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Research Supervisor: Prof. **Tommaso Melodia**

## RESEARCH FOCUS AND TECHNICAL EXPERTISE

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Design and experimental evaluation of next-generation AI-based embedded wireless systems for the Internet of Things (IoT) and 5/6G. My technical expertise includes (i) FPGA-level embedded systems design; (ii) machine learning algorithms and frameworks; (iii) wireless communication standards and architectures; (iv) software-defined radio design and development.

## EDUCATION

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### Doctor of Philosophy (Ph.D.) in Computer Science

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY, Rolla, MO, United States

August 2012 - December 2016

Advisor: Prof. **Sajal K. Das**, Daniel St. Clair Endowed Chair of Computer Science

Thesis: “*Mechanisms for Improving Information Quality in Smartphone Crowdsensing Systems*”

### Master of Science (M.S.) in Computer Engineering

UNIVERSITY OF PISA, Pisa, Italy

Concentration: Networking and Multimedia

October 2009 - October 2011

Level of Distinction: *Summa Cum Laude*

Top GPA (29.95/30) among graduates, attended *Percorso di Eccellenza* (excellence curriculum)

### Bachelor of Science (B.S.) in Computer Engineering

UNIVERSITY OF PISA, Pisa, Italy

October 2006 - July 2009

Level of Distinction: *Summa Cum Laude*

Top 5% GPA (28.2/30) among undergraduates

## PUBLICATIONS

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### • BOOK CHAPTERS

- F. Restuccia, S. D’Oro, L. Zhang, and T. Melodia, “The Role of Machine Learning and Radio Reconfigurability in the Quest for Wireless Security”, in *Proactive and Dynamic Network Defense*, pp. 191-221, Springer, May 2019, ISBN: 9783030105976. DOI: 10.1007/978-3-030-10597-6\_8.
- J. Jagannath, N. Polosky, A. Jagannath, F. Restuccia and T. Melodia, “Neural Networks for Signal Intelligence: Theory and Practice,” in *Machine Learning for Future Wireless Communications*, John Wiley and IEEE, November 2019, ISBN: 9781119562252. DOI: 10.1002/9781119562306.ch13.

