

Dr. Binbin Yang

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PROFESSIONAL EXPERIENCE

North Carolina Agricultural and Technical State University Assistant Professor	Greensboro, NC <i>Aug 2019 - Present</i>
Motorola Mobility Staff Antenna Engineer	Chicago, IL <i>Aug 2017 - Aug 2019</i>
Futurewei Technologies (Huawei) RF System Engineer - Intern	Bridgewater, NJ <i>May 2016 - Aug 2016</i>
North Carolina State University Research Assistant	Raleigh, NC <i>August 2013 - July 2017</i>

EDUCATION

North Carolina State University Ph.D. in Electrical Engineering	Raleigh, NC <i>Dec 2017</i>
University of Chinese Academy of Sciences M.Eng. in Electrical Engineering	Beijing, China <i>July 2013</i>
Hunan University B.S. in Electrical Engineering	Changsha, China <i>July 2010</i>

RESEARCH INTERESTS

My research interests span the areas of antennas, electromagnetics, RF and microwave circuits, wireless communication, and numerical methods. I have a specific interest in small antennas, dielectric antennas and microwave devices, characteristic mode theory, transformation optics, MIMO antenna system, microwave imaging, and numerical methods modeling fields and wave propagation.

DISSERTATION

Title: "A Modal Approach to Compact MIMO Antenna Design"
Advisor: Prof. Jacob J. Adams

My thesis developed a novel shape-first, feed-next design method for planar multi-mode antennas of arbitrary geometry based on characteristic mode theory. Specifically, it investigated the feed-independent antenna shape synthesis technique for MIMO antennas, and also pioneeringly developed a physics-based circuit model for general MIMO antennas that could be used for efficient and optimal antenna feed specification. It also investigated the physical limitation of small antennas, where a bounding relation is mathematically established between the quality factor of an arbitrary structure and that of its substructures. Novel decoupling and matching techniques for multi-port antennas are also developed and reported therein.

HONORS AND AWARDS

- MBG Bravo Award, Motorola Mobility LLC, 2019.
- Fellowship Grant Award, USNC-URSI conference, 2017.
- Third Place in ECE Graduate Research Symposium, North Carolina State University, 2016.
- Third Place in Student Paper Contest, Antenna Applications Symposium, 2015.
- Outstanding Student Scholarship, the Institute of Microelectronics of Chinese Academy of Sciences, 2012.
- The National Encouragement Scholarship of China, 2008.
- Third Place in Mathematics Competition, Hunan University, 2008.
- Wang Youzeng Special Scholarship, Hunan University, 2007.
- Second-place Scholarship, Hunan University, 2007.
- Excellent Student Leader, Hunan University, 2007.

GRANTS

- NCAT Center of Excellence Seed Grant, 2021
- NSF Award CNS-2128511, 2021-2024
- NSF Award ECCS-2138741, 2022-2024

PUBLICATIONS

JOURNAL PAPERS

1. Zhang, L., Zhang, Z., Weisbecker, H., Yin, H., Liu, Y., Han, T., Guo, Z., Berry, M., **Yang, B.**, Guo, X., Adams, J., Bai, W., 3D morphable systems via deterministic microfolding for vibrational sensing, robotic implants, and reconfigurable telecommunication. *Science Advances*, 8(51), p.eade0838, 2022.
2. Daniel Guidotti, **Binbin Yang**, Muhammad S. Omar, Shang-Jen Su, Yahya M. Alfadhli, Gee-Kung Chang, and Xiaoli Ma, "Small Formfactor Phased Array for Simultaneous Spatial and Channel Diversity Communications," *Progress In Electromagnetics Research Letters*, Vol. 104, 37-46, 2022.
3. J. J. Adams, S. Genovesi, **B. Yang**, E. Antonio-Daviu, "Antenna Element Designs Using Characteristic Modes Analysis", *IEEE Antennas and Propagation Magazine*, 2022.
4. **B. Yang**, J. Kim and J. J. Adams, "Fundamental Limits on Substructure Dielectric Resonator Antennas", in *IEEE Open Journal of Antennas and Propagation*, vol. 3, pp. 59-68, 2022, doi: 10.1109/OJAP.2021.3133725.
5. **B. Yang**, A. Eroglu, J. J. Adams. Shape Synthesis of Multi-mode Dielectric Resonator Antennas Using Characteristic Modes. *Applied Computational Electromagnetics Society Journal*. 2020; 35(11):1280-1281.
6. B. Chowdhury, T. Walpita, **B. Yang**, A. Eroglu, Resonant Characteristics of Split Ring Resonator And Unit Cell for Periodic Metamaterial Devices. *Applied Computational Electromagnetics Society Journal*. 2020; 35(11):1378-1379.
7. **B. Yang**, J. Zhou and J. J. Adams, "A Shape-First, Feed-Next Design Approach for Compact Planar MIMO Antennas", *Progress in Electromagnetics Research M*, Vol. 77, 157-165, 2019.
8. K. Schab, **B. Yang** and J. J. Adams, "Lower Bounds on Substructure Antenna Q-Factor", in *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 7, pp. 3278-3285, July 2018.

