Novella Bartolini

Highlights of Major Achievements

I am Associate Professor in the Department of Computer Science, Sapienza University of Rome. I have the **National Scientific Habilitation as Full Professor in Computer Science and in Computer Engineering (Abilitazione Professore Ordinario 01/B1 and 09/H1)**.

I spent **four years abroad**, carrying out research in highly ranked universities, establishing important and solid collaborations with many international researchers and scholars: I spent three years at the Computer Science and Engineering Department of Penn State University, and almost one year at the University of Texas at Dallas. I also made several shorter visits, from two to four weeks, at prestigious institutions including Penn State University, US Army Research Laboratory, King's College.

I won the **JPMorgan Faculty Research Award in 2020** for my research on the study of AI techniques for ensuring fairness of financial markets.
I was awarded the **prize "Sapienza Ricerca 2010"** for my research on autonomous deployment of mobile sensors.
I won the **Best Paper Award at the prestigious 17-th IEEE International Conference on Network Protocols (ICNP)** and the Best Poster Award from U.S. DoD DTRA (Department of Defense, Defense and Threat Reduction Agency).

I am **NATO Partner Director (PI) of the Project "Hybrid Sensor Networks for Emergency Critical Scenarios"** (2015-2019). I was **co-Principal Investigator of a DoD DTRA research award "State Estimation and Optimal Recovery in Networks with Massive Cascading Failures"** (2015-2017). I was **Principal Investigator of the Army Research Lab Project "Modeling and Robust Design of Dynamic Interdependent Networks"** (2014-2015). I was also the **co-Principal Investigator of the Prin Project "Autonomic Security"**.

In 2016 I was elevated to **Senior Member of IEEE**.
I am regularly invited to join the Technical Program Committee of flagship conferences including IEEE INFOCOM, IEEE ICDCS, IEEE Secon. I am currently in the Editorial Board of the journal Wireless Networks. Previously I was in the Editorial Board of the journal Computer Networks. I was General Chair of the conference QShine 2009. I was Program Chair of the workshops IEEE AAA-IDEA 2005, ACM AAA-IDEA 2006. I am in the steering committee of ICST AAA-IDEA 2009.

I regularly publish in the most important conferences and journals in the area of computer networks, including IEEE INFOCOM, IEEE ICDCS, IEEE ICNP, IEEE/IFIP DSN, IEEE Transactions on Networking, IEEE Transactions on Wireless Communications, IEEE Transactions on Mobile Computing, ACM Transactions on Sensor Networks, ACM Transactions on Autonomous and Adaptive Systems, IEEE Transactions on Network Science and Engineering, IEEE Transactions on Network and Service Management, IEEE Transactions on Control of Network Systems.

Education

PhD in Computer Science and Automation Egineering,
University of Rome "Tor Vergata", 2001
Thesis title: *Analytical models for the evaluation and optimization of QoS in wireless cellular networks*

Laurea degree (five years degree) in Computer Engineering, score: 100/100 with honors
University of Rome "Tor Vergata", 1997
Thesis title: *Performance optimization in wireless cellular networks by means of access control techniques*

Appointments

Sapienza, University of Rome
Computer Science Department — September 2015 – today
Associate Professor

Penn State University (PSU), USA
Computer Science and Engineering Department — August 2014 – June 2017
Visiting Professor (on extended **sabbatical leave** from Sapienza)

Sapienza, University of Rome
Computer Science Department — November 2002 – August 2015
Assistant Professor

Tor Vergata, University of Rome
Department of Computer Science, Systems and Production — November 2000 – March 2002
Research and teaching assistant

University of Texas at Dallas (UTD), USA
Department of Computer Engineering — August 1999 – May 2000
Visiting Scholar and Research Associate

Fondazione Ugo Bordoni — March 1997 – December 1997
Junior Researcher Grant

Career breaks: from February 1, 2006 to July 6, 2006 (maternity leave).

Periods abroad for research studies as visiting professor

- February 2018 - **One month**
  Visiting professor at the Computer Science Department of Penn State University, PA, USA (invited by Prof. Tom La Porta)
- From August 2014 to June 2017 - **Three years**
  Visiting professor at the Computer Science Department of Penn State University, PA, USA (invited by Prof. Tom La Porta) on extended sabbatical leave from Sapienza
- July 2016 - **Two weeks**
  Visit for research collaboration at U.S. Army Research Laboratory (ARL), Adelphi Laboratory Center, MD, USA (invited by Dr. Ananthram Swami)
- February 2014 - **Two weeks**
  Visiting professor at the Computer Science Department of Penn State University, PA, USA (invited by Prof. Tom La Porta)
- September 2013 - **One month**
  Visiting professor at the Computer Science Department of Penn State University, PA, USA (invited by Prof. Tom La Porta)
- From August 1999 to May 2000 - **Ten months**
  Visiting scholar at the Computer Engineering Department of the University of Texas at Dallas, TX, USA (invited by Prof. Imrich Chlamtac)

Patents

- *A system and method for remote monitoring utilizing static, moving and flying sensors*, provisional application filed in November 2018, at the Hashemite Kingdom of Jordan, Ministry of Industry and Trade Directorate of Industrial Property Protection

Conference Committees

- **General Chair** of ICST QShine 2009
- **Steering Committee** member of ICST AAA-IDEA 2009
- **Program co-chair** of the Wireless Communications track of IEEE ICCCAS 2008
- **Program co-chair** of ACM AAA-IDEA 2006 (with Virgilio Almeida)
- **Program co-chair** of IEEE AAA-IDEA 2005 (with Lucy Cherkasova)
- Member of forty **program committees** of international conferences including IEEE INFOCOM, IEEE SECON, IEEE ICDCS, IEEE GLOBECOM, IEEE ICAC, IEEE IC2E, IEEE ICC, IEEE QEST, IEEE VTC, IFIP Wireless Days, IEEE ICNC as well as several other minor conferences. Frequent reviewer of many leading journals and conferences.

Editorial boards

- **Guest editor** of the special issue of ACM/Springer Mobile Networks Journal on "Heterogeneous Networking", 2009
- **Member of the editorial board** of ACM/Springer Wireless Networks (IF:2.659) since 2008 until today.
- **Member of the editorial board** of Elsevier Computer Networks in 2006-2007.

