

Syed Abdullah Nauroze

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Education **Georgia Institute of Technology**

Ph.D., Electrical & Computer Engineering, 2019.

Thesis: *Additively Manufactured Origami-inspired "4D" RF Structures with On-demand Continuous-range Tunability*

M.Sc., Electrical & Computer Engg. (*Major: Applied Electromagnetics*), 2018.

Management of Technology Certificate, Scheller School of Business, 2018.

Royal Institute of Technology

M.Sc., Electrical Engineering (*Major: Wireless Systems*), 2008.

Thesis: *Novel On-Chip Antennas For 77GHz Automotive Radars.*

University of Engineering & Technology, Taxila

B.Sc., Computer Engineering, 2005.

Research **Amazon Lab126**

Antenna Engineer, Nov '20 - Present

Key responsibilities:

- Lead design, fabrications and evaluation of antenna & desense for two high volume products throughout complete PDP cycle.
- Realized desense reduction mechanisms to remove shielding components in smart devices thereby achieving USD 3.5 million cost saving.
- Utilized novel heat dissipating materials to increase efficiency, reduce weight and cost of high volume products such as Amazon Echo with an overall USD 13.5 million cost savings.

Atheraxon

Co-founder and entrepreneurial lead, Jan '18 - Dec '19

About: The atlanta-based startup which uses batteryless mm-wave RFIDs with integrated sensors to realize real-time tracking and location services as well as asset health monitoring for high-value products

Key responsibilities:

- Lead customer discovery, market evaluation and identification of early adapters for the product
- Successfully secured \$50k and \$500k from NSF and angel investor respectively within first year
- Realized minimal viable product for initial demos for shipping industry applications.

Amazon Lab126, CA (USA)

Co-op – RF Desense/Antenna Engineer, Jun '19 - Aug '19

Project: Noise Immune Antennas for Smart Home Devices

Key responsibilities:

- Formulated novel noise modeling techniques for desense mitigation.
- Lead efforts to study the effect of desense on antenna polarization, location and type leading to realization of miniaturized WiFi antenna with -17dB desense improvement for smart devices.

ATHENA Lab, Georgia Institute of Technology (USA)

Graduate Research Assistant, Aug '15 - Dec '19

Projects:

- Origami-inspired inkjet-printed RF structures.
- Multilayer flexible X-band (10-12 GHz) antenna arrays for CW radars.
- 3D-printed EMI shielding structures and modules for mm-wave SoP solutions.

Other responsibilities:

- Entrepreneurial lead for NSF I-Corps startup program.
- Supervised high school teacher under GT STEM Teacher Leadership Program (STLP) for advancement of local high schools' curriculum, labs and teaching methodologies.
- Lead team of 3 graduate students to realize smart light fixtures with inkjet-printed integrated sensors for EATON.

Approved Research Grants:

- NSF I-Corps (amount: \$50,000).
- NSF Ideas-Lab for CubeSat Innovation.
- NSF EFRI-ODISSEI: Novel Perpetual Reconfigurable & Multi-Band structures.

Qualcomm, CA (USA)

Co-op Antenna Engineer, Aug '17 - Dec '17

Project: Design 5G Phased antenna array for handheld devices

Key responsibilities:

- Design & optimize single and dual band 5G phased array antennas.
- Lead process corner simulations and material characterization to evaluate overall performance variation due to fabrication tolerances.

Microsystems Tech. Lab, Royal Institute of Technology (Sweden)

Research Graduate

Project: Novel on-chip antennas for 77 GHz automotive radar applications.

University of Technology Petronas (Malaysia)

Research Graduate

Project: Fractal antenna design for MIMO systems.

Teaching

National Uni. of Computer & Emerging Sciences (Pakistan)

Assistant Professor, 2011-14

Taught courses: Electromagnetic Theory, Wave propagation, Antenna theory, Microwave Engineering, Digital Logic Design & Freshman Physics Lab

Other responsibilities

- Member of EE program *accreditation committee* and *undergraduate curriculum committee*.
- Supervised four (5) undergraduate final year project groups.
- Established undergraduate physics lab – designed lab manual, experiments and in-house lab equipment.

LUMS – School of Science & Engineering (Pakistan)

Teaching Fellow, 2009-13

Taught courses: EM fields & waves, Introductory electronics, Digital Logic Circuits and Signals & systems.

Other responsibilities

- Member of *accreditation & industrial liaison committee*.
- Member of *undergraduate curriculum committee*.
- Supervisor for four (4) undergraduate summer interns.

University of Engineering & Technology, Taxila (Pakistan)

Lecturer, 2008-09

Taught courses: Linear Algebra, Differential Equations & Queuing Theory.

Other responsibilities

- Head of *Mathematics & Communication system committee*.
- Mentored TA for queuing theory course.

