Sourangsu Banerji

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Summary of Research Interests

My current research interests are in the areas of diffractive optics, metamaterials, plasmonics, nanotechnology, and nanophotonics, with particular focus on computational approaches aimed towards the design of engineered nano-structures. My recent research work spans a broad range of topics including ultra-thin aberration corrected lens design, planar visible/THz optical elements, computational spectrometers, transmissive broadband holograms, wireless demultiplexers, energy efficient photovoltaics right up to planar reconfigurable nano-scale optical devices designed using digital metamaterials, advanced metasurfaces, and topological photonics.

In this context, I have also extensively worked on translating and exploiting well-established methods and concepts from computer science engineering to the realm of optics, photonics and nanotechnology. That is to say, that my work also includes looking into a number of different optimization algorithms as well as machine learning techniques (deep learning) for possible use in designing nano-scale photonic and optical devices, beyond the current non-linear optimization technique i.e. modified direct-binary-search (m-DBS) algorithm, which I have used till now. My work in general, intends to cater to the growing computational need for the majority of computationally complicated designed visible/THz devices in an effort to avoid having to build up much computational pressure which is expensive, time consuming, and not scalable.

Education

Ph.D. in Electrical and Computer Engineering — Aug.'2016 – Present
University of Utah, Salt Lake City, UT, USA
- Advisor: Prof. Berardi Sensale-Rodriguez
- GPA: 3.74/4.00

B.Tech. in Electronics and Communication Engineering — Sept.'2010 – Jul.'2014
West Bengal University of Technology, Kolkata, WB, India
- Advisor: Prof. Arpan Deyasi
- GPA: 8.21/10.00
- Thesis Dissertation: *Study of Electronic and Electromagnetic Properties of One-Dimensional Photonic Crystal*

Professional Experience

Graduate Research Assistant — Sept.'2016-Present
University of Utah, Salt Lake City, UT, USA

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Terahertz Optoelectronics Research Group
- Advisor: Prof. Berardi Sensale-Rodriguez
- Research Activity: Computational diffractive optics; engineered nano-structures; digital metamaterials; plasmonics.
- Key Achievements:
  - ✓ Developed an algorithm (mDBS) which speeds up computation time ~10-100X times faster than previously used.
  - ✓ Developed fabrication error tolerant and efficient (~50%) planar THz/optical elements.

Programmer Analyst Jan.'2015-May'2016
Cognizant Technology Solutions India Pvt. Ltd., Kolkata, WB, India
- Key Achievements:
  - ✓ Developed an IBM I.D. toolkit for automated mail integration over the client server (handling capacity ~50,000).

Research Assistant Jul.'2013-Aug.'2014
West Bengal University of Technology, Kolkata, WB, India
- Advisor: Prof. Arpan Deyasi
- Research Activity: Photonic crystals; engineered nano-structures; fundamental physical bounds in band gap engineering.
- Key Achievements:
  - ✓ Developed an analytical framework for the study of band structures and wave propagation of 1D photonic crystals.

Visiting Research Student Feb.'2012-Nov.'2014
Indian Statistical Institute, Kolkata, WB, India
Mathematical Genomics Research Group
- Advisor: Prof. Pabitra Pal Chowdhury
- Research Activity: fractals; fractal image compression techniques.
- Key Achievements:
  - ✓ Developed a fractal image processing technique to with research activities within the group.

Winter Research Intern Dec.'2012-Jan.'2013
Variable Energy Cyclotron Center, Kolkata, WB, India
Mechanical Engineering Group (Cryogenic Instrumentation Section)
- Advisor: Dr. Tamal Kumar Bhattacharya
- Research Activity: Data acquisition module design for collecting synchrotron data; TCP/Modbus protocols.
- Key Achievements:
  - ✓ Developed a GUI for remote control of the synchrotron facility; later adopted in other units due to robust design.

Teaching Experience

Graduate Teaching Assistant Jan.'2017-May'2017
University of Utah, Salt Lake City, UT, USA
Department of Electrical and Computer Engineering
- **EC 3200 (Introduction to Semiconductor Physics)**

- Tutored students on solid-state physics, optics and electronics. Office hour assistance to students. Organized additional one-to-one sessions for students in need of further assistance. Graded homework, student presentations and exams.

Graduate Teaching Assistant Sept.'2017-Dec.'2017
University of Utah, Salt Lake City, UT, USA

Department of Electrical and Computer Engineering
- **EC 3300 (EM Theory & Transmission Lines)**
- Tutored students on basic electromagnetic theory. Office hour assistance to students. Graded homework, student presentations and exams.