Membership of Technical Societies

- Elevated to **Senior Member of IEEE**[1]
- Nominated **Fellow Member of the European Alliance for Innovation (EAI)**[2]
- Member of the Technical Committee of IEEE on Multi-Robot Systems

Awards

- **JPMorgan Chase AI Faculty Research Award**
- **Best Poster Award** at the *DTRA (Defense and Threat Reduction Agency, Department of Defense, USA) Basic Research and Technical Review Meeting*, 2015.
- **Prize "Sapienza Ricerca 2010"** for my work on autonomous deployment of mobile sensors.
- **Best Paper Award** at the 17-th *IEEE International Conference on Network Protocols* (ICNP 2009) for the paper "Autonomous Deployment of Heterogeneous Mobile Sensors".
  This paper has also been awarded the prize for the **Best PhD Student Paper** of the Computer Science Department, from a student I advised.
- **Selected best paper for journal publication:** the paper *Variable density deployment and topology control for the solution of the sink-hole problem* was selected as **one of the five best papers** of the conference QShine 2009 for journal publication.
- **Selected best paper for journal publication:** the paper *Optimal Channel Assignment in Mobile Cellular Networks* was selected as **one of the best papers** of the conference IEEE Dial-M 1997 for journal publication.

Student advising and mentoring

Advisor of more than 40 undergraduate students, 25 graduate students, several PhD students and PostDoc researchers.

- **Matteo Prata**, PhD advisor and researcher grant, Sapienza University (current)
- **Federico Trombetti**, PhD advisor and researcher grant, Sapienza University (current)
- **Stefano Ciavarella**, PhD advisor and researcher grant, Sapienza University
- **Francesco Vincenti**, PhD advisor, Sapienza University
- **Simone Silvestri**, PhD and Post Doc advisor, Sapienza University
- **Sara Mirzaie,** co-mentored PhD, Shiraz University of Technology, Iran
- **Xiaojie Liu,** co-mentored PhD, Northeastern University, China
- **Hana Khamfroush**, co-mentored Post Doc, Penn State University
- **Diman Zad Tootaghaj**, co-mentored PhD, on PhD committee, Penn State University
- **Michael Lin**, co-mentored PhD, on PhD committee, Penn State University
- **Federico Trombetta**, advisor of a Junior researcher grant, Sapienza University
- **Matteo Prata**, advisor of a Junior researcher grant, Sapienza University
- **Matteo Dell'Orefice**, advisor of a Junior researcher grant, Sapienza University
- **Justin Dillman**, mentored undergraduate research thesis, Penn State University
- **Seamus Hayes**, mentored undergraduate research thesis, Penn State University
- **Mike Giallorenzo**, mentored undergraduate research thesis, Penn State University
- **Giorgio Agosta**, advisor of honor student program, Sapienza University

[1] Elevation to Senior Membership of IEEE is obtained by nomination, and three reference letters from fellow/senior members, and a final evaluation. Only 9% of IEEE members are elevated to the Senior role.

[2] The elevation to Fellow Member of EAI happens upon election and unsolicited decision by a technical committee, based on the recognized leadership in advancing and organizing research. A current list of EAI fellows is available at `https://blog.eai.eu/we-are-proud-to-announce-the-first-eai-fellows/`.

Coordination of research activities in national and foreign institution

I led numerous research initiatives on many interdisciplinary topics, most of which where funded by prestigious entities, including NATO, ARL, and JPMorgan Chase Research. I hereby describe the most important and recent ones.

In 2014 I received a grant from ARL of which I was the sole PI, for the study of interdependent networks. For this grant I coordinated the activities of a large group of researchers, including PhD and PostDoc students and Faculty members of the **University of Kentucky** (Hana Khamfroush), of **Penn State** (Ting He, Diman Toothagaj) and of **ARL** (Ananthram Swamy), as well as some PhD students of mine. The research focused on cascading phenomena and failure propagation. The project was reason of my frequent visits to both Penn State University and to the Adelphi (Maryland) site of the **Army Research Lab**. It led to a considerable number of publications and to another funded project, this time from the **Defense and Threat Reduction Agency, DTRA, DoD**, of which I was co-PI. This research is still ongoing, with the contribution of new students under my supervision.

In 2015 I was the promoter and director of a research on heterogeneous monitoring networks which involved members of the **Istituto Nazionale di Geofisica e Vulcanologia (INGV)**, the **Science and Technology University of Missouri**, the **University of Kentucky**, the **German Jordan University**, and the **King Abdullah II Design and Development Bureau** (KADBB) in Jordan. The research project lasted for 4 years (2015-2019). Its focus was the use of terrestrial and aerial drones for monitoring in civilian and military applications. The research collaboration led to numerous publications, as well as to a research project funded by NATO, under my direction. Some of the research results where included in a **patent submission**.

During the three years (2014-2017) in which I was visiting professor at **Penn State University**, I personally promoted a research involving faculty members of three departments, the Computer Science and Engineering Department, the Department of Mechanics and Nuclear Engineering, and the Department of Biology. The main focus of the research was the use of aerial drones for crop disease detection in developing countries. This research led to some relevant publications and to projects funded by Penn State University (of which I was co-PI), by the Bill and Melinda Gates Foundation and FAO (of which I am participant). I also contributed to the design of a large **test-bed in Kenya** [j4] for the PlantVillage project (https://plantvillage.psu.edu/), where drones and smartphones are used for the realization of a crowd-sensing framework through which farmers can inspect their field and learn about the status of their plantations.

Recently I promoted a research on the use of traditional tools of computer science (performance models, interconnected networks, artificial intelligence) in the study of financial market systems. This research granted me the prestigious JPMorgan Faculty Award. The activity of this award brought me in contact with the **AI team of JPMorgan**, with which I am carrying on research on the use of AI techniques in financial markets, and on the way they cause shock propagation within interdependent assets. On this topic, I am **leading the research of a large group at my department (about 10 people)**, also involving external collaborators, namely Tucker Balch and Svitlana Vyetrenko, directors of research at JPMorgan. My activity on the study of algorithmic trading and artificial intelligence for financial markets is increasingly being recognized and I have been invited to join the **Program Committee of the NeurIPS 2020 Workshop on Fair AI in Finance**, I have been **invited to give a talk at JPMorgan** and I will be **invited speaker** at the workshop on forecasting techniques at ICPR 2021.