University of Engineering & Technology, Taxila (Pakistan)

Teaching/Research Associate, 2004-05

Taught courses: Computer programming and Electronics .

Publications **Books**

1. S. A. Nauroze, *Novel On-Chip Antennas for 77GHz Automotive Radars*. LAP Lambert Academic Publishing GmbH & Co Germany, 2013

Book Chapters

1. Y. Cui, S. A. Nauroze, and M. M. Tentzeris, “Origami-inspired 4d rf and wireless structures and modules,” in *4D-Printed Smart Materials and Structures*. Elsevier, 2022, vol. 1
2. M. M. Tentzeris, A. Eid, T.-H. Lin, J. G. Hester, Y. Cui, A. Adeyeye, B. Tehrani, and S. A. Nauroze, “Inkjet-/3D-/4D-printed Nanotechnology-enabled Radar, Sensing, and RFID Modules for Internet of Things, “Smart Skin,” and “Zero Power” Medical Applications,” in *Antenna and Sensor Technologies in Modern Medical Applications*. Wiley Online Library, 2021, pp. 399–434

3. A. Adeyeye, A. Eid, J. Hester, S. A. Nauroze, B. Tehrani, Y. Cui, and M. M. Tentzeris, "Inkjet-/3D-/4D-printed Wireless Ultrabroadband Modules for IoT, Smartag and Smart City Applications," in *Nanotechnology for Electronics, Photonics, Biosensors, and Emerging Technologies*. World Scientific, 2021, pp. 41–49
4. L. Novelino, S. A. Nauroze, M. Tentzeris, and G. H. Paulino, "Multiphysics origami: Achieving tunable frequency selective surfaces from origami principles," in *Origami 7: Seventh International Meeting of Origami Science, Maths, and Education*. Springer, 2018, vol. 3
5. M. M. Tentzeris and A. Nauroze, "Flexible RF components and sensors using inkjet-printing technologies," in *Wiley Encyclopedia of Electrical and Electronics Engineering*. Wiley Online Library, 2017, pp. 1–14

Journals

1. Y. Cui, T. Cheng, R. Bahr, S. A. Nauroze, T. S. S. Almonneef, and M. M. Tentzeris, "3d printed deployable bi-focal beam-scanning dielectric reflectarray antenna for mm-wave applications," *Transactions on Antennas and Propagation*, 2022
2. S. A. Nauroze and M. M. Tentzeris, "A thermally actuated fully inkjet-printed origami-inspired multilayer frequency selective surface with continuous-range tunability using polyester-based substrates," *IEEE Transactions on Microwave Theory and Techniques*, vol. 67, no. 12, pp. 4944–4954, 2019
3. S. A. Nauroze, L. S. Novelino, M. M. Tentzeris, and G. H. Paulino, "Continuous-range tunable multilayer frequency-selective surfaces using origami and inkjet printing," *Proceedings of the National Academy of Sciences*, vol. 115, no. 52, pp. 13 210–13 215, 2018
4. A. Eid, J. Hester, Y. Fang, B. Tehrani, S. A. Nauroze, R. Bahr, and M. M. Tentzeris, "Nanotechnology-empowered flexible printed wireless electronics: A review of various applications of printed materials," *IEEE Nanotechnology Magazine*, vol. 13, no. 1, pp. 18–29, 2018
5. S. A. Nauroze, J. G. Hester, B. K. Tehrani, W. Su, J. Bito, R. Bahr, J. Kimionis, and M. M. Tentzeris, "Additively manufactured rf components and modules: Toward empowering the birth of cost-efficient dense and ubiquitous iot implementations," *Proc. IEEE*, vol. 105, no. 4, pp. 702–722, April 2017
6. J. Bito, R. Bahr, J. G. Hester, S. A. Nauroze, A. Georgiadis, and M. M. Tentzeris, "A novel solar and electromagnetic energy harvesting system with a 3-d printed package for energy efficient internet-of-things wireless sensors," *IEEE Transactions on Microwave Theory and Techniques*, vol. 65, no. 5, pp. 1831–1842, 2017

7. J. Bito, R. Bahr, J. Hester, J. Kimionis, A. Nauroze, W. Su, B. Tehrani, and M. M. Tentzeris, “Inkjet-/3d-/4d-printed autonomous wearable rf modules for biomonitoring, positioning and sensing applications,” vol. 10194, p. 101940Z, 2017
8. R. Ramzan, O. Siddiqui, A. Nauroze, and O. Ramahi, “A microstrip probe based on electromagnetic energy tunneling for extremely small and arbitrarily shaped dielectric samples,” *IEEE antennas and wireless propagation letters*, vol. 14, pp. 1554–1556, 2015