Graduate Teaching Assistant Sept.'2017-Dec.'2017
University of Utah, Salt Lake City, UT, USA
Department of Electrical and Computer Engineering
- **EC 5410/6322 (Microwave Engineering-I)**
- Office hour assistance to students. Graded homework, student presentations and exams.

Selected Scientific Honors, Awards, and Recognitions

Semiconductor Science and Technology "Cover Image" (2018)
- For the paper "Graphene–dielectric integrated terahertz metasurfaces" in the Special Issue on "Special Issue on Terahertz Devices".

Best Student Paper Award (Runners Up) (2018)
Award Committee: The International Society of Infrared, Millimeter, and Terahertz Waves
- Best Student Paper Award (Runners Up) for presentation titled "Demonstration Of Computational THz Diffractive Optical Elements Enabled By A Modified Direct Binary Search Technique". (Top 6 out of 150+ submissions)
- Keynote Talk for presentation titled "Demonstration Of Computational THz Diffractive Optical Elements Enabled By A Modified Direct Binary Search Technique".

SPIE Chapter Officer Travel Award (2018)
Award Committee: Society of Photographic Instrumentation Engineers (SPIE)
- To attend "Leadership Workshop" at SPIE Optics + Photonics at San Diego, CA, USA.
- To present research at SPIE Optics + Photonics at San Diego, CA, USA.

Student Poster Award (2018)
Award Committee: São Paulo School of Advanced Science (SPSAS) + XVI Jorge André Swieca School on Non linear and Quantum Optics (SWIECA)
- For the paper titled "From Visible to THz: Planar Optics for Lightweight, Small Form-Factor High-Precision, Energy Efficient Laser Applications".
- Selected among 25 candidates from all over the world to be invited to attend the São Paulo School of Advanced Science (SPSAS) + XVI Jorge André Swieca School on Non linear and Quantum Optics (SWIECA), organized by the Center for Lasers and Applications, located inside the Nuclear and Energy Research Institute, IPEN, at the University of São Paulo (USP) in Brazil.

University of Utah Graduate School Travel Assistance Award (2018)
Award Committee: University of Utah, Salt Lake City, UT, USA
- For "Technical Merit" to present research at CLEO: Laser Science and Applications at San Jose, CA, USA.

Sourangsu Banerji

SPIE Optics + Photonics Travel Award (2017)
Award Committee: Society of Photographic Instrumentation Engineers (SPIE)

- For "Technical Merit" to present research at SPIE Optics + Photonics at San Diego, CA, USA.

University of Utah Graduate Fellowship (2016)
Award Committee: University of Utah, Salt Lake City, UT, USA

- One-year fellowship that is reserved for a very limited number of Ph.D. applicants. The fellowship provides for support during first year at a level of $21,000/year. During this initial time, the fellow needs to assist with the teaching activities within the department.

GATE M.Tech. Fellowship (Offer Declined) [All India Rank: 24] (2016)
Award Committee: Government of India – Ministry of Human Resource Development

- The award of postgraduate Scholarship/Assistantship to GATE qualified candidates is for a maximum period of 24 months for master's degree programs, as per the prevailing procedure of the admitting institution.

Indian National Mathematics Olympiad (Qualified) (2009)
Homi Bhabha Centre for Science Education (HBCSE)

Scientific Contributions

Peer-Reviewed Journal Papers

[1] Sourangsu Banerji, Ashish Chanana, Ajay Nahata and Berardi Sensale-Rodriguez, "High NA THz Lens for THz Beam Focusing Enabled by Computational Design ", Scientific Reports. (***Accepted***)

[2] Sourangsu Banerji, Ashish Chanana, Hugo Condori Quispe, Sara Arezoomandan, Ajay Nahata and Berardi Sensale-Rodriguez, "Efficient and fabrication-error tolerant 3D-printed computational diffractive THz optical elements", Optics Express. (***Accepted***)

[3] Sara Arezoomandan, Hugo Condori Quispe, Ashish Chanana, Prashanth Gopalan, Sourangsu Banerji, Ajay Nahata and Berardi Sensale-Rodriguez, "Graphene–dielectric integrated terahertz metasurfaces", Semiconductor Science and Technology, Volume-33(10), September 2018. (*Invited article*) (Cover Image for Issue "Special Issue on Terahertz Devices")

[4] Sourangsu Banerji, and Arpan Deyasi, 'Simulating Reflectivity Property for Propagating Wave inside One-Dimensional Photonic Crystal with Different Material Systems*",* Journal of Electron Devices, Volume-21, March 2015.