Thanks to the experience with the JPMorgan award, I came in contact with researchers of the **Management Department of Sapienza** (Prof. Sergio Barile and others), with whom I am coordinating a research on the impact of High Frequency Transactions (HFT) on market fairness.

Recently, I also promoted a research activity on federated networks of unmanned aerial vehicles for provisioning parcel delivery services for commercial as well as emergency scenarios. For this research I am leading a group of seven people at my department. I also involved researchers from foreign universities, namely Enrico Natalizio (**LORIA, University of Lorraine, France**) and Evsen Yanmaz (**Ozyegin University, Turkey**) as well as two SMEs for the design of application specific hardware solutions. On this topic I am leading a project proposal that has already passed the first round of evaluation and is currently undergoing the final evaluation for an EU call.

RESEARCH FUNDING OBTAINED AS PRINCIPAL INVESTIGATOR (PI, CO-PI)

International projects funded on the basis of a call for proposal and peer evaluation:

- **2020-2021**
  JPMorgan Chase Faculty Research Award **150,000 USD**
  PI of the project:
  The impact of trading strategies and market rules on fairness of financial markets
  The research focuses on Artificial Intelligence techniques applied to the study of financial markets with emphasis on the role of trading strategies and market rules on the market fairness towards investors.

- **2015-2019**
  NATO SPS Project SONiCS G4936 **400,000 Euro**
  PI of the project (coordination of the entire international consortium):
  Hybrid Sensor Networks for Emergency Critical Scenarios
  funded under the Science for Peace and Security (SPS) program. The project envisions the design of an entirely autonomous hybrid monitoring network where flying and terrestrial drones cooperate to ensure monitoring in critical or hostile environments. It addresses the design of algorithms and protocols for device coordination and autonomous path planning.

- **2017**
  PSU ICS Seed Grant Program **30,000 USD**
  Co-PI of the project:
  Digital innovation in food security using a 28,000 farmer living lab in Kenya
  funded under a program of the Strategic Interdisciplinary Research Office (SIRO) of PSU. The ambitious goal of the project is to provide a monitoring tool based on mobile phones and crowd sensing, to quickly detect the outbreak of crop field diseases. Such a tool is currently under experimentation in Kenya, and other low income countries where, due to the lack of skilled personnel and of appropriate supporting infrastructure, monitoring is otherwise left to a small number of insufficiently prepared extension workers.

- **2015-2017**
  DoD DTRA Award HDTRA-1-10-1-0085 **personal share 140,000 USD**
  Co-PI of the project:
  State Estimation and Optimal Recovery in Networks with Massive Cascading Failures
  funded under the DTRA (Department of Defense, Defense Threat Reduction Agency, USA) Basic and Fundamental Research program. The project studies the problems of damage assessment and fast recovery of the communication infrastructure, in the aftermath of large scale natural disasters or attacks. More specifically, it addresses the problem of monitoring the communication network under partial and uncertain knowledge of the status of individual network components and provides progressive recovery strategies which minimize the time to sufficiently recover the most critical services and communications.

- **2014-2015**
  US Army Research Lab Award W911NF-14-0610 **50,000 USD**
  PI of the award (individual investigator award):
  Modeling and Robust Design of Dynamic Interdependent Networks
  funded under the ARL Broad Agency Announcement (BAA) for Basic and Applied Scientific Research. The project studies techniques to model cascading failures in multiple interdependent networks. It provides stochastic models of failure and congestion propagation from network to network, with particular emphasis on the interdependence between the communication network and the power grid. In addition it provides metrics to characterize the role of network components in the propagation of phenomena through interdependent networks, providing tools for robust network design.

- **2010-2012**
  MIUR PRIN project **129,011 Euro, personal share $\sim$ 33,000 Euro**
  Co-PI, i.e., leader of the research unit of the CS Department, Sapienza, for the project:
  Autonomic Security
  funded under the MIUR PRIN call of 2008. The project studies algorithms and protocols to automate the configuration of security systems. The study covers multiple aspects of autonomous security, spanning from software control mechanisms to face cyber attacks, to the use of mobile monitoring devices to detect intruders in homeland security applications.

- **2012**
  EPIC project - Erasmum Mundus Action 2
  Co-PI of the European Partnerships & International Cooperation (EPIC) exchange project, in cooperation with the German Jordan University:
  Heterogeneous sensor networks
  which led to the funded visit at my department of Prof. Ala' Khalifeh in summer 2013. The project focused on the problem of autonomous coordination of sensing devices in a field subject to radio interference. As a result of this initial collaboration, Prof. Khalifeh and I ended up submitting the successful proposal which led to the aforementioned NATO grant.

- **2009-2012**
  EU Project GrEen sensor NEtworks for Structural monItoring (GENESI)
  Work Package Leader.
  In the context of a large project focused on the use of energy harvesting techniques to power sensing devices for structural monitoring, I led the activities related to the study of how to predict energy availability and use this prediction to dynamically adjust the workload of the monitoring devices accordingly. By embedding the designed energy aware sensors in a building at the time of construction, we provide a monitoring network capable of surviving over the whole structure lifetime.

Funded University Projects as PI

Sapienza University - Visiting professor grants

- **2019 - PI of a three months visit grant (Sapienza University) 9,000 Euro**
  Visit of Prof. David Hughes (Penn State University) on Mobile Crowd Sensing applications.
- **2015 - PI of a one month visit grant (Sapienza University) 5,000 Euro**
  Visit of Prof. Simone Silvestri (University of Kentucky) on Mobile Sensor Networks.