• JOURNAL PAPERS

- S. D'Oro, **F. Restuccia**, and T. Melodia, "Toward Operator-to-Waveform 5G Radio Access Network Slicing," to appear in *IEEE Communications Magazine (IEEE ComMag)*, 2019. URL: <https://arxiv.org/pdf/1905.08130.pdf>.
- K. Sankhe, M. Belgiovine, F. Zhou, L. Angioloni, **F. Restuccia**, S. D'Oro, T. Melodia, S. Ioannidis, and K. Chowdhury, "No Radio Left Behind: Radio Fingerprinting Through Deep Learning of Physical-Layer Hardware Impairments," to appear in *IEEE Transactions on Cognitive Communications and Networking (IEEE TCCN)*, Special Issue on Evolution of Cognitive Radio to AI-enabled Radio and Networks, 2019. DOI: 10.1109/TCCN.2019.2949308.
- J. Jagannath, N. Polosky, A. Jagannath, **F. Restuccia**, and T. Melodia, "Machine Learning for Wireless Communications in the Internet of Things: A Comprehensive Survey," *Ad Hoc Networks (ADHOC)*, Volume 93, pp. 101913, October 2019. DOI: 10.1016/j.adhoc.2019.101913.
- S. D'Oro, **F. Restuccia**, T. Melodia, and S. Palazzo, "Low-Complexity Distributed 5G Network Slicing: Analysis, Algorithms, and Experimental Results," *IEEE/ACM Transactions on Networking (IEEE/ACM TNET)*, Vol. 26, No. 6, pp. 2815-2828, December 2018. DOI: 10.1109/TNET.2018.2878965.
- L. Zhang, **F. Restuccia**, T. Melodia, and S. Pudlewski, "Taming Cross-Layer Attacks in Wireless Networks: A Bayesian Learning Approach," *IEEE Transactions on Mobile Computing (IEEE TMC)*, Vol. 18, No. 7, pp. 1688-1702, July 2019. DOI: 10.1109/TMC.2018.2864155.
- **F. Restuccia**, S. D'Oro, and T. Melodia, "Securing the Internet of Things in the Age of Machine Learning and Software-defined Networking," *IEEE Internet of Things Journal (IEEE IoT-J)*, Vol. 5, Iss. 6, pp. 4829-4842, December 2018. DOI: 10.1109/JIOT.2018.2846040.
- **F. Restuccia**, P. Ferraro, S. Silvestri, T.S. Sanders, S. K. Das, and G. Lo Re, "FIRST: A Framework for Optimizing Information Reliability in Smartphone Crowdsensing," *ACM Transactions on Sensor Networks (ACM TOSN)*, Vol. 15, Iss. 1, February 2019. DOI: 10.1145/3267105.
- **F. Restuccia**, P. Ferraro, S. Silvestri, S. K. Das, and G. Lo Re, "IncentMe: Effective Mechanism Design to Stimulate Crowdsensing Participants with Uncertain Mobility," *IEEE Transactions on Mobile Computing (IEEE TMC)*, Vol. 18, No. 7, pp. 1571-1584, July 2019. DOI: 10.1109/TMC.2018.2863288.
- **F. Restuccia**, N. Ghosh, S. Bhattacharjee, S.K. Das, and T. Melodia, "Quality of Information in Mobile Crowdsensing: Survey and Research Challenges," *ACM Transactions on Sensor Networks (ACM TOSN)*, Vol. 13, Iss. 4, No. 34, December 2017. DOI: 10.1145/3139256.
- **F. Restuccia**, S.K. Das, and J. Payton, "Incentive Mechanisms in Participatory Sensing: Survey and Research Challenges," *ACM Transactions on Sensor Networks (ACM TOSN)*, Vol. 12, Iss. 2, No. 13, February 2016. DOI: 10.1145/2888398.
- **F. Restuccia** and S. K. Das, "Optimizing the Lifetime with QoS of Sensor Networks with Uncontrollable Mobile Sinks," *ACM Transactions on Sensor Networks (ACM TOSN)*, Vol. 12, Iss. 1, No. 2, March 2016. DOI: 10.1145/2873059.
- D. De Guglielmo, **F. Restuccia**, G. Anastasi, M. Conti, and S.K. Das, "Accurate and Efficient Modeling of 802.15.4 Unslotted CSMA/CA through Event Chains Computation," *IEEE Transactions on Mobile Computing (IEEE TMC)*, Vol. 15, No. 12, pp. 2954-2968, December 2016. DOI: 10.1109/TMC.2016.2528248.

- **F. Restuccia**, G. Anastasi, M. Conti, S. K. Das, “Analysis and Optimization of Protocol for Mobile Element Discovery in Sensor Networks”, *IEEE Transactions on Mobile Computing (IEEE TMC)*, Vol. 13, No. 9, pp. 1942-1954, September 2014. DOI: 10.1109/TMC.2013.88.