9. **B. Yang** and J. J. Adams, "Computing and Visualizing the Input Parameters of Arbitrary Planar Antennas via Eigenfunctions," in *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 7, pp. 2707-2718, July 2016.
10. **B. Yang** and J. J. Adams, "Systematic shape optimization of symmetric MIMO antennas using characteristic modes", in *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 7, pp. 2668-2678, July 2016.
11. F. Liu, **B. Yang**, B. Li et al., "A Surface Mounting Embedded Optical Transceiver with Bi-Directional Data Rate of Eight Channels \times 10 Gbps," *Fiber and Integrated Optics*, vol. 33, no. 1-2, pp. 17-25, Jan. 2014.

PREPRINTS

12. **B. Yang**, "Synthesis of General Decoupling Networks Using Transmission Lines." *arXiv preprint arXiv:2207.00615* (2022).

CONFERENCE PAPERS

13. T. Bellundagi and **B. Yang**, "A Wideband Rectangular Dielectric Resonator Antenna with Varying Material Distributions," *2023 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting (USNC-URSI)*, Portland, OR, USA, 2023, pp. 713-714.
14. K. Mensah-Bonsu, **B. Yang**, A. Eroglu, H. Xu and L. Qian, "Polarization Analysis of Reflectarray Unit Elements Using Characteristic Modes," *2023 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting (USNC-URSI)*, Portland, OR, USA, 2023, pp. 1133-1134.
15. E. S. Edhere and **B. Yang**, "Design of a Ceramic-Based Stepped-Index Rectangular Dielectric Rod Antenna," *2023 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting (USNC-URSI)*, Portland, OR, USA, 2023, pp. 1-2.
16. H. F. Adeagbo and **B. Yang**, "Microwave Imaging Using Quasi-Conformal Transformed Luneburg Lens," *2023 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting (USNC-URSI)*, Portland, OR, USA, 2023, pp. 469-470.
17. Y. Zhang, L. Qian, A. Eroglu, **B. Yang** and H. Xu, "Reinforcement Learning based Optimal Dynamic Resource Allocation for RIS-aided MIMO Wireless Network with Hardware Limitations," *2023 International Conference on Computing, Networking and Communications (ICNC)*, Honolulu, HI, USA, 2023, pp. 148-152.
18. **B. Yang**, "Validation of Physics-Based Circuit Model For Multiport Microstrip Antennas Using DCIM," *2022 IEEE International Symposium on Antennas and Propagation (APSURSI)*, July 2022.
19. **B. Yang**, J. J. Adams, "Bounds on Substructure Dielectric Resonator Antennas Using Characteristic Modes," *2022 IEEE International Symposium on Antennas and Propagation (APSURSI)*, July 2022.
20. K. Mensah-Bonsu, **B. Yang**, A. Eroglu, H. Xu, L. Qian, "Equivalent Circuit Model for Varactor-Loaded Reconfigurable Intelligent Surfaces," *2022 IEEE International Symposium on Antennas and Propagation (APSURSI)*, July 2022.
21. **B. Yang**, Y. Oh, X. Hu, J. J. Adams, "Implementation of A Flat-Bottom Luneburg Lens Based on Conformal Transformation Optics," *2021 IEEE MTT-S International Microwave Symposium*, June 2021.
22. **B. Yang**, J. J. Adams, "A Decoupling Network Based on Characteristic Port Modes," *2020 IEEE International Symposium on Antennas and Propagation (APSURSI)*, July 2020.
23. **B. Yang**, A. Eroglu, J. J. Adams, "Shape Synthesis of Multi-mode Dielectric Resonator Antennas Using Characteristic Modes," *2020 36th International Review of Progress in Applied Computational Electromagnetics (ACES)*, July 2020.
24. B. Chowdhury, T. Walpita, **B. Yang**, and A. Eroglu, "Resonant Characteristics of Split Ring Resonator and Unit Cell for Periodic Metamaterial Devices," *2020 36th International Review of Progress in Applied Computational Electromagnetics (ACES)*, July 2020.