Sapienza University - Research grants (progetti di ateneo e FARI)

- **2019 - PI of research project (ricerca di ateneo) 13,200 Euro**
  On the use of drones for increasing food security through science and technology.
- **2018 - PI of research project (ricerca di ateneo) 15,000 Euro**
  Eyes on crop fields: flying monitoring networks and machine intelligence to detect spreading diseases in crop fields at farm to region scale.
- **2017 - PI of the research project (ricerca di ateneo) 4,000 Euro**
  Autonomous monitoring networks for detection, inspection and mitigation plan of spreading plant diseases in harsh and critical terrains
- **2016 - PI of the research project (ricerca di ateneo) 5,000 Euro**
  Heterogeneous mobile networks for emergency critical scenarios
- **2015 - PI of the research project (ricerca di ateneo) 4,000 Euro**
  Vulnerability of dynamic interdependent networks
- **2014 - PI of the research project (ricerca di ateneo) 3,000 Euro**
  Networks of aerial and terrestrial mobile sensors: integrated hybrid monitoring systems
- **2012 - PI of the research project FARI 7,000 Euro**
  Quantitative models for Infertility Related Endocrinological Diseases (IRED)
- **2011 - PI of the research project FARI 6,200 Euro**
  Homeland security monitoring systems based on mobile sensors
- **2010 - PI of the research project FARI 7,500 Euro**
  Green Cloud
- **2006 - PI of the research project (ricerca di ateneo) ∼13,000 Euro**
  Progettazione ed analisi di architetture, applicazioni e servizi di rete innovativi ad alte prestazioni

Selected list of other projects in the role of investigator

ITA (International Technology Alliance - USA and UK), BPP13-IPP15 funded project

- **Network and Information Sciences (NIS) ITA: "Network Tomography in Multi-domain Networks"**
  with the ARL and Penn State University Unit

Bill & Melinda Gates Foundation

- **"Pest and disease surveillance via high-resolution satellites" (2017)**
  with the Penn State University Unit, for research on drones and mobile phones in crowd-sensing monitoring applications.

EU funded projects

- **ITEA POLLENS (2003-2006)**
  with the UniRoma1 research unit, for research on content delivery networks.
- **IST Mobi-Dev (2001-2003)**
  with the Tor Vergata research unit, for research on wireless network performance.
- **ACTS INSIGNIA (1998)**
  with the Fondazione Ugo Bordoni research unit, for research on ATM network performance.

MIUR funded projects

- **FIRB Web-Minds (2002-2006)**
  task leader with the UniRoma1 research unit, for research on web system performance.
- **PRIN VICON (2003-2005)**
  with the UniRoma1 research unit, for research on sensor deployment.
- **PRIN TRAMP (2006-2012)**
  with the UniRoma1 research unit, for autonomous system research and dissemination.

Project proposals as PI

ERA-NET Cofund Call (H2020): Urban Accessibility and Connectivity (ENUAC)

- **DRUBER: parcel delivery through federated fleets of drones**
  The proposal positively passed the first round of evaluation and is now under submission for the final stage of the selection process.

Teaching Statement

I have been teaching university level courses on a regular basis since 2004.

Over the years, my teaching activities have spanned several topics, from computer architectures, operating systems and web programming, in courses designed for bachelor studies, to more advanced topics related to autonomous systems and performance of computer networks, targeted to students of the master level.

In my courses I first ensure that students acquire confidence with the basic theory and tools of the course, then I challenge them with the study of advanced problems. For master students, I always introduce cutting-edge topics, and research problems.

I hereby give a short description of the three courses that I currently teach.

In my **Web Programming** course, for BS students, after covering the basics of server side programming, I challenge the students with the design of a complex web based application. This year the students programmed a video streaming application, supporting automatic and dynamic user profiling based on the user behavior.

In my **Performance of Computer Networks** course, for MS students, I aim at providing students with the capability to analyze network performance by means of the classic tools of statistics and stochastic analysis. I give my students a modern course in which the basics of network measurement and queueing theory are applied to design and solve complex performance optimization problems, as well as network measuring issues. This year the students faced problems related to the application of Markov Chains to web page ranking, as in the Google PageRank algorithm. They also studied how to model the propagation of fake news in a social network and possible strategies to slow it down by controlling the behavior of a limited number of influencers in the social network.

I also teach a new course in the form of a Subsidiary Formative Activity (Attività Formativa Complementare) on **Artificial Intelligence for Trading**. In this course the students learn to apply computer science to finance. In particular I teach the students how to apply graph theory, and stochastic models to study the interdependence among financial assets and the way shocks propagate in market networks due to the spread use of artificial intelligence tools and algorithmic trading. I challenge the students by requesting them to apply their background on computer network performance, artificial intelligence and statistics, to a new context. The activity includes the design and implementation of market models and strategies on multi-agent simulators.

Teaching Record

- MS course of **Performance of Computer Networks**, for 6 CFU, Sapienza University
  Course taught **from 2011 to 2014**, and **from 2017 to 2020**
- BS course of **Web Programming**, for 6 CFU, Sapienza University
  Course taught **from 2004 to 2014**, and **from 2017 to 2020**
- BS course of **Web Programming**, for 6 CFU, UNITELMA (teledidattica)
  Course taught **from 2017 to 2020**
- MS Subsidiary Formative Activity (Attività Formativa Complementare) of **Artificial Intelligence for Trading**, for 6 CFU, Sapienza University
  Course taught in **2020**
- MS course of **Elective in Computer Networks**, for 1 CFU, Sapienza University
  Course taught in **2017, 2018**
- Postgraduate course of **Autonomous systems**, Sapienza University
  Course taught in **2008**
- BS course of **Computer Architecture**, Tor Vergata University (Computer Engineering)
  Course taught in **2004**
- TA of **Computer Architectures**, Sapienza University
  Teaching Assistant **from 2002 to 2008**
- TA of **Operating Systems** - Tor Vergata University (Computer Engineering)
  Teaching Assistant in **2000**