[5] Sourangsu Banerji, "Group Theoretic Approach to Study Transfer Matrix Method in One Dimensional Photonic Crystals*",* GESJ: Physics, Volume-11(1), July 2014.

[6] Sourangsu Banerji, Sayan Bose, Abhishek Halder, Subhasis Mandal, and Arpan Deyasi, "Comprehensive Review on Band Structure, Density of States and Wave Propagation inside One-Dimensional Photonic Crystal*",* International Journal for Research in Applied Science and Engineering Technology, Volume-2(4), April 2014.

[7] Sourangsu Banerji, Abhishek Halder, Arpan Deyasi, Sayan Bose, and Subhasis Mandal , "Analytical Computation of Density of States of One-Dimensional Photonic Crystal under Polarized Incident Wave for Different Materials*",* Journal of Electron Devices, Volume-19, April 2014.

[8] Sourangsu Banerji, "Design and Implementation of an Unmanned Vehicle using a GSM Network without Microcontrollers", Journal of Electrical Engineering, Volume-14 (1), April 2014.

[9] Abhishek Halder, Sourangsu Banerji, Sayan Bose, Subhasis Mandal, and Arpan Deyasi, "Computing Density of States of One-Dimensional Photonic Crystal under P-Polarized Incident Wave", International Journal of Modern Communication Technologies & Research, Volume-2 (3), March 2014.

[10] Sourangsu Banerji, "To Study the Effect of Grating Length on Propagating Modes in Bragg Filters with $Al_{(x)}Ga_{(1-x)}N/GaN$ Material Composition", International Journal of Advanced Science and Technology, Volume-63, February 2014.

[11] Sourangsu Banerji, and Rahul Singha Chowdhury, "On IEEE 802.11: Wireless LAN Technology", International Journal of Mobile Network Communications & Telematics, Volume-3 (4), August 2013.

[12] Sourangsu Banerji, and Rahul Singha Chowdhury, "Wi-Fi & WiMAX: A Comparative Study", Indian Journal of Engineering, Volume-2 (5), March 2013.

[13] Sourangsu Banerji, "Design and Implementation of developed an Unmanned Vehicle using a GSM Network with Microcontrollers", International Journal of Science, Engineering and Technology Research, Volume-2 (2), February 2013.

Book Chapters

[1] Arpan Deyasi, Sourangsu Banerji, Sayan Bose, and Abhishek Halder, "Analytical Computation of Band Structure of 1D Photonic Crystal under Normal Incidence of Electromagnetic Wave", Lecture Notes in Electrical Engineering: Computational Advancement in Communication Circuits and Systems, Part 6: Advances in Devices and Circuit, vol. 335, Chapter 36, September 2014.

Keynote and Invited Talks

[1] Sourangsu Banerji, Ashish Chanana, Ajay Nahata and Berardi Sensale-Rodriguez, "Efficient, fabrication-error tolerant 3D-printed diffractive THz optical elements and reconfigurable THz devices through computational design", SPIE Defense + Commercial Sensing, April 2019. (***Accepted***)

[2] Sourangsu Banerji, Ashish Chanana, Hugo Condori, Sara Arezoomandan, Ajay Nahata, and Berardi Sensale-Rodriguez, "Demonstration of computational THz diffractive optical elements enabled by a modified direct binary search technique", 43rd International Conference on Infrared, Millimeter and Terahertz Waves, Nagoya, NP, Japan, September 2018. [**Best Student Paper Award (Runners Up)]**

[3] Sourangsu Banerji, "Simulation Tool to Design Diffractive Lenses", Undergraduate Computer Science Capstone Project Seminar Series, University of Utah, Salt Lake City, UT,USA May 2017.

Contributed Talks

[1] Sourangsu Banerji, Ashish Chanana, Hugo Condori, Ajay Nahata, and Berardi Sensale-Rodriguez, "Efficient Design of Diffractive THz Lenses for Aberration Rectified Focusing via Modified Binary Search Algorithm", CLEO: Science and Innovations, San Jose, CA, USA, May 2017.

[2] Yunshan Wang, Sourangsu Banerji, Jieying Mao, Sara Arezoomandan, Berardi Sensale Rodriguez, and Steve Blair, "Modification of UV Surface Plasmon Resonances in Aluminum Hole-Arrays with Graphene", SPIE Optics + Photonics, San Diego, CA, USA, August 2017.

[3] Yunshan Wang, Sourangsu Banerji, Jieying Mao, Sara Arezoomandan, Berardi Sensale Rodriguez, and Steve Blair, "Modification of UV Surface Plasmon Resonances in Aluminum Hole-Arrays with Graphene", CLEO: Science and Innovations, San Jose, CA, USA, May 2017.

