

Ojas Kulkarni

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Research interests

My research interests lie at an intersection of integrated photonics and VLSI. My research background is in nanotechnology - specifically in PVD processes, as well as FPGA and hardware security. I am aiming to pursue a doctoral degree in silicon/integrated photonics under electrical engineering as I believe my 3.5+ years of background in diversified, but focused research and industry fields can significantly improve the current state of this research.

Education

Aug 2020 – University of Utah – Salt Lake City, Utah
May 2024 *B.E. in Computer Engineering, B.S. in Applied Mathematics*
Capstone Project: Retrofit Smart Home System 

Selected coursework

- *Electrical & Computer Engineering*: Optical Communication Systems, Optoelectronics, Digital Signal Processing, Antenna Theory & Design, Computer Architecture, Embedded Systems Design
- *Applied Mathematics*: Algebraic & Geometric Topology

Research experience

Jan 2024 – *Research Assistant*
Present Mentors: Prof. Weilu Gao (PI) (University of Utah).
• Currently working in the broad area of optical machine learning with experience in integrated chip photonic device design

May 2023 – *NSF REU: Side-Channel Electromagnetic Analysis of FPGA-based Matrix Multiplier* 
Sep 2023 (4 mo.) Mentors: Prof. Boyang Wang (PI), and Prof. Rashmi Jha (University of Cincinnati).
• Designed and implemented a reconfigurable matrix multiplier systolic array using Verilog HDL
• Verified and simulated implemented circuit using Vivado logic simulator/ModelSim
• Accelerated the aging process of the implemented circuit using elevated temperature/voltage conditions
• Performed side-channel EM analysis to characterize differences between nominal and aged circuits
• Presented culminating research at the 2023 REU Symposium leading to the Best Research Presentation Award

May 2022 – *NSF REU: Simulation of Glancing Angle Deposition* 
Sep 2022 (4 mo.) Mentors: Prof. Kevin Walsh (PI), and Dr. Chuang Qu (University of Louisville).
• Designed, and developed a Monte-Carlo style simulation of a nanostructure growth technique called Glancing Angle Deposition (GLAD) resulting in a 200-fold time increase from previous research efforts
• Achieved simulation using 3D ray-tracing particle trajectories and implemented in Python utilizing the VPython visual interface
• Fabricated nanostructures on Si substrate in class 100/1000 cleanroom and verified experimental results using Scanning Electron Microscopy (SEM) leading to significantly more accurate result predictions

Feb 2022 – *NSF REU: Detection of Airborne Particles using Ionization Spectroscopy*
 May 2022 Mentors: Prof. Massood Tabib-Azar (PI – University of Utah).
 (3 mo.)

- Implemented plasma ionization system for real-time detection of airborne analytes for rapid sensing applications such as in detecting viral loads, microparticles etc.
- Several iterations for ionization systems were tested including variations in size/shape, electrode material, and electrode distance
- Analytes like aluminosilicate zeolite, DNA bases, and carbon black, and others were identified using UV-Vis fiber optic spectroscopy

Industry experience

Dec 2020 – *Lead Software/Game Developer* 
 Dec 2023 University of Utah – Salt Lake City, Utah
 (3+ years)

- Lead game programmer for ASPIRE, the outreach program of the Telescope Array Project
- Developed 30+ game simulations for physics lectures using modern web technologies
- Generated 500,000+ visits per year for the game widgets and implemented custom resources such as writing supplements depending on institutional need
- Delivered weekly project updates, modernized games for experience, and proposed ideas for new games
- Extensive software engineering through algorithms and data structures with emphasis on efficiency

Publications, Manuscripts & Posters

July 2023 Ojas Kulkarni, Manoj Vutukuru, Rashmi Jha, "Aging and Side-Channel EM Analysis", *REU Final Presentation*, Cincinnati, OH, July 28, 2023
 Poster: 2023 REU Poster Presentation

Aug 2022 Ojas Kulkarni, Chuang Qu, Shamus McNamara, Kevin Walsh, "Monte-Carlo Simulation of Glancing Angle Deposition", *NNCI Nano + Additive Manufacturing Summit*, Louisville, KY, August 10-11, 2022
 Posters: UoL Medical Campus Culminating Poster Reception & NNCI REU Convocation

Outreach & Service

Dec 2022 – *Computer Engineering Content Creator* 
 Present (1+ years)

- Designed and created short (30 sec - 1 min) videos teaching topics such as binary, hexadecimal, truth tables, MOSFETs, logic gates, flip-flops, latches were covered leading to 5000+ reactions.
- Future topics include ALU architecture, floating point operations, pipelining, and cache policies.
- Content is presented in a very simplified way such that it is easy to follow with no prerequisite knowledge, and is accessible to everyone.

Skills

Electrical Engineering Toolset

Oscilloscopes, Digital Multimeters, Logic Analyzers, VNAs, FPGA, SPICE, MATLAB, Class 100/1000 Cleanroom, SEM, Semiconductor Fab Equipment (Sputtering, Deposition)

Software Engineering Toolset

C, C++, Java, Verilog HDL, ARM, Python, JavaScript (TypeScript), HTML/CSS, Linux, Git, 

Design Software

Altium Designer, Fusion 360, EagleCAD, KiCAD

Honors and Awards

2023 RHEST REU Best Research Presentation Award
 2020 Dean's List – University of Utah