Institutional responsibilities and commissions of trust in national universities

- **Commissione Piano Lauree Scientifiche, PLS, per il CAD**
  Member of the committee for scientific degrees
  since January 2019
- **Giunta di dipartimento - ruolo elettivo**
  Elected member of the department board as representative of the assistant professors,
  from 2011 to 2013
- **Commissione didattica per il Dottorato di Ricerca in Informatica**
  Member of the committee for teaching and research activities of the PhD program
  from 2010 to 2014
- **Commissione didattica per il CAD**
  Member of the committee for teaching and research activities of the graduate and undergraduate program
  from 2010 to 2014
- **Commissione Valutazione Lauree triennali in Informatica per il CAD**
  Member of the evaluation committee for the bachelor degree programs in computer science
  from 2007 to 2009
- **Commissione Pubblicità e Orientamento del CAD in Informatica**
  Member of the External Communication and Tutoring Committee
  from 2005 to 2007
- **Commissione Piani di Studio per il CAD**
  Member of the committee for individual academic curriculum
  from 2002 to 2005
- **Collegio di Dottorato**
  Member of the PhD Faculty board
  since 2002
- **Chair of the PhD admission committee** in 2018
- **Member of the PhD admission committee** in 2009
- **Member of the PhD admission committee** in 2004
- **Member of several hiring committees for PostDoc positions** at Sapienza University of Rome
- **Member of the hiring committee** for an Assistant Professor position at the University of Modena and Reggio Emilia
- **Member of the final defense committee** of the PhD in Computer Engineering at the University of Rome "Tor Vergata" in 2018
- Participant to University orientation programs (Porte Aperte alla Sapienza) with **talks to high school students on "Drones and artificial intelligence"**.

Institutional responsibilities and commissions of trust in foreign universities

- **Member of the PhD advising board** of the PhD in Computer Science at the University of Penn State, USA in the period 2014-2017
- **Member of the final defense committee** of the PhD in Computer Science at the University of Penn State, USA in 2016-2017
- **Member of the examiner panel** for the PhD in Computer Science at the Agalappa University, India in 2020

Summary of citation record

Citation values reported by Web of Science, Journal Citation Report
Average impact factor per product: **2.83** (over 22 of my journal papers)
Total impact factor: **62.35** (over 22 of my journal papers)

Average impact factor in the last 5 years (2016-2020): **4.20** (over 12 of my journal papers)
Total impact factor in the last 5 years (2016-2020): **50.37** (over 12 of my journal papers)

Citation values reported by Google Scholar
H-index: **15**
Total number of citations: **908**

Citation values reported by Scopus over 55 products (valid for ASN)
H-index: **13**
Total number of citations: **537**
Average number of citations per product: **9.76**

List of recent collaborators **last 48 months**

Co-authors and/or co-PIs (in the last 48 months)
In the last 48 months I carried out research with the following 40 collaborators:

Stefan Achleitner (Palo Alto Networks, CA - USA) - co-author
Viviana Arrigoni (Sapienza University of Rome) - co-author
Giancarlo Bongiovanni (Sapienza University of Rome) - co-author
Tiziana Calamoneri (Sapienza University of Rome) - co-author
Berkay Celik (Purdue University, IN - USA) - co-author
Nilanjan Ray Chaudhuri (Department of Electrical Engineering, PSU, PA - USA) - co-author
Stefano Ciavarella (Sapienza University of Rome) - co-author
Andrea Coletta (Sapienza University of Rome) - co-author
Justin Dillman (CSE Department, PSU, PA - USA) - co-author
Marek Flaska (Dept. of Mech. and Nuclear Eng., PSU, PA - USA) - co-PI
Mike Giallorenzo (EE Department, University of Michigan, MI - USA) - co-author
Seamus Hayes (CSE Department, PSU, PA - USA) - co-author
Ting He (IBM/CSE Department, PSU, PA - USA) - co-author
Nan Hu (CSE Department, PSU, PA - USA) - co-author
David Hughes (Department of Biology, PSU, PA - USA) - co-author and co-PI
Annalyse Kehs (College of Agricultural Sciences, PSU, PA - USA) - co-author
Ala' Khalifeh (German Jordan University, Jordan) - co-author and co-PI
Hana Khamfroush (University of Kentucky, KY - USA) - co-author
Injung Kim (CSE Department, PSU, PA - USA) - co-author
Tom La Porta (CSE Department, PSU, PA - USA) - co-author and co-PI
Karl Levitt (UCDavis, CA - USA) - co-author
Yun Li (UCDavis, CA - USA) - co-author
Michael Lin (CSE Department, PSU, PA - USA) - co-author
Liang Ma (IBM T. J. Watson Research Center, NY -USA) - co-author
Gaia Maselli (Sapienza University of Rome) - co-author
Annalisa Massini (Sapienza University of Rome) - co-author
Patrick McDaniel (CSE Department, PSU, PA - USA) - co-author
Peter McCloskey (College of Agricultural Sciences, PSU, PA - USA) - co-author
Enrico Natalizio - (LORIA, University of Lorraine, France) - co-PI
Nicholas Papernot (University of Toronto, Canada) - co-author
Mauro Piva (Sapienza University of Rome) - co-author
Matteo Prata (Sapienza University of Rome) - co-author
Jeff Rowe (UCDavis, CA - USA) - co-author
Simone Silvestri (University of Kentucky, UKY, KY - USA) - co-author and co-PI
Joseph Sommer (Dept. of Mech. and Nuclear Eng., PSU, PA - USA) - co-PI
Ananthram Swami (Army Research Lab, MD - USA) - co-author
Diman Toothagaj (CSE Department, PSU, PA - USA) - co-author
Federico Trombetti (Sapienza University of Rome) - co-author
Robert Walls (CSE Department, PSU, PA - USA) - co-author
Evsen Yanmaz (Ozyegin University, Turkey) - co-PI

These values consider the only papers with published impact factor. For the papers appearing in 2020, I used the impact factor of 2019, as the values of 2020 are not available yet.

PUBLICATIONS

The **leading journals** in the area of computer networks are **IEEE-ACM Transactions on Networking** and **IEEE Transactions on Mobile Computing**. The **INFOCOM** conference is universally and consistently recognized as the **leading conference**. In the following, publications are listed along with their respective ranking, when available. The highest possible ranking value for CORE is A*, for GRIN is A, and for GGS is A++.

