Indrasen Bhattacharya

github.com/indrasen1
PhD ◇ UC Berkeley
(510) · 761 · 1435 ◇ indrasen@berkeley.edu

INDUSTRIAL RESEARCH EXPERIENCE

KLA Corporation *2017 - 2023*
Computational Imaging Research Scientist
System Architecture and Technology group, Wafer Inspection Division
Contributions:

- Critical analysis and evaluation of computational imaging pipeline for sensitivity roadmap of a nanoscale semiconductor defect inspection platform
- EM simulation and image system analysis for broadband inspection sensitivity analysis
- Ab-initio simulation based stack engineering for extreme-UV printcheck based reticle inspection
- Unsupervised deep learning for image anomaly detection
- System analysis and attribution of image noise contributions
- Intellectual property generation: two patent applications
- Multiple customer engagement and product feature contribution for mitigating process-related variation of defect inspection sensitivity across customer wafers

EDUCATION

University of California, Berkeley (MS+PhD) *Graduation: Dec 2017*
Applied Science and Technology (UC Berkeley's version of Applied Physics)
Qualifying exam committee: Prof. Connie Chang-Hasnain (research advisor), Prof. Ming Wu (chair), Prof. Eli Yablonovitch, Prof. Liwei Lin (external)
GPA: 3.846/4.000, Research in Computational Imaging and Nanophotonics, Coursework in Computational Optical Imaging, Advanced Photonics, Lightwave devices, Electromagnetism, Nanofabrication, Quantum Electronics, Thin film science and technology

Indian Institute of Technology, Bombay (B-Tech Honors) *Graduation: Aug 2012*
BTech (Bachelor in Technology) in the Electrical Engineering Department
Honors in Electrical Engineering and Minor in Computer Science
GPA: 9.86/10.00, Department Valedictorian and Institute Silver Medalist
Coursework in Signals and systems, Signal processing, Devices, Circuits, Microprocessors, Machine learning, Data structures, Quantum mechanics, Semiconductor Physics, Optics

Stanford Systems Engineering Certificate (Non Degree) *Received: Spring 2021*
Coursework in Deep Learning (CS230), Convolutional Neural Networks (CS231N), Engineering Risk Management (MSE250A), Algorithms for Optimization (AA222), KLA Systems Engineering Course

REFERENCES

· Prof. David Attwood, Professor at UC Berkeley
· Prof. Laura Waller, Professor at UC Berkeley
· Prof. Hayden Taylor, Professor at UC Berkeley
· Prof. Christophe Moser, Professor at EPFL

TECHNICAL COMPETENCIES

Computational Imaging	Digital Filtering, Image alignment, Inverse Problems, Computed Tomography, OpenCV, Matlab, Python
Statistical Learning	Logistic regression, Outlier Detection, Random Forests, Convolutional Neural networks, Recurrent Models, LSTMs Python: tensorflow, keras, sci-kit learn, t-SNE and visualization
Electromagnetic Simulation	finite difference time domain (Lumerical, Meep), RCWA (Prolith), finite element (JCMwave), electrostatics (Sentaurus)
Electro-optic Characterization	fluorescence microscopy, time resolved photoresponse, solar simulator, quantum efficiency, RF network analyzer
Nanofabrication	clean room procedures, photolithography, etching, deposition, electron beam lithography, electron microscopy

AWARDS AND SCHOLASTIC ACHIEVEMENTS

- Gold medalist at the Indian National Physics Olympiad
- US Permanent residence based on the Outstanding Researcher Category (EB1-B)
- Graduate research on tomographic 3D printing generated two patents; covered by *Nature*, *Science*, *MIT Technology Review*, *Washington Post*, *Guardian*, *TechCrunch*, *C-Net*
- Paper awards at International Nano-Optoelectronics Workshop (iNOW): second prize (Tokyo, Japan, *2015*) and third prize (Cargese, Corsica, France, *2013*)
- Extraordinary achievement in 3 courses at UC Berkeley: Computational Optical Imaging (Prof. L. Waller, Prof. R. Ng), Advanced Photonics (Prof. M. C. Wu), Optical Engineering (Prof. L. Waller)
- 5-Year Berkeley Graduate Fellowship through the Anselmo J. Macchi fund for Graduate Students
- Department Valedictorian (Electrical Engineering) at the Indian Institute of Technology Bombay, awarded Institute Silver Medal for graduating class of 2012
- Selected for Cyclotron road entrepreneurial fellowship based on 3D printing research (declined)

