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JORDAN BUDHU

Postdoctoral Research Fellow – Radiation Laboratory
University of Michigan – Since January 2019
Radiation Laboratory-Electromagnetic Metamaterials Laboratory
Principle Investigator Prof. Anthony Grbic

EDUCATION

Doctor of Philosophy in Electrical Engineering- Physical and Wave Electronics
University of California, Los Angeles, Graduated—Fall 2018
UCLA Antenna, Research, Analysis, and Measurement Laboratory
Under Advisement of Prof. Yahya Rahmat-Samii

Master of Science in Electrical Engineering- Microwave and Antenna Engineering
California State University, Northridge, Graduated—May 2010 *with Distinction*
Under Advisement of Prof. Sembiam Rengarajan

Bachelor of Science in Electronics Engineering Technology
Devry University, Graduated—February 2006 *Magna Cum Laude*

AWARDS AND HONORS

- **2019 First Place USNC-URSI Ernst K. Smith Student Paper Competition Award**
- **2018 UCLA Henry Samueli School of Engineering Excellence in Teaching Award**
- **2012 First Place Best Poster Award at the 2012 IEEE Coastal Los Angeles Class-Tech Meeting.**
- **2010 UCLA Eugene Cota-Robles Fellowship**
- **2005 First Place Award / Undergraduate Senior Project**

ACADEMIC THESIS AND PROJECTS

Postdoctoral Research – Metamaterials, Metasurfaces, Reflectarrays, Dielectric Resonator Antenna Coupled Infrared Photodetectors

Graduate Ph.D. Dissertation -- Numerical Synthesis Algorithms for Next Generation Spaceborne Wind Scatterometer and CubeSat Antennas

Graduate Master's Thesis – Investigations into Reflectarray Design Using the Infinite Array Approximation

Undergraduate Senior Project – Automatic Automobile Oil Change System

TEACHING EXPERIENCE

University of Michigan **January 2021- May 2021**
LEO Intermittent Lecturer
Primary Instructor for Winter 2021 semester (EECS430 Wireless Link Design).

University of Michigan **January 2020- May 2020**
LEO Intermittent Lecturer
Primary Instructor for Winter 2020 semester (EECS430 Wireless Link Design).

University of California Los Angeles **September 2018- December 2018**
Teaching Fellow
Teaching Fellow position for Fall 2018 quarter (EE101A Electromagnetic Wave).

University of California Los Angeles **January 2018- March 2018**
Teaching Associate
Teaching Associate position for Winter 2018 quarter (EE101A Electromagnetic Wave).

University of California Los Angeles **March 2017- June 2017**
Teaching Associate
Teaching Associate position for Spring 2017 quarter for EE162A Communication Systems and Antennas.

University of California Los Angeles **January 2017- March 2017**
Teaching Associate
Teaching Associate position for Winter 2017 quarter for EE101B Electromagnetic Wave.

University of California Los Angeles **September 2012-December 2012**
Teaching Assistant
Teaching Assistant position for Fall 2012 quarter for EE1 Electrical Engineering Physics.

University of California Los Angeles **March 2012- June 2012**
Teaching Assistant
Teaching Assistant position for Spring 2012 quarter for EE162A Communication Systems and Antennas.

California State University Northridge **January 2010-July 2010**
Teaching Assistant
Teaching assistant for the course ECE 371 for Electromagnetic Fields and Wave I for the Spring semester.

Frog Tutoring **January 2017-Present**
Engineering, Physics, and Mathematics Tutor
Tutoring kids from K-12 all the way up to Graduate School in various subject areas such as Mathematics, Geometry, Physics, and Engineering.

BookAnyone Online Tutoring **June 2018-Present**
Advanced Math Science Engineering Tutor
Tutoring kids from K-12 all the way up to Graduate School in various subject areas such as Mathematics, Geometry, Physics, and Engineering.

Ingenius Academic Prep Mentoring **Jan 2019-Present**
Academic Mentor
Mentorship role in one-on-one project development with a student hand selected by their academic institution to participate in the program. An 8-week project is planned, executed, and presented by the student and I in complex engineering or computer science topics.

INDUSTRY EXPERIENCE

NASA Jet Propulsion Laboratory **June 2012—September 2012**
Summer Intern III, Spacecraft Antennas Group
Antenna design, analysis, and characterization for the Surface Water Ocean Topography (SWOT) satellite.