- CONFERENCE PAPERS

- **F. Restuccia** and T. Melodia, “DeepWiERL: Bringing Deep Reinforcement Learning to the Internet of Self-Adaptive Things,” to appear in *Proc. of the IEEE International Conference on Computer Communications (IEEE INFOCOM)*, Beijing, China, April 2020. URL: <https://tinyurl.com/DeepWiERL>.
- A. Al-Shawabka, **F. Restuccia**, S. D’Oro, T. Jian, B. Costa Rendon, N. Soltani, J. Dy, K. Chowdhury, S. Ioannidis and T. Melodia, “Exposing the Fingerprint: Dissecting the Impact of the Wireless Channel on Radio Fingerprinting,” to appear in *Proc. of the IEEE International Conference on Computer Communications (IEEE INFOCOM)*, Beijing, China, April 2020. URL: <https://tinyurl.com/RadioINFOCOM>.
- R. Guida, N. Dave, **F. Restuccia**, E. Demirors, and T. Melodia, “U-Verse: A Miniaturized Platform for End-to-End Closed-Loop Implantable Internet of Medical Things Systems,” *Proc. of the ACM Conference on Embedded Networked Sensor Systems (ACM SenSys)*, pp. 311-323, New York, NY, USA, November 2019. DOI: 10.1145/3356250.3360026.
- M. Polese, **F. Restuccia**, A. Gosain, J. M. Jornet, S Bhardwaj, V. Ariyaratna, S. Mandal, K. Zheng, A. Dhananjay, M. Mezzavilla, J. Buckwalter, M. Rodwell, X. Wang, M. Zorzi, A. Madanayake and T. Melodia, “MillimeTera: Toward A Large-Scale Open-Source mmWave and Terahertz Experimental Testbed,” *Proc. of the ACM Workshop on Millimeter-Wave Networks and Sensing Systems (ACM mmNets)* co-located with **ACM MobiCom**, pp. 27-32, Los Cabos, Mexico, October 2019. DOI: 10.1145/3349624.3356764.
- K. Sankhe, **F. Restuccia**, S. D’Oro, T. Jian, Z. Wang, A. Al-Shawabka, J. Dy, T. Melodia, S. Ioannidis, and K. Chowdhury, “Impairment Shift Keying: Covert Signaling by Deep Learning of Controlled Radio Imperfections,” *Proc. of the IEEE/AFCEA Military Communications Conference (MILCOM 2019)*, Norfolk, Virginia, November 2019. URL: <https://tinyurl.com/ImpairmentShiftKeying>.
- **F. Restuccia**, S. D’Oro, A. Al-Shawabka, M. Belgiovine, L. Angioloni, S. Ioannidis, K. Chowdhury and T. Melodia, “DeepRadioID: Real-Time Channel-Resistent Optimization of Deep Learning-based Radio Fingerprinting Algorithms,” *Proc. of the ACM International Symposium on Mobile Ad Hoc Networking and Computing (ACM MobiHoc)*, pp. 51-60, Catania, Italy, July 2019. DOI: 10.1145/3323679.3326503.
- L. Zhang, **F. Restuccia**, T. Melodia and S.M. Pudlewski, “Jam Sessions: Analysis and Experimental Evaluation of Advanced Jamming Attacks in MIMO Networks,” *Proc. of the ACM International Symposium on Mobile Ad Hoc Networking and Computing (ACM MobiHoc)*, pp. 61-70, Catania, Italy, July 2019. DOI: 10.1145/3323679.3326504.
- **F. Restuccia** and T. Melodia, “Big Data Goes Small: Real-Time Spectrum-Driven Embedded Wireless Networking Through Deep Learning in the RF Loop,” *Proc. of the IEEE International Conference on Computer Communications (IEEE INFOCOM)*, pp. 2152-2160, Paris, France, April 2019 (**Best In-session Presentation Award**). DOI: 10.1109/INFOCOM.2019.8737459.
- S. D’Oro, **F. Restuccia**, A. Talamonti, and T. Melodia, “The Slice Is Served: Enforcing Radio Access Network Slicing in Virtualized 5G Systems,” *Proc. of the IEEE International Conference on Computer Communications (IEEE INFOCOM)*, pp. 442-450, Paris,

France, April 2019 (**Best In-session Presentation Award**). DOI: 10.1109/INFOCOM.2019.8737481.

- S. D'Oro, **F. Restuccia**, and T. Melodia, "Hiding Data in Plain Sight: Undetectable Wireless Communications Through Pseudo-Noise Asymmetric Shift Keying," *Proc. of the IEEE International Conference on Computer Communications (IEEE INFOCOM)*, pp. 1585-1593, Paris, France, April 2019 (**Best In-session Presentation Award**). DOI: 10.1109/INFOCOM.2019.8737581.
- **F. Restuccia**, E. Demirors, and T. Melodia, "iSonar: Software-defined Underwater Acoustic Networking for Amphibious Smartphones," *Proc. of the ACM International Conference on Underwater Networks & Systems (ACM WUWNet)*, pp. 1-9, Halifax, Canada, November 2017. DOI: 10.1145/3148675.3148710.
- L. Zhang, **F. Restuccia**, T. Melodia, and S. Pudlewski, "Learning to Detect and Mitigate Cross-layer Attacks in Wireless Networks: Framework and Applications", *Proc. of the IEEE Conf. on Communications and Network Security (IEEE CNS)*, pp. 1-9, Las Vegas, Nevada, October 2017. DOI: 10.1109/CNS.2017.8228631.
- **F. Restuccia** and S. K. Das, "Lifetime Optimization with QoS of Sensor Networks with Uncontrollable Mobile Sinks", *Proc. of the IEEE International Symposium on a World of Wireless, Mobile, and Multimedia Networks (IEEE WoWMoM)*, pp. 1-9, Boston, Massachusetts, June 2015. DOI: 10.1109/WoWMoM.2015.7158130.
- **F. Restuccia** and S. K. Das, "FIDES: A Trust-based Framework for Secure User Incentivization in Participatory Sensing", *Proc. of the IEEE International Symposium on a World of Wireless, Mobile, and Multimedia Networks (IEEE WoWMoM)*, pp. 1-9, Sydney, Australia, June 2014. DOI: 10.1109/WoWMoM.2014.6918972.
- **F. Restuccia**, G. Anastasi, M. Conti, S. K. Das, "Performance Analysis of a Hierarchical Discovery Protocol for WSNs with Mobile Elements", *Proc. of the IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (IEEE WoWMoM)*, pp. 1-9, San Francisco, California, June 2012. DOI: 10.1109/WoWMoM.2012.6263708.
- K. Kondepu, **F. Restuccia**, G. Anastasi, M. Conti, "A Hybrid and Flexible Discovery Algorithm for WSNs with Mobile Elements", *Proc. of the IEEE International Symposium on Computers and Communications (IEEE ISCC)*, pp. 295-300, Cappadocia, Turkey, July 2012. DOI: 10.1109/ISCC.2012.6249311.