25. K. Schab, **B. Yang** and J. J. Adams, "Antenna bounds for reduced basis problems," *ICEAA-IEEE APWC*, September, 2017, Verona, Italy.
26. **B. Yang** and J. J. Adams, "Quality factor calculations for the characteristic modes of dielectric resonator antennas," *2017 United States National Committee of URSI National Radio Science Meeting (USNC-URSI NRSM)*, Boulder, CO, USA, 2017, pp. 1-2.
27. K. Schab, **B. Yang** and J. J. Adams, "EFIE singularity treatments and their effects on characteristic mode dynamic range", *2017 11th European Conference on Antennas and Propagation (EUCAP)*, March 2017.
28. **B. Yang** and J. J. Adams, "A Modal Approach to Shape Synthesis and Feed Placement for Planar MIMO Antennas", *2016 IEEE International Symposium on Antennas and Propagation (APSURSI)*, Fajardo, 2016, pp. 15-16, doi: 10.1109/APS.2016.7695716. (invited).
29. **B. Yang** and J. J. Adams, "Mode-based analytical models for arbitrary wire and planar antennas," in *Proc. 2016 European Conference on Antennas and Propagation (EuCAP)*, Davos, Switzerland, April 2016 (invited).
30. **B. Yang**, and J. J. Adams, "Modal Q and Efficiency Limits on The Characteristic Modes of Multiport Apertures," in *Proc. 2015 Antenna Application Symposium*, 22-24 September, 2015.
31. J. J. Adams, and **B. Yang**, "Physics-based circuit models for MIMO antennas using characteristic modes," in *Proc. 2015 IEEE Antennas and Propagation Int. Symp.*, 19-24 July, 2015.
32. **B. Yang** and J. J. Adams, "Modal Q as a bounding metric for MIMO antenna optimization," *2015 31st International Review of Progress in Applied Computational Electromagnetics (ACES)*, Williamsburg, VA, 2015, pp. 1-2.
33. F. Liu, **B. Yang**, B. Li, H. Wang and L. Wan, "Optical transceiver sub-system package based on SiOB with 8×14Gbps two-way bandwidth," *2013 IEEE 63rd Electronic Components and Technology Conference*, Las Vegas, NV, 2013, pp. 2173-2178.
34. F. Liu, H. Xue, F. Wan, F. Hou, B. Li, H. Wang, **B. Yang**, J. Song, L. Wan and L. Cao, "Reliability research on optoelectronics packaging," *2013 14th International Conference on Electronic Packaging Technology*, Dalian, 2013, pp. 1061-1063.
35. F. Liu, Y. Chu, B. Li, J. Song, H. Wang, T. Du, **B. Yang** and L. Wan, "Optical vertical interconnect and integration based on Silicon carrier," *2012 13th International Conference on Electronic Packaging Technology & High Density Packaging*, Guilin, 2012, pp. 97-100.
36. F. Liu, B. Li, Z. Li, L. Wan, W. Gao, Y. Chu, T. Du, J. Song, H. Xiang, H. Wang, K. Yang, and **B. Yang**, "A 9pJ/bit SOP optical transceiver with 80 Gbps two-way bandwidth," *2011 Asia Communications and Photonics Conference and Exhibition (ACP)*, Shanghai, 2011, pp. 1-5.