Conference papers

1. M. Holda, Y. Cui, S. A. Nauroze, M. Tentzeris, and P. Dahmen, “Pop-up card inspired, 3D-printed corner reflector antenna—a novel deployable antenna,” in *2021 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*. IEEE, 2021
2. Y. Cui, S. A. Nauroze, R. Bahr, and M. M. Tentzeris, “A novel additively 4D printed origami-inspired tunable multi-layer frequency selective surface for mm-wave IoT, RFID, WSN, 5G, and Smart City Applications,” in *2021 IEEE MTT-S International Microwave Symposium (IMS)*. IEEE, 2021, pp. 86–89
3. Y. Cui, S. A. Nauroze, R. Bahr, and E. M. Tentzeris, “3D printed one-shot deployable flexible “kirigami” dielectric reflectarray antenna for mm-wave applications,” in *2020 IEEE/MTT-S International Microwave Symposium (IMS)*. IEEE, 2020, pp. 1164–1167
4. S. A. Nauroze and M. M. Tentzeris, “Fully inkjet-printed multi-layer tunable origami FSS structures with integrated thermal actuation mechanism,” in *2019 IEEE MTT-S International Microwave Symposium (IMS)*. IEEE, 2019, pp. 1363–1366
5. S. A. Nauroze, X. He, and M. M. Tentzeris, “Fully additively manufactured tunable active frequency selective surfaces with integrated on-package solar cells for smart packaging applications,” in *2019 IEEE 69th Electronic Components and Technology Conference (ECTC)*. IEEE, 2019, pp. 119–125
6. Y. Cui, S. A. Nauroze, and M. M. Tentzeris, “Novel 3d-printed reconfigurable origami frequency selective surfaces with flexible inkjet-printed conductor traces,” in *2019 IEEE MTT-S International Microwave Symposium (IMS)*. IEEE, 2019, pp. 1367–1370
7. S. A. Nauroze and M. M. Tentzeris, “Fully inkjet-printed tunable hybrid n-ripple miura (n-rim) frequency selective surfaces,” in *2019 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting*. IEEE, 2019
8. A. Eid, J. Hester, A. Nauroze, T.-H. Lin, J. Costantine, Y. Tawk, A. Ramadan, and M. Tentzeris, “A flexible compact rectenna for 2.40 GHz ISM energy harvesting applications,” in *2018 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*. IEEE, 2018, pp. 1887–1888

9. S. A. Nauroze, A. Eid, and M. M. Tentzeris, "n-rim: A paradigm shift in the realization of fully inkjet-printed broadband tunable fss using origami structures," in *2018 IEEE/MTT-S International Microwave Symposium - IMS*, June 2018, pp. 51–54
10. S. A. Nauroze, B. Tehrani, and M. Tentzeris, "An inkjet-printed origami-based frequency selective surface with wide frequency and bandwidth tunability," in *2018 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*. IEEE, 2018, pp. 1677–1678
11. B. K. Tehrani, S. A. Nauroze, R. A. Bahr, and M. M. Tentzeris, "On-package mm-wave fss integration with 3D-printed encapsulation," in *2017 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*. IEEE, 2017, pp. 9–10
12. H. Griguer, M. M. Tentzeris, A. Nauroze, and M. Drissi, "A novel ultra-thin flexible metamaterial absorber for human body protection from emf hazards," in *2017 XXXIIInd General Assembly and Scientific Symposium of the International Union of Radio Science (URSI GASS)*. IEEE, 2017, pp. 1–4
13. W. Su, R. Bahr, S. A. Nauroze, and M. M. Tentzeris, "Novel 3D-printed "chinese fan" bow-tie antennas for origami/shape-changing configurations," in *2017 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*. IEEE, 2017, pp. 1245–1246
14. S. A. Nauroze, L. Novelino, M. M. Tentzeris, and G. H. Paulino, "Inkjet-printed "4D" tunable spatial filters using on-demand foldable surfaces," in *2017 IEEE MTT-S International Microwave Symposium (IMS)*. IEEE, 2017, pp. 1575–1578
15. W. Su, S. A. Nauroze, B. Ryan, and M. M. Tentzeris, "Novel 3D printed liquid-metal-alloy microfluidics-based zigzag and helical antennas for origami reconfigurable antenna "trees"," in *2017 IEEE MTT-S International Microwave Symposium (IMS)*. IEEE, 2017, pp. 1579–1582
16. R. Bahr, A. Nauroze, W. Su, and M. Tentzeris, "Self-actuating 3D printed packaging for deployable antennas," in *2017 IEEE 67th Electronic Components and Technology Conference (ECTC)*. IEEE, 2017, pp. 1425–1430
17. S. A. Nauroze, J. Hester, W. Su, and M. M. Tentzeris, "Inkjet-printed substrate integrated waveguides (SIW) with "drill-less" vias on paper substrates," in *2016 IEEE MTT-S International Microwave Symposium (IMS)*. IEEE, 2016, pp. 1–4
18. S. A. Nauroze, J. Kimionis, J. Bitto, W. Su, J. G. Hester, K. Nate, B. Tehrani, and M. M. Tentzeris, "Additive manufacturing technologies for near-and far-field energy harvesting applications," in *2016 IEEE Radio and Wireless Symposium (RWS)*. IEEE, 2016, pp. 159–161

