-IMS Interdisciplinary Summit on the Foundations of Data Science ($1,100) 2019
- International Conference in Machine Learning (ICML) ($1,250) 2019
- CRA Grad Cohort Workshop for URMD ($1,500) 2019
- Tapia Conference Doctoral Consortium ($1,500) 2018
- IU Graduate and Professional Student Government ($500) 2017
- IEEE Symposium on Security and Privacy (IEEE S&P) ($900) 2017
- GREPSEC III Workshop ($700) 2017
- American Control Conference (ACC) ($800) 2014

Best Paper Award
- 9th ACM CCS International Workshop on Managing Insider Security Threats **(MIST)** 2017

Talks and events

Invited Talks

- **Next Generation Anomaly Detection**. United States Army Research Laboratory 2019
- **Data and Network Science Methods for Detecting Anomalies in Time-Varying Networked Systems**. Oak Ridge National Laboratory 2019
- **Next Generation Anomaly Detection**. Information Sciences Institute. University of Southern California 2019
- **Macroeconomic analysis of routing anomalies**. Cisco Systems Research Summit. University of Pennsylvania 2016
- **Anomaly detection in temporal social networks**. Cisco Systems Research Summit. University of Pennsylvania 2016

Contributed Talks

- **COVID-relevant Scalable Computational Research Directions and Tools**. Information Exchange Seminar. Discrete Computing Systems Group. Oak Ridge National Laboratory 2020

Community service

Memberships
- Institute of Electrical and Electronics Engineering (IEEE) member
- Association for Computing Machinery (ACM) member

- Complex Systems Society (CSS) member
- Federation of Automatic Control (IFAC) technical committee member for Technology, Culture, and International Stability

Mentoring and Advising

- DongInn Kim, Ph.D. in Computer Science, Indiana University 2020
- Jayati Dev, Ph.D. in Informatics, Indiana University 2019–2020
- Clint McElroy, B.S. in Informatics, Indiana University 2017–2018
- Srivatsan Iyer, M.S. in Computer Science, Indiana University 2015–2017
- Soumya Achar, M.S. in Computer Science, Indiana University 2015–2016

Master Thesis Committee

- Juan Camilo Campos, M.S. in Electrical Engineering, Pontificia Universidad Javeriana 2018

Reviewing

Journal Referee

- Recent Advances in Computer Science and Communications
- Computers & Security
- PLOS One
- IEEE Transactions on Knowledge and Data Engineering
- IEEE Access
- ACM Transactions on Information and System Security (TISSEC)

Technical Program Committees

- Society for Advancement of Chicanos/Hispanics & Native Americans in Science (SACNAS) Conference 2019
- ICML Latin in AI Workshop 2019
- ACM Internet Measurement Conference (Shadow PC 2017)

Grant Proposal Reviewer

- Internal Reviewer for DoE Grant Proposals

Skills

Programming Languages

- Frequent user of Python for data analysis using Matplotlib, igraph, Pandas, Scikit-learn
- Experience in LaTeX, R, MATLAB, Mathematica, C/C++
- Familiar with HTML, CSS, JS for frontend
- Used SQLite, NoSQL (MongoDB)

Spoken Langauges

- English (fluent), Spanish (native)

Extracurricular Activities

- Tennis, travel, hiking