- UNDER REVIEW/SUBMISSION

- **F. Restuccia**, S. D'Oro, A. Al-Shawabka, B. Costa Rendon, K. Chowdhury, S. Ioannidis and T. Melodia, "Wireless Adversarial Deep Learning," *ACM International Symposium on Theory, Algorithmic Foundations, and Protocol Design for Mobile Networks and Mobile Computing (ACM MobiHoc)*, 2020.
- **F. Restuccia** and T. Melodia, "PolymoRF: Self-Adaptive Waveform-Driven Polymorphic Wireless Receivers," *ACM International Symposium on Theory, Algorithmic Foundations, and Protocol Design for Mobile Networks and Mobile Computing (ACM MobiHoc)*, 2020.
- S. D'Oro, L. Bonati, **F. Restuccia**, M. Polese, M. Zorzi and T. Melodia, "SI-EDGE: Network Slicing at the Edge," *ACM International Symposium on Theory, Algorithmic Foundations, and Protocol Design for Mobile Networks and Mobile Computing (ACM MobiHoc)*, 2020.
- S. D'Oro, L. Bonati, **F. Restuccia**, and T. Melodia, "Coordinated 5G Network Slicing: How Constructive Interference Can Boost Network Throughput," submitted for publication, *IEEE/ACM Transactions on Networking (IEEE/ACM TNET)*, 2020.

## PATENT APPLICATIONS

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- **F. Restuccia**, S. D'Oro and T. Melodia, "Neural Network for Adversarial Deep Learning in Wireless Systems," U.S. Patent Application No.: 62/952,629, PD: December 23th, 2019.
- **F. Restuccia** and T. Melodia, "Mechanism for Embedded Deep Reinforcement Learning in Wireless Internet of Things Devices," U.S. Patent Application No.: 62/903,701, PD: September 20th, 2019.
- S. D'Oro, **F. Restuccia** and T. Melodia, "Undetectable Wireless Communications Through Pseudo-Noise Asymmetric Shift Keying," U.S. Patent Application No.: 62/839,874, PD: April 29th, 2019.
- **F. Restuccia** and T. Melodia, "Deep Learning-Based Polymorphic Internet of Things Platform," U.S. Patent Application No.: 62/837,916, PD: April 26th, 2019.
- **F. Restuccia**, S. D'Oro and T. Melodia, "Mechanism for Real-Time Channel-Resilient Optimization of Deep Learning-based Radio Fingerprinting Algorithm," U.S. Patent Application No.: 62/826,255, PD: May 29th, 2019.
- S. D'Oro, **F. Restuccia** and T. Melodia, "Mechanisms for the Enforcement of Network Slicing Policies in Virtualized Cellular Networks," U.S. Patent Application No.: 62/796,780, PD: January 23rd, 2019.
- **F. Restuccia** and T. Melodia, "Real-Time Cognitive Wireless Networking Through Deep Learning in Transmission and Reception Communication Paths," U.S. Patent Application No.: 16/591,772, PD: October 3rd, 2018.
- **F. Restuccia**, E. Demirors, and T. Melodia, "Underwater Ultrasonic Communication System and Method," U.S. Patent Application No.: 15/992,304, PD: May 30th, 2018.

## RESEARCH GRANTS AND AWARDS

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- Mario Gerla Award for Young Investigators in Computer Science, \$3,000, Italian Scientists and Scholars of North America Foundation (ISSNAF), 2019.
- Co-PI with T. Melodia, "Deep Reinforcement Learning for Polymorphic IoT Platforms," \$100,000, Raytheon Corp., 2018.
- Co-PI with T. Melodia, "Toward Secure-by-design Polymorphic IoT Platforms," \$355,000, Office of Naval Research, 2018.
- Entrepreneurial Lead (EL), Innovation Corps (I-corps) Program, \$50,000, National Science Foundation, 2014.

