

Sourangsu Banerji

Ph.D. Student of Department of Electrical and Computer Engineering, University of Utah

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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 an emphasis on utilizing computational approaches towards their design. In this context, I have extensively worked on translating and exploiting well-established methods and concepts from computer science engineering right up to the realm of optics and photonics by demonstrating the computational design of planar passive and reconfigurable nano-scale devices in the THz/visible regime. Nonetheless, my work also includes looking into several different optimization algorithms as well as machine learning techniques for possible use in designing on-chip integrated nanophotonic and free-space optical devices.

My work caters to the growing need for designing challenging and complicated devices/systems by employing computational approaches that are neither time-consuming nor memory-intensive yet readily scalable.

Education

Ph.D. in Electrical and Computer Engineering Aug.'2016 – May'2020 (estimated)
[University of Utah, Salt Lake City, UT, USA](#)

- Advisor: [Prof. Berardi Sensale-Rodriguez](#) and [Prof. Rajesh Menon](#)
- Dissertation: *Solving Inverse Design Problems through Computational Methods*

B.Tech. in Electronics and Communication Engineering Sept.'2010 – Jul.'2014
[West Bengal University of Technology, Kolkata, WB, India](#)

- Advisor: [Prof. Arpan Deyasi](#)
- 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](#)

[Terahertz Optoelectronics Research Group](#)

- Advisor: [Prof. Berardi Sensale-Rodriguez](#)
- Research activity: Computational diffractive optics; digital metamaterials; plasmonics.
- Key achievements:
 - ✓ Developed an algorithm (**GDABS**) for designing planar free-space diffractive optical devices with a lower computation space and time complexity (up to ~10-100X times). (**Patent pending**)
 - ✓ Developed a machine-learning algorithm (**b-ARLA**) for designing on-chip integrated nanophotonic devices.

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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; fundamental physical bounds in bandgap engineering.
- Key achievements:
 - ✓ Developed an analytical framework for the study of band structures and wave propagation in 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, image compression techniques.
- Key achievements:
 - ✓ Developed an image compression technique based on fractals.

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 into 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. Designed and conducted laboratory sessions.

Graduate Teaching Assistant

Sept.'2016-Dec.'2016

[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. Designed and conducted laboratory sessions.

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Graduate Teaching Assistant

Sept.'2016-Dec.'2016

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. Designed final course projects for the students.

Scientific Honors, Awards, and Recognitions (Selected)

Best Paper Award

(2019)

Award Committee: [Optical Society of America](#)

- For the paper titled "Metalenses or diffractive lenses for imaging?"

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.

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](#)

- A one-year fellowship that is reserved for a limited number of Ph.D. applicants. The fellowship provides for support during the first year at a level of \$21,000/year.

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Scientific Contributions

Patents

- [1] Sourangsu Banerji, and Berardi Sensale-Rodriguez, “Optimization algorithm for nanophotonic structures” (Patent pending).

Journal Papers

- [1] Monjurul Meem, Sourangsu Banerji, Apratim Majumder, Christian Pies, Timo Oberbiermann, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Large-area, high-NA Multi-level Diffractive Lens via inverse design](#),” Optica, Volume-7(3), March 2020.
- [2] Sourangsu Banerji,* Monjurul Meem,* Apratim Majumder, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Diffractive flat lens enables Extreme Depth-of-focus Imaging](#),” Optica, Volume-7(3), March 2020. (*denotes equal contribution)
- [1] Sourangsu Banerji, Monjurul Meem, Apratim Majumder, Fernando Vasquez Guevara, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Ultra-thin near infrared camera enabled by a flat multi-level diffractive lens](#)”, Optics Letters, Volume-44(22), November 2019.
- [2] Sourangsu Banerji,* Monjurul Meem,* Apratim Majumder, Curt Dvornik, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Single flat lens enabling imaging in the short-wave infra-red \(SWIR\) band](#),” OSA Continuum, Volume-2(10), October 2019. (*denotes equal contribution)
- [3] Monjurul Meem,* Sourangsu Banerji,* Apratim Majumder, Fernando Vasquez Guevara, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Broadband lightweight flat lenses for longwave-infrared imaging](#),” Proceedings of the National Academy of Sciences (PNAS), Volume-116(43), October 2019. (*denotes equal contribution)
- [4] Sourangsu Banerji, Monjurul Meem, Apratim Majumder, Fernando Vasquez Guevara, Berardi Sensale-Rodriguez and Rajesh Menon, “[Imaging with flat optics: metalenses or diffractive lenses?](#)” Optica, Volume-6(6), June 2019.
- [5] Sourangsu Banerji and Berardi Sensale-Rodriguez, “[A Computational Design Framework for Efficient, Fabrication Error-Tolerant, Planar THz Diffractive Optical Elements](#)”, Scientific Reports, Volume-9, April 2019.
- [6] 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”](#)]
- [7] 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.
- [8] Sourangsu Banerji, “[Group Theoretic Approach to Study Transfer Matrix Method in One Dimensional Photonic Crystals](#),” GESJ: Physics, Volume-11(1), July 2014.

