

Raymond K. Lennon

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EDUCATION

Duke University, Pratt School of Engineering, Class of 2024

Major: B.S. Mechanical Engineering

Minor: Computer Science

GPA: 3.96

DukeEngage: Kampala, Uganda

Summer 2022

- International Research Collaboration: Conducted ethnographic research in Kampala hospitals to scope high impact project. Designed and prototyped low-cost medical device in partnership with Makerere University biomedical engineers. Development process included mechanical and electronics design and fabrication, project management, local sourcing of materials.
 - *Low-Cost Integrated Phototherapy and Monitoring Device for Resource-Limited Neonatal Care*, **Lennon R.**, Cherkas S., Kigenyi D., Mackline M., presented at Ugandan Safe Motherhood Conference, Health Promotion Conference Uganda, and Uganda Pediatrician Conference 2022.

UNDERGRADUATE RESEARCH

Advisor: Dr. Kenneth Gall, Professor, Mech Eng. & Material Sci., Duke University

Sept 2022 – Present

- **Additively Manufactured Metal Implants:** Leading an independent research project improving design of titanium 3D-printed metamaterials for seamless orthopedic integration into bone tissue. Scope includes design, manufacture, testing, and simulation of 3D-printed gyroidal structures made from Ti64, and analysis of their varying geometry's effect on structural properties. Tensile, compressive, and torsional load frame studies fully characterize the lattices' behavior. Parallel finite element study offers additional insight into structures' robustness against fatigue.
 - Senior thesis will demonstrate applicability of structures' fatigue resistance to biocompatible bone implants subject to cyclic loading and widely varying load configurations.
 - Collaborating on a joint research publication with polymer 3D printing team to fully capture the design benefits of gyroidal structures across a variety of materials.

Advisor: Dr. Ingrid Daubechies, Professor, Elec. & Comp Eng., Duke University

Oct 2020 – Aug 2021

- **Computational Algorithms for Digital Restoration of 12th Century Italian Paintings.**
Collaboration between North Carolina Museum of Art and Duke Math Department

RESEARCH EXPERIENCE

Research Intern, Johns Hopkins Applied Physics Laboratory (APL), Laurel, MD

Summers 2020-23

Research and Exploratory Development Department, Multi-Scale Mathematical Modeling Group

Active Secret-level security clearance for classified and sensitive projects.

Advanced Manufacturing

- Led an interdisciplinary research investigation into properties of additively manufactured stainless steel and titanium alloys. With NASA and NAVSEA funding, projects studied the effect of varied print parameters – and their associated material defects - on overall part robustness. Executed a full-stack experimental pipeline to sample the input domain of printer settings, manufacture test coupons, perform mechanical testing, synthesize experimental data, and analyze results. Developed a data analysis methodology in collaboration with PhD statisticians that characterizes the noise in sparse

experimental datasets. Variance in outputs classified as either inherent to the underlying stochastic process or symptomatic of insufficient data. Currently writing and pursuing public release for experimental workflow and statistical methodology (lead author); submissions planned for late 2023.

Computational Geometry & Design Optimization

- Devised a novel method of designing lattice shell structures that conform to arbitrary 3D surfaces, applying knowledge of computational geometry and additive manufacturing (*IP disclosure filed, May 2023*). Multiple research teams using method for fabrication of high-strength lightweight structures.
- Developed iterative technique to generate realistic foam microstructure models by adopting random sphere packing algorithms. Applications include simulated testing of airless tires.
- Procedurally generated blockages and aneurysms in blood vessels for fluid flow simulations. Results provided feedback to surgeons on optimal stent placement. Produced 3-D printed models of arterial blockages to facilitate visual and haptic understanding of complex geometric renderings.