## WORK POSITIONS

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### **Associate Research Scientist**

Department of Electrical and Computer Engineering, Northeastern University  
February 2018 - Current

### **Postdoctoral Research Associate**

Department of Electrical and Computer Engineering, Northeastern University  
January 2017 - January 2018

### **Graduate Research Assistant**

Department of Computer Science, Missouri S&T, August 2013 - December 2016  
Department of Computer Science and Engineering, UT Arlington, August 2012 - August 2013

### **Research Assistant**

## TEACHING EXPERIENCE

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- EECE 5698 - Wireless Sensor Networks and the Internet of Things - Graduate class, Northeastern University, Spring 2018 (**Main Instructor**)

## PROFESSIONAL SERVICE

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- **TPC Member:** IEEE INFOCOM (2018-2020); ACM MobiHoc (2020); IEEE SECON (2020); IEEE/ACM IWQoS (2020); IEEE LCN (2016-2019); IEEE SMARTCOMP (2017); IEEE WoWMoM (2017-2020); IEEE GlobeCom (2017-2020); IEEE Network of the Future (2017-2019), IEEE 5G World Forum (2018-2020), IEEE MASS (2018-2019), ACM MSWiM (2018-2019), IEEE WCNC (2020).
- **Publicity Chair:** ITC 30 (2018), ACM MSWiM (2018), IEEE LANMAN (2018), IEEE SECON (2019).
- **Conference Reviewer:** IEEE INFOCOM (2013-2017); IEEE PerCom (2013-2014, 2016); IEEE ICDCS (2013-2014, 2017); IEEE MASS (2013); IEEE ICNP (2013); IEEE LCN (2015); IEEE CNS (2017); IEEE MSWiM (2017), ACM MobiHoc (2017-2019), ACM MobiCom (2019).
- **Journal Reviewer:** IEEE Transactions on Mobile Computing (TMC); IEEE Transactions on Communications (TCOM); IEEE Transactions on Wireless Communications (TWC); IEEE Journal on Selected Areas in Communications (JSAC); IEEE/ACM Transactions on Networking (TNET); IEEE Transactions on Vehicular Technology (TVT); IEEE Transactions on Dependable and Secure Computing (DSC); IEEE Internet of Things Journal (IoTJ); IEEE Wireless Communications Letters (WCL); IEEE Wireless Communications Magazine (WCM); IEEE Communications Letters (CL); IEEE Sensors Journal; IEEE Internet Computing (IC); ACM Transactions on Sensor Networks (TOSN); IEEE Transactions on Molecular, Biological, and Multi-Scale Communications (TMBMC); Computer Networks (COMNET); Ad-Hoc Networks (ADHOC); Computer Communications (COMCOM); Pervasive and Mobile Computing (PMC); Wireless Networks (WINET); Sensors; Journal of Parallel and Distributed Computing (JPDC).

## PROFESSIONAL REFERENCES

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**Tommaso Melodia**, William L. Smith Professor, Dept. of Electrical and Computer Engineering, Northeastern University, 805 Columbus Ave., 412 ISEC, Boston, MA 02115 USA, Phone: +1(617)373-3354, Email: [melodia@ece.neu.edu](mailto:melodia@ece.neu.edu)

**Sajal K. Das**, Daniel St. Clair Endowed Chair Professor, Dept. of Computer Science, Missouri University of Science and Technology, 315 Computer Science Building, 500 W. 15th Street, Rolla, MO 65409 USA, Phone: + 1(573)341-7708, Email: [sdas@mst.edu](mailto:sdas@mst.edu)

**Edward W. Knightly**, Sheafor-Lindsay Professor of Electrical and Computer Engineering and Computer Science, Dept. of Electrical and Computer Engineering, MS 380 6100 South Main, Houston, TX 77005 USA, Phone: +1(713)348-5748, Email: [knightly@rice.edu](mailto:knightly@rice.edu)

**Kaushik R. Chowdhury**, Associate Professor, Dept. of Electrical and Computer Engineering, Northeastern University, 805 Columbus Ave., 523 ISEC, Boston, MA 02115 USA, Phone: +1(617)373-5304, Email: [krc@ece.neu.edu](mailto:krc@ece.neu.edu)

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