Charles J. Carver, PhD

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I am a member of the Technical Staff at the Massachusetts Institute of Technology, researching and developing space-related systems at Lincoln Laboratory. My interdisciplinary academic, industry, and government research lies in the intersection of photonics and mobile systems, spanning application domains from underwater to space and fusing concepts from optics, networking, embedded systems, computer vision, signal processing, and robotics. I am dedicated to leveraging my strong leadership skills, technical expertise, and scientific creativity in all aspects of my research, engineering, and consulting career.

EDUCATION

Columbia University — New York, NY

Doctor of Philosophy, Computer Science — *Sep 2022 – Oct 2024*

Master of Philosophy, Computer Science — *Sep 2022 – May 2024*

- Dissertation: "Illuminating New Frontiers in Communication and Sensing with Laser Light"
- NSF Fellowship
- 4.26 GPA

Dartmouth College — Hanover, NH

Master of Science, Computer Science — *Sep 2018 – Jul 2022*

- NSF Fellowship, M.S. Class Marshal
- 3.93 GPA

Fordham University — Bronx, NY

Bachelor of Science, Physics (Minor, Mathematics) — *Sep 2014 – May 2018*

- Victor F. Hess Award for best record of achievement in Physics
- 3.70 GPA, *magna cum laude*

APPOINTMENTS

Massachusetts Institute of Technology, Lincoln Laboratory — Lexington, MA

Member of Technical Staff — *Oct 2024 – Present*

- Space systems research and development.

Columbia University, Department of Computer Science — New York, NY

NSF Fellow — *Sep 2022 – Jul 2024*

- Advised by Dr. Xia Zhou (primary) and Dr. Shree Nayar (secondary).
- Led two multi-university collaborations investigating Gbps laser networking and mW-level power delivery for mobile systems.
- Designed novel optical/electronic systems, CV algorithms for neuromorphic cameras, and 3D-printed CAD prototypes.
- Published three times in highly selective (14-28% acceptance rates) conferences and journals.
- Funded by National Science Foundation Grant Nos. DGE-2036197 and CNS-1552924.

Google, Network Hotspots Team — Mountain View, CA

Research Intern; Student Researcher — *May 2023 – Apr 2024*

- Advised by Dr. Hamid Bazzaz.
- Built production SQL modules to correlate application latency and network utilization using terabytes of data per day.
- Performed Python data analysis to measure impact on internal and production applications, including ML stack.
- Presented findings during two Technical Infrastructure engineering reviews and co-authored published manuscript (*NSDI '24*).

Google, Optical Networking Technologies Team — Mountain View, CA

Research Intern; Student Researcher — *Jun 2021 – May 2023*

- Advised by Dr. Tad Hofmeister.
- Directed investigation into optical polarization sensing of anthropic and seismic activity over terrestrial fiber-optic networks.
- Constructed a real-time Python pipeline for collecting and preprocessing gigabytes per day of fiber polarization data.
- Assisted in designing database schema for efficient, long-term data collection using Google's infrastructure.
- Authored manuscript (*Nature Comms. Eng.*) quantifying sensing fidelity and network health/geophysical sensing implications.

Dartmouth College, Department of Computer Science — Hanover, NH

Graduate Research Assistant; NSF Fellow — *Sep 2018 – Jun 2022*

- Advised by Dr. Xia Zhou.
- Led two multi-department collaborations exploring wireless, laser-based networking and 3D sensing between AUVs and UAVs.
- Prototyped PCBs, end-to-end software stacks, and experimental optical setups for embedded systems.
- Published six manuscripts in highly selective conferences (18-28% acceptance rates), one in top 4% Springer journals.
- Contributed three invited publications to one IEEE networking conference and two ACM magazines; filed two U.S. patents.

- Received three awards (including Best Paper Award and Best Demo Award), five press articles, and over 85 citations.
- Funded by National Science Foundation Grant Nos. GRFP-1840344 and CNS-1552924.

Fordham University, Department of Physics Bronx, NY

Research Assistant *Sep 2017 – May 2018*

- Advised by Dr. Christopher Aubin.
- Created lightweight Python framework for SU(2) gauge theory (two-color Quantum Chromodynamics) simulations.

New York Institute of Technology, Department of Computer Science New York, NY

NSF REU Fellow *May 2017 – Sep 2017*

- Advised by Dr. Ziqian Dong (primary) and Dr. N. Sertac Artan (secondary).
- Investigated secure phone-to-phone screen communication and passive indoor localization using ambient light.
- Published twice in selective IEEE conferences (30% acceptance rate) and awarded second place for best poster.
- Funded by National Science Foundation Grant No. CNS-1559652.