AUTHORSHIP ORDER STATEMENT

For the works published in the journals listed as j3, j4, j5, j6, j10, and j11, as well as for the conferences c1, c4, c7, c8, c9, c12, c14, c16, the participation of a number of US researchers made us prefer the US practice on authorship order according to which students who made a relevant contribution are listed first. However, in all these works I am the first non-student, and main advisor author. For all these works **my contribution is at least the same as the one of all the other authors**. This is also confirmed by the co-author Prof. Tom La Porta, Distinguished Professor at Penn State University, in the attached reference letter. All the other publications follow the Italian practice for which alphabetical order reflects equal contribution of the authors.

EDITED BOOKS

N. Bartolini, S. Nikoletseas, P. Sinha, V. Cardellini, A. Mahanti, "Quality of Service in Heterogeneous Networks", Springer, *Lecture Notes of ICST*, ISBN: 978-3-642-10624-8

V. Almeida, N. Bartolini, G. Pacifici, "Advanced Architectures and Algorithms for Internet Delivery and Applications, 2006", ACM Press, ISBN: 1-59593-505-3

N. Bartolini, L. Cherkasova, M. Colajanni, "Advanced Architectures and Algorithms for Internet Delivery and Applications, 2005", IEEE Computer Society, ISBN: 0-7695-2525-3

JOURNAL PAPERS

j1) N. Bartolini, A. Coletta, G. Maselli, A. Khalifeh, "A Multi-Trip Task Assignment for Early Target Inspection in Squads of Aerial Drone", in **IEEE Transactions on Mobile Computing**, preprint early access, 2020. [CORE2020: A*, GRIN: A, IF[1]: 5.112].

j2) N. Bartolini, T. He, V. Arrigoni, A. Massini, F. Trombetti[☆], H. Khamfroush[☆], "On Fundamental Bounds on Failure Identifiability by Boolean Network Tomography", in **IEEE-ACM Transactions on Networking**, Vol. 28, N. 2, 2020. [CORE2020: A*, GRIN: A, IF: 3.315].

j3) M. Lin[☆], N. Bartolini, M. Giallorenzo, T. La Porta, "On interference aware power adjustment and scheduling in femtocell networks", in **IEEE\ACM Transactions on Networking**, Vol. 28, N. 2, 2020. [CORE2020: A*, GRIN: A, IF: 3.315].

j4) Andrea Coletta[☆], Novella Bartolini, Gaia Maselli, Annalyse Kehs, Peter McCloskey, David P. Hughes, "Optimal deployment in crowd sensing for plant disease diagnosis in developing countries", in **IEEE Internet of Things Journal**, preprint early access, 2020. [IF: 9.936].

j5) D. Z. Tootaghaj[☆], N. Bartolini, H. Khamfroush[☆], T. La Porta, "On Progressive Network Recovery from Massive Failures under Uncertainty", in **IEEE Transactions on Network and Service Management**, Vol. 16, N. 1, 2019. [IF: 3.878].

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[1]Impact Factor, according to ISI Web of Science JCR when available, otherwise to the journal information site.
[☆]Starred names denote a PhD or Post-Doc student I was mentoring or advising at the time of the publication.

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c38) N. Bartolini, "Optimal Channel Assignment in Mobile Cellular Networks", in *IEEE/ACM Proceedings of the Workshop on Discrete Algorithms and Methods for Mobility*, (**IEEE/ACM Dial-M 1997**).

PAPERS UNDER SUBMISSION

s1) Novella Bartolini, Ting He, Hana Khamfroush, Tom La Porta, Federico Trombetti, "On optimal service placement for failure localization through passive measurements", submitted to **IEEE-ACM Transactions on Networking**.

s2) Novella Bartolini, Stefano Ciavarella, Tom La Porta, Matteo Prata, "Critical service recovery after large scale network failures", submitted to **IEEE-ACM Transactions on Networking**.

s3) Novella Bartolini, Andrea Coletta, Andrea Gennaro, Gaia Maselli, Matteo Prata, "MAD for FANETs: Movement Assisted Delivery for Flying Ad-hoc Networks", submitted to **IEEE INFOCOM 2021**.

s4) Novella Bartolini, Andrea Coletta, Gaia Maselli, "SIDE: Self drIving DronEs embrace uncertainty", submitted to **IEEE INFOCOM 2021**.

s5) Viviana Arrigoni, Novella Bartolini, Annalisa Massini, Federico Trombetti, "Failure Localization through Progressive Network Tomography", submitted to **IEEE INFOCOM 2021**.

Last update: September 14, 2020

Research Statement

Novella Bartolini

In the following I introduce my recent lines of research, and I describe my most important research achievements. On these and other topics, I am willing to broaden my collaborations and to involve and be involved by other faculty members and research groups.

1 Autonomous monitoring systems for critical scenarios

Situation awareness is necessary for any autonomous control system and is at the basis of safety and security in many indoor/outdoor scenarios, from the interior of private and public buildings to outdoor areas such as forests, harbors, or nation boundaries, for both civil and military applications. Monitoring systems are widely recognized as an invaluable tool whenever surveillance, intrusion, anomaly or hazard detection are needed to ensure prevention, prediction and protection against unwanted or critical events such as natural disasters or homeland security threats.

Complex monitoring systems provide collaborating sensing devices to gather measures concerning the status of the monitored field of interest, to report the collected information to data collection and processing points, and to ultimately trigger the necessary intervention when needed. While sensor networks are common place in safely accessible environments, such as production plants, bridges, or buildings, where sensing devices are deployed and maintained by skilled personnel, their use in harsh landscapes, or critical scenarios inaccessible to humans is severely limited. For some applications it may be sufficient to drop static sensors from an aircraft, but in most cases, this does not guarantee the necessary precision of detection, and the required network connectivity.

Perhaps the most relevant obstacle to the use of such networks in the above mentioned operative settings is the difficulty in quickly deploying a network which guarantees complete coverage of the area of the critical event of interest, with the necessary connectivity and time responsiveness.

In my research I envision the realization of a hybrid monitoring network, in which the use of static sensors is integrated with the adoption of mobile devices, both aerial and terrestrial, capable of autonomous configuration and deployment. This responds to the need of on-demand, event-driven deployments, where complete and prompt coverage are achieved even in hostile environments or critical areas subject to natural disasters such as earthquakes, volcano eruptions, floods or to large scale accidents such as nuclear plants explosions.