PATENTS

1. Binbin Yang, Hariharan Muthukrishnan, Juan Martinez, Eric Krenz, "Wireless Communication Device Having a Two-Part Rotatable Housing with Multiple Antenna Conductors", US patent No.:10886596.
2. Daniel Guidotti, Binbin Yang, Shang-Jen Su, Muhammad S. Omar, Yahya M. Alfadhli, Gee-Kung Chang, Xiaoli Ma, "Small formfactor phased array antenna system and method for simultaneous spatial and channel diversity communications", WO, application No.:WO2023133300A1.

TALKS & POSTERS

INVITED TALKS

1. "3D-Printed Dielectric Antennas for mmWave Imaging Applications", at the Center of Excellence Research Symposium at NC A&T State University, November 2021.
2. "Application of Characteristic Mode Theory to MIMO Antennas", presented at the webinar held by the Characteristic Modes - Special Interest Group (CM SIG), December 2020.

3. “A Modal Approach to Modeling and Design of Compact MIMO Antennas ” at North Carolina Agricultural and Technical State University, Greensboro, North Carolina, May 2019.
4. “A Modal Approach to Compact MIMO Antenna Design” at Motorola Mobility, a Lenovo company, Chicago, Illinois, April 2017.
5. “Systematic Design of MIMO Antennas using Characteristic Mode Theory” at Futurewei Technologies, Inc. (Huawei R&D USA), Bridgewater, New Jersey, May 2016.

POSTERS

1. “Systematic Design of Optimal Planar MIMO Antennas Using Characteristic Mode Theory”, The 11th Graduate Student Research Symposium, North Carolina State University, Raleigh, NC, March 2016.

TEACHING EXPERIENCES

- **ECEN 325 - Introduction to Electromagnetics**

This undergraduate course covers the fundamentals of electromagnetism. Topics include transmission line theory, reflection and transmission, smith chart, impedance matching, electrostatics, magnetostatics and time-varying fields. (Fall 2019, Spring 2020, Fall 2020, Spring 2021, Fall 2021, Spring 2022, Fall 2022, Spring 2023, Fall 2023)

- **ECEN 450 - Electromagnetic Wave Propagation and Transmission**

This undergraduate course covers electromagnetic wave propagation and radiation. Topics include Maxwell’s equations, wave reflection and transmission at media interface, plane waves, guided waves, Poynting theorem, equivalence principle, antenna radiation, etc. (Spring 2021, Spring 2022, Spring 2023)

- **ECEN 625 - Microwave Circuits**

This graduate course covers both fundamental theories behind microwave circuits, such as transmission line theory, waveguides and network analysis (Z/Y/S/ABCD parameters), as well as specific designs such as power dividers, couplers and filters. System level analysis such as link budget, non-linearity and noise analysis will also be briefly covered. (Fall 2020, Spring 2021, Spring 2022)

- **ECEN 885, ECEN 685 - Antenna Design, Simulation and Measurement**

This graduate course covers antenna theory, radiation parameters (gain, efficiency, directivity, antenna pattern, etc.), design method and properties of various types of antennas (dipole, loop, microstrip patch, aperture antenna, frequency independent antenna, dielectric antennas, etc.), and lastly antenna design through HFSS simulation, prototyping using PCBs and antenna measurement. (Fall 2022, Fall 2023)

RESEARCH TRAINING AND SUPERVISION

GRADUATE RESEARCH

- Trupti Bellundagi, Dielectric Antennas, Spring 2021 - Present
- Ewomazino Samuel Edhere, 3D Printed Electromagnetic Devices, May 2021 - Dec 2022 (MS graduated)
- Kitch Mensah-Bonsu, Reconfigurable Reflectarrays and Metasurfaces, Jan 2022 - Present
- Habeeb Adeagbo, Transformation Optics and Gradient-index Beamforming Lenses, Aug 2022 - Present
- Babatunde Olatujoye, Microwave Imaging Using Vivaldi Antenna Arrays, Spring 2023-Present
- Shantu Ghose, Dielectric Reflectarrays, Fall 2023 - Present
- Augustine Kludze, ML-based Microwave Imaging System, Fall 2023-Present