HONORS AND AWARDS

Best Demo Award, ACM MobiCom	*Oct 2023*
Second Place Winner, ACM MobiCom Student Researcher Competition	*Oct 2023*
M.S. Class Marshal, Dartmouth College Commencement	*Jun 2022*
Grand Prize Winner, Dartmouth Innovation and Technology Festival	*May 2022*
Best Paper Award, USENIX NSDI	*Feb 2022*
Best Demo Award, ACM HotMobile	*Feb 2020*
Victor F. Hess Award, Fordham University Department of Physics	*May 2018*
Best Poster Runner-Up, NYIT 8th Annual Cybersecurity Conference	*Sep 2017*

FUNDING

National Science Foundation, GRFP (DGE-2036197), $49,000	*2022 – 2024*
Association for Computing Machinery, SIGMOBILE Travel Grant, $1,110	*2022*
National Science Foundation, GRFP (GRFP-1840344), $92,000	*2019 – 2022*
Dartmouth College, Guarini School, $32,510	*2018 – 2019*
National Science Foundation, REU (CNS-1559652), $7,800	*2017*

PUBLICATIONS

21. **Charles J. Carver**, Hadleigh Schwartz, Toma Itagaki, Zachary Englhardt, Kechen Liu Megan Graciela Nauli Manik, Chun-Cheng Chang, Vikram Iyer, Brian Plancher, and Xia Zhou. "Set Phasers to Stun: Beaming Power and Control to Mobile Microrobots with Laser Light." 2025 (With Reviewers).

20. Xiaoxin Wang, **Charles J. Carver**, Nicholas R. Shade, Eric R. Fossum, Xia Zhou, and Jifeng Liu. "High-efficiency, low-speckle contrast white laser lighting via multi-stage scattering and photon recycling." *Nature Light: Science & Applications*. 2025 (With Reviewers). Preprint: doi.org/10.21203/rs.3.rs-3182555/v1

19. Yanchen Liu, Minghui Zhao, Kaiyuan Hou, Junxi Xia, **Charles J. Carver**, Stephen Xia, Xia Zhou, and Xiaofan Jiang. "AIRA: A Low-cost IR-based Approach Towards Autonomous Precision Drone Landing and NLOS Indoor Navigation." 2025 (With Reviewers). Preprint: doi.org/10.48550/arXiv.2407.05619

18. Hamid Bazzaz, Weiwu Pang, Yingjie Bi, Minlan Yu, Ramesh Govindan, Neal Cardwell, Nandita Dukkipati, Meng-Jung Tsai, Chris DeForeest, Yuxue Jin, **Charles J. Carver**, Jan Kopanski, and Liqun Cheng. "Preventing Network Bottlenecks: Accelerating Datacenter Services with Hotspot-Aware Placement for Compute and Storage." In *Proceedings of the 22nd USENIX Conference on Networked Systems Design and Implementation (USENIX NSDI)*. 2025.

17. **Charles J. Carver**. "Illuminating New Frontiers in Communication and Sensing with Laser Light." Columbia University. 2024. DOI: doi.org/10.7916/2c83-bn79

16. **Charles J. Carver** and Xia Zhou. "Polarization sensing of network health and seismic activity over a live terrestrial fiber-optic cable." *Nature Communications Engineering*. 2024. DOI: doi.org/10.1038/s44172-024-00237-w

15. **Charles J. Carver**, Toma Itagaki, Kechen Liu, Megan G. N. Manik, Zachary Englhardt, Vikram Iyer, and Xia Zhou. "Demonstration of laser power delivery for mobile microrobots." In *Proceedings of the 10th Workshop on Micro Aerial Vehicle Networks, Systems, and Applications (ACM MobiSys DroNet)*. 2024. DOI: doi.org/10.1145/3661810.3663466

14. **Charles J. Carver**, Hadleigh Schwartz, Qijia Shao, Nicholas Shade, Joseph Lazzaro, Xiaoxin Wang, Jifeng Liu, Eric Fossum, and Xia Zhou. "Catch me if you can: laser tethering with highly mobile targets." In *Proceedings of the 21st USENIX Conference on Networked Systems Design and Implementation (USENIX NSDI)*. 2024. DOI: usenix.org/conference/nsdi24/presentation/carver

13. **Charles J. Carver**, Hadleigh Schwartz, Qijia Shao, Nicholas Shade, Joseph P. Lazzaro, Xiaoxin Wang, Jifeng Liu, Eric R. Fossum, and Xia Zhou. "Catch me if you can: demonstrating laser tethering with highly mobile targets." In *Proceedings of the 29th Annual International Conference on Mobile Computing and Networking (ACM MobiCom)*. 2023. DOI: doi.org/10.1145/3570361.3614081 **Best demo award and 2nd place SRC winner.**