My vision is to develop a new generation of large-scale, heterogeneous monitoring systems, which can be deployed on demand, even in the most critical scenarios, guaranteeing a very flexible service which can adapt to geographical conditions, dynamically changing operative settings, and upcoming critical events. I want to address realistic problems that have plagued real deployments of hybrid mobile sensor networks existing so far, in security critical scenarios. With the proposed solutions, I believe that practical implementations may be pursued to make such autonomous hybrid sensor networks a reality.

My research on this topic is currently funded by NATO for a project of which I am Director (PI), under the Science for Peace and Security (SPS) program. On this project I collaborate with Professor Simone Silvestri, of MS&T, and with Professor Ala' Kalifeh, of the German Jordan University.

I have been working on this topic for about ten years. At first, I explored solutions for fast and complete autonomous deployment, in which terrestrial mobile devices communicate with each other by means of a special purpose communication protocol, and agree on which movements to make to achieve complete coverage and realize a connected network. I studied pattern based deployment schemes, as well as models where device movements are guided by locally constructed models of computational geometry. My work on this topic won the Best Paper Award at the IEEE ICNP conference [1]. I also tackled the problem of the sink-hole where communications towards a common sink may cause non uniform energy depletion in the network [2]. In some follow on works I complemented previous studies with the analysis of the vulnerabilities of most mobile sensor deployment algorithms and proposed related countermeasures [3, 4]. Later, I addressed the problem of how to deploy mobile terrestrial nodes in an unknown environment in the presence of obstacles and ground asperities. This work requires a multidisciplinary approach, where robotics meets computer science, and deployment

algorithms have to be integrated with obstacle detection and avoidance, and path planning capabilities [5].

I am currently working on the realization of hybrid networks where unmanned aerial vehicles are used to support the monitoring activity of the ground network, where present. I am studying integrated path planning and mission scheduling algorithms where aerial vehicles are used to respond to dynamic missions at different locations, and are required to coordinate with each other to ensure prompt deployment of the monitoring network and fast detection of the events of interest. A preliminary study provided a centralized solution with proven approximation of the optimal [6]. I am currently studying dynamic and distributed solutions in which the vehicles' behavior adapts to the monitored situation.

Unmanned aerial vehicles can be used for enhancing network coverage by both performing additional sensing and dropping additional small sized static sensors, and for increasing network connectivity by acting as data mules to drive the information collected by the static sensors towards a possibly remote collection and processing center. Furthermore they can be used to offload the static network, when sensors have limited memory and quickly saturate their capacities due to upcoming events which require a sudden increase in the data collection rate.

I also see the potential for my work within the Water-Energy-Food Nexus. Specifically I am working with Prof. Hughes of the College of Agriculture of Penn State University, on the use of unmanned aerial vehicles in fields to automatically monitor crop diseases. Hughes co-created PlantVillage [7] and pioneered the application of artificial intelligence to disease monitoring. He and I see a great potential to use unmanned aerial vehicles in remote, inaccessible locations in Africa where the existing infrastructure is poor but the need for disease monitoring is high. The African Development Bank invested 800m USD last year in applying technology to increasing on-farm productivity [8] and we could be key players.

On new ideas related to this topic, I am writing a research project proposal to be submitted to the Gates Foundation Grand Challenges program.

2 Network failures: assessment, analysis and recovery

Major disruptions resulting from natural disasters such as hurricanes, floodings, earthquakes or designed malicious attacks can compromise critical infrastructures and hamper services critical for human safety and homeland security. In 2011, the "great east Japan earthquake" and the subsequent tsunami hit the north-east of Japan causing enormous life losses and an overall damage estimated around 309 billions of US dollars [9]. Almost all wired communication networks and emergency municipal radio communication systems were destroyed [10]. Recovery of the network infrastructure required months, during which there was no sufficient support to the most critical services, not to mention normal communications in the devastated areas.

This is just one of the many real life examples that motivate the need of new methodologies for fast damage assessment and prompt recovery of critical services.

I started addressing these topics in 2014, while working on two projects funded by DTRA and ARL respectively, and in collaboration with Prof. Tom La Porta of Penn State University and several students of ours, and with Ananthram Swami, of the Army Research Lab. The related problems have been studied from different perspectives, and evidenced new challenges.

2.1 Network recovery

One line of research on the topic of large scale network failures deals with the restoration of critical network functionality after massive disruptions. We initially assumed perfect knowledge of the disaster extent, and worked on the problem of restoring sufficient resources to enable safety critical services, e.g. communication between emergency and governmental entities. We recognized the NP-hardness of this problem and addressed it with the proposal of new heuristic algorithms. This work was published in IEEE/IFIP DSN [11] and in IEEE Transactions on Networking [12] which are premier venues in the area.

From this work, we gradually moved to a more realistic formulation of the problem, by considering the case of only partial knowledge of the damage extent. We proposed to perform network recovery and monitoring in a joint manner, so that the network could be progressively repaired and incrementally monitored from the repaired nodes. When recovery is performed in a progressive manner, it is important to schedule the recovery interventions so as to maximize the utility achieved while operations are still in progress. For this purpose we formulated the problem in terms of maximum accumulative throughput, aiming at maximizing the total demand that the system can accommodate over time. This work was published in IEEE INFOCOM [13]. It

was realized by a group including Stefano Ciavarella, a PhD student of mine, and Hana Khamfroush and Tom La Porta, PostDoctoral student and Professor at Penn State University, respectively.

In a successive attempt to make the problem even more realistic, we considered partial and uncertain knowledge of the failure extent, modeling the failure spread as a geographic multivariate distribution. We used an estimate of the failure probability to perform a stochastic optimization of the recovery costs. In this case we showed that the problem is at least as hard as any of our previous problem formulations, and addressed it with optimization techniques trading off computational complexity and efficacy of the proposed solution to meet the demand and optimize cost. To this purpose we combined exact optimization and approximation techniques. This work was published in IEEE Transactions on Network and Service Management [14].

In addition to the described work, I am studying the recovery problem considering the potential correlation of failures and repairs due to the presence of common physical elements in the underlying physical layer network, and considering the dynamic of cascading failures.