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- [9] 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.
- [10] 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.
- [11] Sourangsu Banerji, “[Design and Implementation of an Unmanned Vehicle using a GSM Network without Microcontrollers](#),” Journal of Electrical Engineering, Volume-14(1), April 2014.
- [12] 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.
- [13] Sourangsu Banerji, “[To Study the Effect of Grating Length on Propagating Modes in Bragg Filters with \$\text{Al}_{\(x\)}\text{Ga}_{\(1-x\)}\text{N}/\text{GaN}\$ Material Composition](#),” International Journal of Advanced Science and Technology, Volume-63, February 2014.
- [14] 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.
- [15] Sourangsu Banerji, and Rahul Singha Chowdhury, “[Wi-Fi & WiMAX: A Comparative Study](#),” Indian Journal of Engineering, Volume-2(5), March 2013.
- [16] 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.

Journal Papers (Under Review)

- [1] Monjurul Meem,* Sourangsu Banerji,* Apratim Majumder, Juan Garcia, Philip Hon, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Imaging from the Visible to the Longwave Infrared wavelengths via an inverse-designed flat lens](#),” arXiv: 2001.03684 [physics.optics], January 2020. (under review: **Nature Photonics**) (*denotes equal contribution)

Preprints (Un-published)

- [1] Sourangsu Banerji, Monjurul Meem, Apratim Majumder, Berardi Sensale-Rodriguez, and Rajesh Menon “[Imaging over an unlimited bandwidth with a single diffractive surface](#),” arXiv: 1910.07928 [physics.optics], July 2019. (*denotes equal contribution)

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, Volume-335, Chapter 36, September 2014.

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Keynote and Invited Talks

- [1] Sourangsu Banerji and Berardi Sensale-Rodriguez, “[3D-printed diffractive terahertz optical elements through computational design](#)”, SPIE Defense + Commercial Sensing, Baltimore, MD, USA, 10982, May 2019.
- [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, Monjurul Meem, Apratim Majumder, Fernando Vasquez Guevara, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Multi-Level Diffractive Lenses for Real-Time Long-Wave IR Imaging](#),” 44th International Conference on Infrared, Millimeter and Terahertz Waves, Paris, France, September 2019.
- [2] Sourangsu Banerji, Monjurul Meem, Apratim Majumder, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Metalenses or diffractive lenses for imaging?](#)”, Optical Society of America Imaging and Applied Optics Congress, Munich, Germany, June 2019. [[Best Paper Award](#)]
- [3] Sourangsu Banerji, Monjurul Meem, Apratim Majumder, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Achromatic Broadband Diffractive Lenses for Focusing and Imaging in LWIR](#),” Optical Society of America Imaging and Applied Optics Congress, Munich, Germany, June 2019.
- [4] Apratim Majumder, Sourangsu Banerji, Kazumasa Miyagawa, Monjurul Meem, Mark Mondol, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Programmable metamaterials & metasurfaces for ultra-compact multi-functional photonics](#)”, CLEO: Applications and Technology, San Jose, CA, USA, May 2018.
- [5] Monjurul Meem, Sourangsu Banerji, Apratim Majumder, Berardi Sensale-Rodriguez, and Rajesh Menon, “[Flat Lenses for Ultra-lightweight Longwave-Infrared Broadband Imaging](#),” CLEO: Applications and Technology, San Jose, CA, USA, May 2018.
- [6] 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.
- [7] 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.
- [8] 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.
- [9] 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.