NASA Jet Propulsion Laboratory **July 2011—October 2011**
Summer Intern III, Spacecraft Antennas Group
Antenna design, analysis, and characterization for the Surface Water Ocean Topography (SWOT) satellite.

Meggitt Safety System Inc. **October 2006—September 2010**
Software Engineer
Design, Implement, and Test DO-178B compliant embedded software for avionics platforms.

Lucix Cooperation **March 2006—October 2006**
Engineering Technician
Testing of microwave phase locked oscillators and test/tuning of microwave hybrid amplifiers.

Meggitt Safety Systems Inc. **November 2005— March 2006**
Engineer Intern
Interning as an Engineer assisting coworkers on various projects.

PUBLICATIONS

Journal Papers:

J. Budhu, Y. Rahmat-Samii, R. E. Hodges, D. C. Hofmann, D. F. Ruffatto and K. C. Carpenter, "Three-Dimensionally Printed,

Shaped, Engineered Material Inhomogeneous Lens Antennas for Next-Generation Spaceborne Weather Radar Systems," in IEEE Antennas and Wireless Propagation Letters, vol. 17, no. 11, pp. 2080-2084, Nov. 2018.

J. Budhu and Y. Rahmat-Samii, "A Novel and Systematic Approach to Inhomogeneous Dielectric Lens Design Based on Curved Ray Geometrical Optics and Particle Swarm Optimization," in IEEE Transactions on Antennas and Propagation, vol. 67, no. 6, pp. 3657-3669, June 2019.

J. Budhu and Y. Rahmat-Samii, "3D-Printed Inhomogeneous Dielectric Lens Antenna Diagnostics: A Tool for Assessing Lenses Misprinted Due to Fabrication Tolerances," in IEEE Antennas and Propagation Magazine, vol. 62, no. 4, pp. 49-61, Aug. 2020.

A. Papathanasopoulos, **J. Budhu**, Y. Rahmat-Samii, R. E. Hodges, and D. F. Ruffatto, "3D-Printed Shaped and Material-Optimized Slimmed Lenses for Next-Generation Spaceborne Wind Scatterometer Weather Radars," Under Review in IEEE Transactions on Antennas and Propagation, February 2021.

J. Budhu and A. Grbic, "Perfectly Reflecting Metasurface Reflectarrays: Mutual Coupling Modeling Between Unique Elements Through Homogenization," in IEEE Transactions on Antennas and Propagation, vol. 69, no. 1, pp. 122-134, Jan. 2021.

J. Budhu, E. Michielssen, and A. Grbic, "The Design of Dual Band Multilayer Stacked Metasurfaces Using Integral Equations," – Under Review in IEEE Transactions on Antennas and Propagation, February 2021 (available on arxiv.org arXiv:2103.03676 [physics.app-ph]).

J. Budhu and A. Grbic, "Fast and Accurate Optimization of Metasurfaces with Gradient Descent and the Woodbury Matrix Identity," – Under Review in IEEE Transactions on Antennas and Propagation, July 2021. (available on arxiv.org, arXiv:2108.02762 [math.NA])

J. Budhu, N. Pfiester, K.K. Choi, S. Young, C. Ball, S. Krishna, and A. Grbic, "Dielectric Resonator Antenna Coupled Antimonide-Based Detectors (DRACAD) for the Infrared," in IEEE Transactions on Antennas and Propagation, doi: 10.1109/TAP.2021.3069522. (also available on arxiv.org, arXiv:2011.10818 [physics.ins-det])

J. Budhu and A. Grbic, "Recent Advances in Bianisotropic Boundary Conditions: Theory, Capabilities, Realizations, and Applications," Under Review in Nanophotonics, July 2021. *Invited Paper* (available on arxiv.org, arXiv:2108.05965 [physics.app-ph])

M. Almunif, W. Alomar, **J. Budhu**, and A. Grbic, "A Bianisotropic Metasurface for Focusing Between Regions of High Dielectric Contrast," –In Preparation for IEEE Transactions on Antennas and Propagation.

Books and Book Chapters:

J. Budhu and A. Grbic of Part, "Field manipulation through MbD-oriented Devices," in Title: Metamaterials-by-Design: Theory, Technologies, and Vision, ELSEVIER-SPIE Joint Series on Photonic Materials and Applications, Amsterdam, Netherlands, 2022. (*Invited book chapter*)

Conference Papers:

J. Budhu and Y. Rahmat-Samii, "Understanding the appearance of specular reflection in offset fed reflectarray antennas," 2011 IEEE International Symposium on Antennas and Propagation (APSURSI), 2011, pp. 97-100.