[4] Arpan Deyasi, and Sourangsu Banerji, "On the Comparative Analysis of the Band Structure of One-Dimensional Photonic Crystal with Different Material Composition under Oblique Wave Incidence", National Level Conference on Frontline Research in Computer, Communication and Device, Kolkata, WB, India, December 2015.

[5] Sourangsu Banerji, and Arpan Deyasi, "Application of Group Theory in Transfer Matrix Technique for Band Structure Calculation in 1D Photonic Crystal", International Conference on Computer, Communication and Control, Kolkata, WB, India, September 2015.

[6] Arpan Deyasi, and Sourangsu Banerji, "Computing Photonic Eigen-Modes and Bandwidth for 1D Photonic Crystal with Different Material Compositions", 2nd National Conference on Emerging Trends in Engineering & Sciences, Kolkata, WB, India, July 2015.

[7] Arpan Deyasi, Sourangsu Banerji, "Analysis of Reflectivity for Propagating Wave inside 1D Photonic Crystal with Different Material Systems", International Conference on Computing, Communication & Manufacturing, Kolkata, WB, India, December 2014.

[8] Arpan Deyasi, Sourangsu Banerji, Abhishek Halder, Sayan Bose, "Theoretical Investigation on Photonic Bandgap Tailoring in One-Dimensional Photonic Crystal using Different Numerical Methods", International Conference on Devices, Circuits and Communications, Kolkata, WB, India, September 2014.

[9] Sayan Bose, Abhishek Halder, Sourangsu Banerji, Arpan Deyasi, "First-order Calculation of Band Structure of One-Dimensional Photonic Crystal", National Conference on Materials, Devices and Circuits in Communication Technology, Burdwan, WB, India, February 2014.

[10] Sourangsu Banerji, Arpan Deyasi, Abhishek Halder, Sayan Bose, "Comparative Study of Density of States of 1D Photonic Crystal for Different Polarization Conditions of Incident Wave", National Conference on Materials, Devices and Circuits in Communication Technology, Burdwan, WB, India, February 2014.

Contributed Abstracts

[1] Sourangsu Banerji, Ashish Chanana, Hugo Condori, Ajay Nahata, and Berardi Sensale-Rodriguez, "Modified direct binary search: an algorithm for designing aberration corrected diffractive THz lenses", SPIE Optics + Photonics, San Diego, CA, USA, August 2018.

[2] Sourangsu Banerji, Monjurul Meem, Ashish Chanana, Ajay Nahata, Rajesh Menon and Berardi Sensale-Rodriguez, "From Visible to THz: Planar Optics for Lightweight, Small Form-Factor High-Precision, Energy Efficient Laser Applications", São Paulo School of Advanced Science (SPSAS) + XVI Jorge André Swieca School on Non linear and Quantum Optics, Sao Paulo, SP, Brazil, July 2018. **[Student Poster Award]**

[3] Sourangsu Banerji, Hugo Condori, Ashish Chanana, Ajay Nahata, and Berardi Sensale-Rodriguez, "Aberration Rectified THz Beam Focusing via Diffractive Lens Design Using a Modified Direct Binary Search Algorithm",

2018 IEEE International Symposium on Antennas and Propagation and USNC-URSI National Radio Science Meeting, Boston, MA, USA, July 2018.

[4] Sourangsu Banerji, Yunshan Wang, Jieying Mao, Sara Arezoomandan, Steve Blair, Berardi Sensale Rodriguez, "UV Surface Plasmon Resonance Modification in Aluminum Nanohole-Arrays Using Graphene", Electronic Materials Conference (EMC), Notre Dame, IN, USA, June 2017.

Service and Professional Leadership

Academic Committees and Responsibilities

- President, Society of Photographic Instrumentation Engineers (SPIE) (2017 – 2018).
- Vice-President, Society of Photographic Instrumentation Engineers (SPIE) (2016 – 2017).

Professional Society Memberships

- Student Member, Society of Photographic Instrumentation Engineers (SPIE) (2016 - present).
- Student Member, Optical Society of America (OSA) (2017 - present).
- Student Member, Institute of Electrical and Electronics Engineers (IEEE) (2017 - present).
- Student Member, IEEE Photonics Society (IEEE IPS) (2017 - present).

Media and Press Interest

[1] "Sourangsu Banerji , University of Utah, USA, discusses his work in the next generation of metasurfaces", OSA Stories, August 2018.

[2] "New tech may lead to 'Star Wars' style 3D holograms" Deccan Chronicle, July 2017.

References

Prof. Berardi Sensale-Rodriguez
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Prof. Ajay Nahata
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