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- [10] 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.
- [11] 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.
- [12] Arpan Deyasi, and 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.
- [13] Arpan Deyasi, Sourangsu Banerji, Abhishek Halder, and 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.
- [14] Sayan Bose, Abhishek Halder, Sourangsu Banerji, and 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.
- [15] Sourangsu Banerji, Arpan Deyasi, Abhishek Halder, and 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] Xueling Cheng, Sourangsu Banerji, Jieying Mao, Sara Arezoomandan, Ting Zhang, Steve Blair, and Berardi Sensale Rodriguez, and Yunshan Wang, “[UV surface plasmon resonance modification by graphene Pi plasmon resonance](#),” SPIE Optics + Photonics, San Diego, CA, USA, August 2019.
- [2] Sourangsu Banerji, Monjurul Meem, Apratim Majumder, Berardi Sensale-Rodriguez, and Rajesh Menon. “[Imaging with ultra-lightweight flat lenses: visible near-IR to long-wave IR](#),” SPIE Optics + Photonics, San Diego, CA, USA, August 2019.
- [3] 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.
- [4] 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](#)]
- [5] 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.
- [6] Sourangsu Banerji, Yunshan Wang, Jieying Mao, Sara Arezoomandan, Steve Blair, and Berardi Sensale Rodriguez, “[UV Surface Plasmon Resonance Modification in Aluminum Nanohole-Arrays Using Graphene](#),” Electronic Materials Conference (EMC), Notre Dame, IN, USA, June 2017.

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Research Funding

- [1] [Amazon Cloud Credits for Research Program](#) (Principal Investigator)
- **Proposal:** Free Space Optical Devices Based on Computational Design of Diffractive Optic Elements
 - **Status:** Completed
 - **Funding amount:** \$10,000

Professional Service

Reviewer

- **OSA Journals:** Optica, Optics Express, Optical Materials Express, Journal of Optical Society of America B
- **IEEE Journals:** Journal of Lightwave Technology, IEEE Transactions on THz Science and Technology
- **Nature Journals:** Scientific Reports

Academic Committees and Responsibilities

- Student Chapter President, [Society of Photographic Instrumentation Engineers \(SPIE\)](#) (2017 – 2018).
- Student Chapter 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).

Media and Press (Selected)

- [1] [Thin to Win](#) – News Wise, November 2019.
- [2] [Ultra-thin lens being developed in Utah to change future smartphones and drones](#) - Fox 13 News, November 2019.
- [3] [New Lens Could Provide Thermal Imaging Capabilities in More Compact Camera](#) – Photonics.com, November 2019.
- [4] [New Cheap, Thin, and Light Camera Lens for Thermal Imaging](#) - azooptics.com, New Cheap, Thin, and Light Camera Lens for Thermal Imaging - azooptics.com, November 2019.
- [5] [New lens 20 times thinner than human hair set to replace camera bumps](#) - Daily Mail UK, November 2019.
- [6] [Engineers develop thin, lightweight lens that could produce slimmer camera phones, longer-flying drones](#) - Science Daily, November 2019.
- [7] [New lens design could lead to slimmer smartphones, longer-flying drones](#) - The Times of India (ET Telecom), November 2019.
- [8] [ECE Student wins Best Paper](#) - Utah ECE News, July 2019.
- [9] [Sourangsu Banerji, University of Utah, USA, discusses his work in the next generation of metasurfaces](#) - OSA Stories, August 2018.

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[10] [New tech may lead to 'Star Wars' style 3D holograms](#) - Deccan Chronicle, July 2017.

A full list can be found here:

https://github.com/Sourangsu/sourangsu.github.io/blob/master/files/LWIR_PNAS_press_coverage_2019.xlsx

References

Available on request.