J. Budhu and Yahya Rahmat-Samii, "Offset Fed Reflectarray Antennas: A Closer Look At How To Remedy Specular Reflection." – IEEE Coastal Los Angeles Annual Meeting, October 2012. (*Won First Place Prize for Best Poster*)

J. Budhu and Y. Rahmat-Samii, "An efficient spectral domain method of moments for Reflectarray antennas using a customized impedance matrix interpolation scheme," 2013 US National Committee of URSI National Radio Science Meeting (USNC-URSI NRSM), 2013, pp. 1-1.

J. Budhu and Y. Rahmat-Samii, "Accelerating the Spectral Domain Moment Method for reflectarray's by two-orders of magnitude," 2013 IEEE Antennas and Propagation Society International Symposium (APSURSI), 2013, pp. 1340-1341.

J. Budhu and Y. Rahmat-Samii, "Synthesizing thin dielectric lenses for conical scanning beams: A hybrid numerical algorithm," 2017 United States National Committee of URSI National Radio Science Meeting (USNC-URSI NRSM), 2017, pp. 1-2.

- J. Budhu** and Y. Rahmat-Samii, "Synthesis of 3D-printed dielectric lens antennas via optimization of Geometrical Optics Ray Tracing," 2017 USNC-URSI Radio Science Meeting (Joint with AP-S Symposium), 2017, pp. 9-10.
- Y. Rahmat-Samii, J.M. Kovitz, **J. Budhu**, V. Manohar, "A Novel Near-field Gregorian Reflectarray Antenna Design with a Compact Deployment Strategy for High Performance CubeSats", AMTA Conference, Atlanta, GA, October 2017
- J. Budhu** and Y. Rahmat-Samii, "Shaped-profiled and material-engineered inhomogeneous lens antennas: GO curved ray tracing and aperture fields," 2018 United States National Committee of URSI National Radio Science Meeting (USNC-URSI NRSRM), 2018, pp. 1-2.
- J. Budhu** and Y. Rahmat-Samii, "A Novel GO-PSO Algorithm for Designing 3D-Printed Optimized Pixelized Inhomogeneous and Shaped-Profiled Lens Antennas", AMTA Conference, Atlanta, GA, October 2018
- Vignesh Manohar, **Jordan Budhu**, and Yahya Rahmat-Samii, "Representative Low-Profile Gregorian Reflector Antenna Designs with a Compact Deployment Strategy for Emerging CubeSats", – presented at the January 2019 National Radio Science Meeting (NRSRM) in Boulder, Colorado
- J. Budhu** and Y. Rahmat-Samii, "A New 3D-Printed Electronically Scanned Spinning Spot Beam Inhomogeneous Dielectric Lens Antenna for Spaceborne Wind Scatterometer Weather Radar Satellites", – presented at the January 2019 National Radio Science Meeting (NRSRM) in Boulder, Colorado. (*Won First Place Award Student Paper Competition*)
- J. Budhu** and Y. Rahmat-Samii, "A Novel Diagnostics Method for Determining the Unknown Permittivity Profile of 3D Printed Lenses," 2019 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, 2019, pp. 87-88.
- Y. Rahmat-Samii, **J. Budhu**, R. E. Hodges, D. C. Hofmann and D. Ruffatto, "A Novel 60-cm Non-spherical 3-D Printed Voxelized Lens Antenna: Design, Fabrication and Measurement," 2019 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, 2019, pp. 1699-1700.
- J. Budhu** and A. Grbic, "A Rigorous Approach to Designing Reflectarrays," 2019 23rd International Conference on Applied Electromagnetics and Communications (ICECOM), 2019, pp. 1-3.
- J. Budhu**, A. Grbic, and E. Michielssen, "Design of Multilayer, Dualband Metasurface Reflectarrays," 2020 14th European Conference on Antennas and Propagation (EuCAP), 2020, pp. 1-4. *Invited Paper*
- J. Budhu**, E. Michielssen, and A. Grbic, "Dualband Stacked Metasurface Reflectarray," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, 2020, pp. 821-822.
- J. Budhu**, A. Grbic, N. Pfiester, C. Ball, K. -K. Choi and S. Krishna, "Dielectric Resonator Antenna Coupled Infrared Antimonide Photodetectors," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, 2020, pp. 23-24.
- A. Kazemi, **J. Budhu**, et. al., "Subwavelength antimonide infrared detector coupled with dielectric resonator antenna," Proceedings Volume 11002, Infrared Technology and Applications XLV; 1100221 (2019).
- N. A. Pfiester, **J. Budhu**, et al., "Modeling and extraction of optical characteristics of InAs/GaSb strained layer superlattice," Proc. SPIE 11407, Infrared Technology and Applications XLVI, p. 114070M, 2020.
- N. A. Pfiester, **J. Budhu**, et al., "Optical properties of III-V superlattices for the design optimization of antenna-coupled detectors," presented at the SPIE Defense and Commercial Sensing 2020 Digital Forum online, Anaheim, CA, March, 2020.
- J. Budhu** and A. Grbic, "A Reflective Metasurface for Perfect Cylindrical to Planar Wavefront Transformation," 2020 Fourteenth International Congress on Artificial Materials for Novel Wave Phenomena (Metamaterials), 2020, pp. 234-236.
- J. Budhu** and A. Grbic, "Passive Reflective Metasurfaces for Far-Field Beamforming," 2021 15th European Conference on Antennas and Propagation (EuCAP), 2021, pp. 1-4. *Invited Paper*
- J. Budhu** and A. Grbic, "Accelerated Optimization of Metasurfaces with the Woodbury Matrix Identity," 2021 ACES conference, Online, 2021, pp. 1-4. *Invited Paper*
- J. Budhu**, L. Szymanski, and A. Grbic, "Accurate Modeling and Rapid Synthesis Methods for Beamforming Metasurface," 2021 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, Singapore, 2021.

