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: 3.96/4.00**

DukeEngage Kampala, Uganda   May – July 2022

- Conducted ethnographic research in Kampala hospitals to scope high impact projects. 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 varying geometry's effect on global structural properties. Tensile, compressive, and torsional load frame studies fully characterize the lattices' behavior. Parallel finite element study offered additional insight into structural stiffness.
  - Spearheading a cross-departmental numerical analysis project to quantify geometric dependence on yielding and ultimate failure of thin-walled lattice structures. Collaborating with Prof. Guglielmo Scovazzi to apply the Shifted Boundary FEA Method to efficiently simulate highly porous geometries and locate stress concentrations within gyroid lattices. Computational trials run on massively parallel computing clusters.
  - Senior thesis will include validation of numerical results against industrial FEA software and microCT observations.

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). Pursuing public release for experimental workflow and statistical methodology.

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. *Work published.*
- 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; 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

Darragh R., Campbell V., Winstead P., **Lennon R.**, Stiles C. (2023) Using Computational Fluid Dynamics to Inform the Future of Public Health and Safety, *Johns Hopkins APL Technical Digest Vol 36, No 4* (pp 440-452) ISSN 0270-5214.

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. (2023) *A Novel Framework for Design of Lightweight Surface-Conformal Lattice Structures*, JHU APL IP Disclosure filed requesting patent protection. Further details & co-inventors restricted as Controlled Unclassified Information (CUI).

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

TECHNICAL SKILLS

Programming:	Python (Numpy, MatPlotLib, scikit-learn, VTK), C/C++, MATLAB, Java, HTML5
3D Model & Visualization:	SOLIDWORKS, NTopology, Autodesk Inventor, Fusion 360, Blender
Computational Simulation:	LS-DYNA, Ansys Mechanical, IMEPTUS Afea, SimScale
Mechanical Testing:	Instrumented universal load frames, Charpy pendulum impact
Fabrication:	Metal & polymer 3D printing, laser cutting, electronics design

FEATURED COURSEWORK   * Graduate Class   † Fall 2023

Finite Element Method *†	Modern Physics	Data Analysis & Decision Sci
Compressible Fluid Flow *	Introduction to AI	Experimental Interface Design
Modern Materials *	Discrete Math	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