PATENTS

- US11639031B2 (active): Maxim Shusteff, James Oakdale, Robert Matthew Panas, Christopher M. Spadaccini, Hayden K. Taylor, Brett Kelly, Indrasen Bhattacharya, Hossein Heidari,"Photocurable Resins for Volumetric Additive Manufacturing", granted: 2023-05-02, UC Berkeley and Livermore National Lab
- US10647061B2 (active): Brett Kelly, Robert Panas, Maxim Shusteff, Christopher Spadaccini, Hayden Taylor, Indrasen Bhattachaya, "System and method for computed axial lithography (CAL) for 3D additive manufacturing", granted: 2020-05-12, UC Berkeley and Livermore National Lab
- P6314US (application): Abdurrahman Sezginer, Patrick McBride, Indrasen Bhattacharya, Robert M. Danen, "Shot noise reduction using frame averaging", KLA Corporation
- P6154US1 (application): Kuljit S. Virk, Minchuan Zhou, Indrasen Bhattacharya, Abdurrahman Sezginer, "Multi-mode Optical Inspection", KLA Corporation

EXEMPLARY RESEARCH PROJECTS

MIT: Dynamics of Terahertz Quantum Cascade Lasers summer, 2011
mentors/collaborators: Dr. Ivan Chan, Prof. Qing Hu

- **Key contribution**: understanding lasing temperature dependence using a more accurate simulation model accounting for the stimulated emission scattering channel in a self-consistent manner
- Publications:

Bhattacharya, I., Chan, C. W. I. and Hu, Q. Effects of stimulated emission on transport in terahertz quantum cascade lasers based on diagonal designs. *Appl. Phys. Lett.* **100**, 011108 (2012).

UC Berkeley: Tomographic single shot 3D printing Prof. H. Taylor

Can tomographic reconstruction algorithms inspire novel 3D printing modalities? *2016-2018*

- Non-linear thresholding provided by resin development process can lead to exact tomographic reconstruction for some test geometries with computationally optimized projections
- **Key Contributions**: Optimization and image computation algorithm, hardware proof-of-principle, physical modeling of printing, python and Matlab based projection computation repository
- Github repository of computational implementation: `https://github.com/indrasen1/tomo3D_repo`
- Resulting publications and conference presentations:

Bhattacharya, I.*, Toombs, J.*, (co-first author) and Taylor, H. High fidelity volumetric additive manufacturing. *Additive Manufacturing*, **47**, 102299, 2021

Kelly, B.*, **Bhattacharya, I.***, Heidari, H.*, (co-first author), Shusteff, M., Spadaccini, C. M. and Taylor, H Volumetric additive manufacturing via tomographic reconstruction. *Science*, **363**, 6431, 2019.

(invited talk) **Bhattacharya, I.**, Kelly, B., Shusteff, M., Spadaccini, C. and Taylor, H. *Computed axial lithography: volumetric 3D printing of arbitrary geometries*, SPIE Defence and Commercial Sensing, Orlando, 2018.

UC Berkeley: Monolithic quantum well nanolasers Prof. C. Chang-Hasnain

How do we build a nanoscale laser to couple directly into silicon waveguides? *2012-2017*

- Context: Integrating optically active materials and devices on a silicon substrate is a long
- Result: Efficient electroluminescence at 1.45 μm and electrically injected gain has been achieved for nanopillar-quantum well devices grown in deterministic locations directly on silicon.
- **Key Contributions**: device fabrication and characterization, optical excitation experiments, FDTD simulations, short-loop material characterization using photoluminescence spectroscopy
- Publications:

Lu, F.*, **Bhattacharya, I.*** (co-first author), Sun, H., Tran, T-T.D., Ng, K.W., Malheiros-Silveira, G. N. and Chang-Hasnain, C. Nanopillar quantum-well lasers grown on silicon with silicon-transparent wavelengths. *Optica*, **4**, 7, 717-723, 2017.

Deshpande, S.*, **Bhattacharya, I.*** (co-first author), Malheiros-Silveira, G. N., Ng, K.W., Schuster, F., Mantei, W., Cook, K. and Chang-Hasnain, C. Ultra-compact position-controlled InP nanopillar LEDs on silicon with bright electroluminescence at telecommunication wavelengths. *ACS Photonics*, **4**, 3, 695-702, 2017.

Stanford: Semantic Segmentation of Aortic Dissection Prof. L. Hahn

Do recurrent deep learning models help with a 3D segmentation problem? *2018*

- Context: Radiologists painstakingly segment 500-1000 z-slices of CT scans for every study on each patient with the aortic dissection pathology
- Result: Modeling Z-dependencies using an Encoder-Decoder U-Net like architecture with recurrent blocks (conv-LSTM) in Decoder led to improvements in segmentation accuracy
- **Key Contributions**: convolutional-LSTM network for 3D segmentation task, metrics for evaluation, data augmentation and preparation, GPU based training with tensorflow

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A full list of resulting publications and conference abstracts is maintained at goo.gl/Fw3AYz