J. Budhu and A. Grbic, "Passive Metasurface Antenna with Perfect Aperture Efficiency," 2021 Fifteenth International Congress on Artificial Materials for Novel Wave Phenomena (Metamaterials), New York, NY, USA, 2021.

N. Pfister, S.A Mills, **J. Budhu**, K.K Choi, C. D Ball, S. M. Young, A. Grbic, S. Krishna, "Progress toward dielectric antenna-coupled LWIR photodetectors based on Type-II superlattices," Infrared Technology and Applications, XLVII 11741, 117410R

INVITED TALKS

J. Budhu, "Directivity Enhancement of Offset Fed Reflectarray Antennas." –presented at the Electrical Engineering Department Annual Research Review, University of California, Los Angeles, March 2012

J. Budhu, "Next Generation Spaceborne Wind Scatterometer Weather Radar Satellite Antenna." –presented at the March 2018 National Science Foundation (NSF) California Academic Alliance Retreat in Berkeley, California.

J. Budhu, "Next Generation Spaceborne Wind Scatterometer and CubeSat Antennas: Lightweight 3D Printed Inhomogeneous Lens Antennas and Dual Reflectarray Antennas." –presented at the University of Michigan Radiation Laboratory Seminar, Ann Arbor, June 2018.

J. Budhu, "Next Generation Spaceborne Wind Scatterometer and CubeSat Antennas: Lightweight 3D Printed Inhomogeneous Lens Antennas and Dual Reflectarray Antennas." –presented at the University of Michigan Radiation Laboratory Seminar for the IEEE Remote Sensing Chapter, Ann Arbor, April 2019. (*more info at: T. Wang and D. Mayers, "Activities of the GRSS University of Michigan Student Chapter [Chapters]," in IEEE Geoscience and Remote Sensing Magazine, vol. 8, no. 1, pp. 166-168, March 2020, doi: 10.1109/MGRS.2020.2970825*)

J. Budhu, "Next Generation Metasurfaces: Multiband Passive Metasurfaces for Arbitrary Amplitude and Phase Control." –presented at the IEEE SEM Chapter IV Trident Seminar Series, Ann Arbor, December 2020. (*can be found at <https://youtu.be/8cURCVxXTH8>*)

SERVICE

Special Session Organizer and Chair for "Recent Advances in Generalized Sheet Transition Conditions (GSTCs): Theory, Capabilities, Realizations, and Applications," at the 2021 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting in Singapore on 4-10 December 2021.

Special Cluster Proposal Submission in "Recent Advances in Generalized Sheet Transition Conditions (GSTCs): Theory, Capabilities, Realizations, and Applications" for IEEE Antennas and Wireless Propagation Letters 2022 Special Clusters.

Reviewed over 18 IEEE articles, with 13 in the last 12 months.