Computational Mechanics & Simulation

- Performed diffuse optics research for a confidential sponsored project. Wrote parallelized simulation scripts and wrapper functions in MATLAB to simulate photon transport through turbid multilayered biological tissue using Monte-Carlo statistical approach. Simulation results aided development of an optical spectroscopy-based medical imaging alternative in battlefield environments.
- Developed a scalable Python package for optimization of material model parameters. Used Bayesian Optimization to iteratively refine FEA simulation trials given field test results. Package is currently in use for precisely characterizing unknown ballistic properties of metal alloys.
- Created interactive applications to explore data from airflow simulations of surgical environments. CDC is applying results to make operating rooms safer and contaminant-free. Publication pending.
- Built a finite-difference simulation codebase to predict dynamic behavior of undersea cables for classified DoD-sponsored project implementing drag, gravitational, added-mass, and tension forces.

Head of Development, Realms Inc., Durham, NC

Nov 2021 – May 2022

- Cofounded Realms, a Zoom and web-based education technology company, partnering with Duke MBA students, and incubated under Duke Innovation & Entrepreneurship. Led development on front and back-end systems, including an interactive HTML interface and cloud-hosted database.
- Pitched to Duke University, UNC, and NC State; ultimately distributed as an open-source platform.

TEACHING EXPERIENCE

Teaching Assistant, EGR 121 Engineering Innovation, Dr. Rebecca Simmons

Spring 2023

- Produced and presented course content; answered questions during lectures, office hours and open-lab sessions. Responsibilities also included grading assignments and mentoring team projects.
- *MEMS Outstanding Undergraduate Teaching Assistant Award, June 2023*

Duke IGNITE Technical Workshop

March 2023

- *Introduction to Low-Poly 3D Character Modeling in Blender*; Created and presented instructional demonstrations for Hackathon workshop.

PUBLICATIONS & PRESENTATIONS

Computational Fluid Dynamics for Public Health and Safety, Darragh R., Campbell V., Winstead P., **Lennon R.**, Stiles C., JHU APL Technical Digest (ISSN 0270-5214), Accepted & publication pending.

Lennon R. (2023, September 21-22), *A Constructal Perspective on Time-Evolution of Online Social Networks* [Oral Presentation], 12th Annual Constructal Law Conference, Torino, Italy.

Lennon R. *A Novel Framework for Design of Lightweight Surface-Conformal Lattice Structures*, JHUAPL IP disclosure filed requesting patent protection, May 2023. Further details & co-inventors restricted as controlled unclassified information (CUI).

TECHNICAL SKILLS

- Programming: Python (Numpy, Matplotlib, scikit-learn, VTK), C/C++, MATLAB, Java, HTML5
- 3D Modeling & Visualization: SOLIDWORKS, NTopology, Autodesk Inventor, Fusion 360, Blender
- Mechanical Testing: Instrumented universal load frames, Charpy pendulum impact
- Computational Simulation: LS-DYNA, Ansys Mechanical, IMEPTUS Afea, SimScale
- Fabrication: Metal & Polymer 3D Printing, Laser Cutting, Electronics Design

FEATURED COURSEWORK

* GRADUATE CLASSES † FALL 2023

Finite Element Method *†
Compressible Fluid Flow *
Modern Materials *

Modern Physics
Introduction to AI
Discrete Math

Data Analysis & Decision Sci
Experimental Interface Design
Independent Study Project †

ACTIVITIES

Duke e-NABLE (Open-Source 3D-Printed Prosthetics) · Duke Student Founders (Entrepreneurship)
HackMIT 2021 & 22 (Winner: Meta Challenge) · HackDuke 2020 & 21 · Duke IGNITE (Tech Mentor) ·
ASME · MEMS Meets (Mech Eng Mentorship) · Resident Assistant, Craven Quad 23-24 AY

AWARDS & GRANTS

- *Metaverse Challenge Winner*, HackMIT, 2022
- *Noble Prize*, APL Annual Achievement Award, 2022
- *Myrna R. and Sam Y. Zamrik Scholarship (\$5,000)*, ASME National Award, 2023
- *Outstanding Undergraduate TA Award*, Mechanical Engineering Dept, Spring 2023
- *Pratt Conference Grant*, 2023
- *Undergraduate Research Support Conference Grant*, 2023
- *Pi Tau Sigma*, Pratt Chapter Mechanical Engineering Honor Society, 2023