2.2 Network tomography

As we have seen, the limited information available during the emergency outbreak constitutes a major challenge when planning a recovery intervention. An intervention plan requires knowledge of the failure locations. In most cases, the site of failed areas is inaccessible, or can only be monitored remotely, due to the limited human personnel.

We addressed the problem of network monitoring by means of measurements taken at the edge of the network, through techniques known as network tomography. In particular, in a team including also Prof. La Porta, with two co-advised PostDocs, Liang Ma of IBM Research, and Prof. Ting He of Penn State University, we developed several algorithms to determine the best monitor location to maximize failure identifiability with measurements conducted at network edges. We considered the case in which software monitors are placed on the endpoints of client-server paths, and developed algorithms for joint server and monitor placement. This work was published in IEEE ICDCS [15],

Inspired by the results of this work, we investigated the problem of network tomography from a more theoretical perspective, formulating a series of upper bounds that constitute fundamental limits to the identifiability of failures by means of a given number of paths. The bound analysis constitutes an independent work which has been accepted for publication in IEEE INFOCOM [16]. A follow on of this result is currently under evaluation for publication in IEEE Transactions on Networking, as it received a major revision request.

I am interested in continuing this line of research in the near future, with the study of monitor placement and path selection schemes that would enable the identification of the status of not just any nodes but of nodes within a set of interest.

Furthermore I would like to explore the possibilities to use techniques of network tomography to determine the truthfulness of topology information, and vice versa, to understand how to structure the topology of a network and the location of its access points to preclude the use of techniques of network tomography to derive private information concerning the inner status and connectivity of network components.

2.3 Failure propagation across interdependent networks

Much of today's infrastructure is organized in the form of interdependent networks. Systems of water and food supply, communications, financial transactions, power generation and transmission are all examples of interdependent networks, where the functionality or performance of one network depends on the other. A failure in one network may cause service degradation or failure in the others. Failures can cascade multiple times between two interdependent networks and result in a catastrophic spread, as described in the work of Parandehgheibi et al. [17].

We studied the spread of failures across multiple interdependent networks by means of stochastic analysis. The purpose of the study is to give a deep understanding of the network features that mostly affect the speed of propagation throughout interdependent networks. In particular we studied how topology characteristics, such as the network generation model (Erdos Renyi, Small World or Scale Free) or the average node degree affect propagation. We gave a thorough analytic and experimental study of the characteristics that affect the node propensity to propagate a failure and formulated a new metric of centrality that captures this aspect. Finally we investigated the role of the interconnectivity in propagating failures across heterogeneous networks, and we determined the configuration of interconnectivity edges that fosters or slows down the propagation.

This work was welcomed by the research community. It received the best poster award at the DTRA annual meeting, and was published in IEEE Transactions on Network Science and Engineering [18]. I conducted this

work in collaboration with Hana Khamfroush and Justin Dillman, a Post Doctoral and an undergraduate student I mentored while I was at PSU, and with Ananthram Swami of the Army Research Lab.

A follow on of this work with more emphasis on device mobility, is currently in progress, with the collaboration of my students at Sapienza, as a joint research with Dr. Ananthram Swami (ARL). We are extending the previous study to the case in which the propagating phenomenon is not a failure but is a piece of information, potentially a virus, or an opinion or consensus which spreads throughout a network that is composed of mobile users. Propagation of such a phenomenon may therefore represent a wanted or unwanted event, and can be controlled accordingly by altering the behavior of few influencer mobile agents.

3 Software Defined Networks

I am currently studying new problems related to preserving security policy consistency and preventing congestion during routing reconfiguration of the switches of a Software Defined Network (SDN) network. This is a work I am carrying on with Prof. Tom La Porta, Prof. Ting He, both at Penn State University, and with Stefan Achleitner, a PhD student I mentored with Prof. La Porta, now working at Palo Alto. As a first contribution to the research in this field, we solved the problem of minimizing the impact of routing updates on flow performance [19].

I am currently exploring the potential use of the results of this research to produce security attacks to SDN, in which new flows can be injected in a network with the specific purpose to cause the most disruptive update of routing tables, causing instability and congestion. I am also planning to extend this work to a multi-domain SDN network, with multiple controllers, potentially belonging to different entities.

4 Artificial Intelligence and Algorithmic Trading

Legitimate use of trading instruments in a market offering equal opportunities to all traders, may still cause unfairness due to temporary information asymmetry. Information asymmetry, in fact, may create non uniform effects on the risk profile of different investors. Unfairness may therefore arise as a consequence of an engineered use of legitimate market instruments, especially when High Frequency Trading (HFT) and dark pools come into play. A quantitative evaluation of market fairness is domain specific and relates to non uniform variations of risk profiles among the market players. Hence, market unfairness cannot be measured appropriately by any of the classic metrics of fairness [20] designed for other domains. With my research I study novel formulations of fairness metrics to capture this phenomenon, and give a multidimensional representation of unfairness. This metrics are incorporated into stochastic models describing the interplay among trading agents and the exchange, for multiple interdependent assets. The proposed models scale with the growing number of interacting entities making up the complex financial system. Such scalability is granted by adaptive granularity techniques that trade off economy of the state representation, which directly translates into system responsiveness, with the accuracy of the model. Through the proposed model I am able to study scenarios where unfairness may propagate across multiple interdependent asset markets. The model is also a tool to design new strategies and market rules to mitigate unfairness. The efficacy of the proposed approaches is verified by means of multi-agent simulations under a wide variety of scenarios, based on the joint use of existing data-sets, and of synthetic traffic mimicking the investors' trading strategies being studied. The research is being conducted with the collaboration of department faculty. The described research obtained the enthusiastic appraisal of the Artificial Intelligence team at JPMorgan, from which I received the prestigious 2020 JPMorgan Chase AI Research Faculty Awards Program (https://www.jpmorgan.com/global/technology/ai/awards/faculty-award-recipients-2020). The novelty of this project is receiving attention from the interested communities. Dr. Tucker Balch and Dr. Svitlana Vyetrenko, directors of AI research at JPMorgan are getting involved. I am receiving invitations to visit their center and give talks on my research. I also received invitations to related conferences for giving invited talks and joining related technical committee.

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