19. W. Su, R. Bahr, S. A. Nauroze, and M. M. Tentzeris, "3D printed reconfigurable helical antenna based on microfluidics and liquid metal alloy," in *2016 IEEE International Symposium on Antennas and Propagation (APSURSI)*. IEEE, 2016, pp. 469–470
20. S. A. Nauroze and M. M. Tentzeris, "A novel printed stub-loaded square helical antenna," in *2015 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*. IEEE, 2015, pp. 774–775
21. A. Rashid, S. Ullah, and S. Nauroze, "Three-dimensional loaded dipoles for applications in frequency selective structures." in *PIERS Proceedings*, 2014
22. O. Sidiqi, A. Nauroze, R. Ramzan, and O. Ramahi, "Tunneling of electromagnetic energy through wires in guided media," in *2013 IEEE Antennas and Propagation Society International Symposium (APSURSI)*. IEEE, 2013, pp. 1370–1371
23. S. A. Nauroze, "In-wafer helical antenna for automotive radars," in *2013 7th European Conference on Antennas and Propagation (EuCAP)*. IEEE, 2013, pp. 2835–2838
24. A. Nauroze, O. Sidiqi, R. Ramzan, and O. Ramahi, "Dielectric sensing based on energy tunneling in wireloaded microstrip cavities," *META*, vol. 13, pp. 18–22, 2013
25. S. B. Slimane, X. Li, B. Zhou, N. Syed, and Dheim, "Delay optimization in cooperative relaying with cyclic delay diversity," in *IEEE International Conference on Communications*, May 2008, pp. 3553 – 3557

Workshops & Talks

1. 4D RF structures for next-generation of outer-space and terrestrial applications – *IEEE New South Wales AP/MTT chapter (Australia)*, September 2020
2. Origami-inspired shaped reconfigurable tunable RF structures using additive manufacturing technologies – *IEEE Int. Sym. on Ant. and Prop.*, Atlanta, 2019
3. Next generation of origami-based tunable RF structures using additive manufacturing – *FlexTech Conference*, Monetary, CA, 2017

Awards

Fellowship/Scholarships

- **Fulbright Scholarship (2014-19)** – covered 5 years of tuition & monthly stipend of Ph.D.
- **Graduate research assistantship (2015-19)** – Georgia Institute of Technology.
- **NSF I-Corps Fellowship (2018)** – grant money: USD 50,000
- **Swedish Institute/Higher Education Commission Scholarship (2006-08)** – covered 2 years of tuition and monthly stipend for MSc.
- **Graduate research fellowship (2005)** – University of Technology Petronas, Malaysia.

Academic Accolades

- Nominated for **Cleaver award 2020** for best Ph.D. proposal at Georgia Institute of Technology.
- **Honorary mention** for Best student paper competition at International Microwave Symposium (IMS) 2019 (Boston,USA).
- **Honorary mention** for 3-Minute Thesis (3MT) competition at IMS 2019 (Boston,USA).
- **Winner** of 3MT competition at IMS 2018 (Philadelphia, USA).
- **Finalist** for 3MT competition at IMS 2017 (Hawaii, USA).
- **2017 gold medal award** at 20th Archimedes Inventions and Innovative Technology Salon held at Moscow.
- **Best project** award 2007 for Wireless Networks at KTH Sweden.
- **5th and 2nd highest scoring student** in the university and class during BSc. at UET, Taxila.
- **Received distinctions** in every semester of undergraduate studies (2001-05).

Academic Accolades

- Awarded **two travel grants** by HEC (Pakistan) in 2013 (most by any faculty in a year) to present papers at EuCAP (Sweden) and META (UAE) conferences.
- Cash price (USD 500) for **Excellence in Research** by NUCES (Islamabad) – 2013.

Professional & services

1. Mentor at National Incubation Center (NIC), Lahore, July 2020 - Present
2. Reviewer/Journals

- Nature – Scientific Reports
- IEEE Antenna & Wireless Propagation Letters (AWLPL)
- IEEE/ASME Transactions on Mechatronics
- IEEE Open Journal of Antennas and Propagation
- Elsevier – Additive Manufacturing Journal
- MDPI – Sensors
- MDPI– Applied Sciences
- MDPI– Computation
- MDPI– Remote sensing

3. Technical Review Committee Member

- IEEE International Symposium on Antennas & Propagation
- IEEE Radio & Wireless Symposium