UNDERGRADUATE RESEARCH

- Oluremi Lawson, High Power Antennas, Fall 2023.
- Joshua Eanes, Reconfigurable Array Antenna, Fall 2023.
- Xinchun Hu, Non-canonical Dielectric Resonator Antenna, Spring 2020 - Spring 2021
- Jaron Silas, Wireless Power Transfer, Spring 2021.
- Daniel Luque Garcia, RF Energy Harvesting, Cyborg Cockroach, Fall 2019 - Spring 2020
- Dorant Smith, Microwave Imaging for Cancer Detection, Spring 2020.

THESES/DISSERTATION COMMITTEES

- Yongduk Oh, ECE, NC State University, PhD, May 2022.
- Ewomazino Samuel Edhere, ECE, NC A&T State University, MS, Dec. 2022.
- Gursewak Ghuman, ECE, NC A&T State University, MS, Oct. 2021.
- Jaewoo Kim, ECE, NC State University, MS, July 2021.

SENIOR DESIGN TEAMS

- Wireless Charging of Underwater Drones
Students: William Moody, Aitouali Tarik, Nicholas Dewitt, Da'Shawn L. Caldwell
Period: Fall 2022 - Spring 2023
- Radar System Design Using a Software Defined Radio
Students: Malkam Hawkins, Essence McClinton, Darrian Jones, Jonathan Ward
Period: Fall 2021 - Spring 2022
- Electromagnetic Wave Power Transfer
Students: Jaron Silas, Darius Burns, Charles Randall
Period: Spring 2020 - Fall 2020

SERVICES

AFFILIATION

- IEEE, Senior Member.
- IEEE Antennas and Propagation Society (AP-S), Member, 2020 - Present.
- ACES (The Applied Computational Electromagnetics Society), Student Member, 2015; Member, 2020.
- Characteristic Modes - Special Interest Group (CM SIG), Member.

CONFERENCE SERVICE

- 2022 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, session chairs, special session organizer.
- 2023 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, session chairs.

UNIVERSITY/DEPARTMENT SERVICE

- Graduate College Faculty Representative for Doctoral Defense, Nov 2021.
- Department Representative for Undergraduate Research, 2021 Summer -Present.
- 10th Annual College of Engineering Graduate Research Poster Presentation Competition, Anchor Judge, April 19-20, 2021.
- Faculty Search Committee, member, Spring 2021.
- Graduate Student Orientation Panelist, College of Engineering, Fall 2020.
- Undergraduate Electrical Engineering Curriculum Committee, member, Fall 2019 - Present.
- Senior Design Committee, member, Fall 2020 - Present.

PEER REVIEWER

- Reviewer - *IEEE Transactions on Antennas and Propagation*
- Reviewer - *IEEE Transactions on Microwave Theory and Techniques*
- Reviewer - *IEEE Open Journal of Antennas and Propagation*
- Reviewer - *IEEE Internet of Things Journal*
- Reviewer - *IEEE Access*
- Reviewer - *Progress in Electromagnetics Research - PIER*
- Reviewer - *Applied Computational Electromagnetics Society Journal*
- Reviewer - *Electronics Letters*
- Reviewer - *Sensors*
- Reviewer - *Radio Science*
- Reviewer - *Applied Sciences*
- Reviewer - *John Wiley & Sons (WILEY)*
- Reviewer - *IEEE International Symposium on Antennas and Propagation and USNC-URSI National Radio Science Meeting*
- Reviewer - *Military Communications Conference*

EDITORIAL ROLES

- Member of Editorial Board - *Frontiers in Communications and Networks*
- Member of Editorial Board - *Frontiers In Antennas and Propagation*
- Editor - *Characteristic Modes Special Interest Group (CM-SIG) Newsletter*

LANGUAGES

Proficient in English and Chinese.