12. Alberto Quattrini Li, **Charles J. Carver**, Qijia Shao, Xia Zhou, and Srihari Nelakuditi. "Communication for underwater robots: recent trends." *Springer Current Robotics Reports*. 2023. DOI: doi.org/10.1007/s43154-023-00100-4

11. **Charles J. Carver**, Qijia Shao, Samuel Lensgraf, Amy Sniffen, Maxine Perroni-Scharf, Hunter Gallant, Alberto Quattrini Li, and Xia Zhou. "Sunflower: locating underwater robots from the air." In *Proceedings of the 20th Annual International Conference on Mobile Systems, Applications and Services (ACM MobiSys)*. 2022. DOI: doi.org/10.1145/3498361.3539773
Grand prize winner at the '22 Dartmouth Innovation and Technology Festival.

10. **Charles J. Carver**, Qijia Shao, Samuel Lensgraf, Amy Sniffen, Maxine Perroni-Scharf, Hunter Gallant, Alberto Quattrini Li, and Xia Zhou. "Sunflower: locating underwater robots from the air: video." In *Proceedings of the 20th Annual International Conference on Mobile Systems, Applications and Services*. 2022. DOI: doi.org/10.1145/3498361.3538656

09. **Charles J. Carver**, Zhao Tian, Qijia Shao, Hongyong Zhang, Kofi M. Odame, Alberto Quattrini Li, and Xia Zhou. "Air-water communication and sensing with light." In *Proceedings of the 2022 14th International Conference on Communication Systems & Networks*. 2022. DOI: doi.org/10.1109/COMSNETS53615.2022.9668473

08. Vimal Kakaraparthi/Qijia Shao, **Charles J. Carver**, Tien Pham, Nam Bui, Phuc Nguyen, Xia Zhou, and Tam Vu. "FaceSense: sensing face touch with an ear-worn system." In *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies*. 2021. DOI: doi.org/10.1145/3478129

07. **Charles J. Carver**, Zhao Tian, Hongyong Zhang, Kofi M. Odame, Alberto Quattrini Li, and Xia Zhou. "AmphiLight: direct air-water communication with laser light." In *Proceedings of the 17th USENIX Conference on Networked Systems Design and Implementation*. 2020. DOI: usenix.org/conference/nsdi20/presentation/carver **Best paper award.**

06. **Charles J. Carver**, Zhao Tian, Hongyong Zhang, Kofi M. Odame, Alberto Quattrini Li, and Xia Zhou. "AmphiLight: direct air-water communication with laser light." *GetMobile: Mobile Computing and Communication*. 2020. DOI: doi.org/10.1145/3447853.3447862

05. Zhao Tian, **Charles J. Carver**, Qijia Shao, Monika Roznere, Alberto Quattrini Li, and Xia Zhou. "PolarTag: invisible data with light polarization." In *Proceedings of the 21st International Workshop on Mobile Computing Systems and Applications*. 2020. DOI: doi.org/10.1145/3376897.3377854 **Best demo award.**

04. Zhao Tian, **Charles J. Carver**, Qijia Shao, Monika Roznere, Alberto Quattrini Li, and Xia Zhou. "Demo: PolarTag - invisible data with light polarization." In *Proceedings of the 21st International Workshop on Mobile Computing Systems and Applications*. 2020. DOI: doi.org/10.1145/3376897.3379160

03. **Charles J. Carver**, Tianxing Li, and Xia Zhou. "Lighting the way to wireless efficiency." *XRDS: Crossroads, The ACM Magazine for Students*. 2019. DOI: doi.org/10.1145/3357229

02. Matthew Stafford, Adriana Rogers, Shela Wu, **Charles Carver**, N. Sertac Artan, and Ziqian Dong. "TETRIS: smartphone-to-smartphone screen-based visible light communication." In *Proceedings of the 2017 IEEE 14th International Conference on Mobile Ad Hoc and Sensor Systems*. 2017. DOI: doi.org/10.1109/MASS.2017.101
Best poster runner-up at NYIT 8th Annual Cybersecurity Conference.

01. **Charles Carver**, Shela Wu, Adriana Rogers, Matthew Stafford, N. Sertac Artan, and Ziqian Dong. "Indoor localization through visible light characterization using front-facing smartphone camera." In *Proceedings of the 2017 IEEE 14th International Conference on Mobile Ad Hoc and Sensor Systems*. 2017. DOI: doi.org/10.1109/MASS.2017.102

PATENTS

"Localizing underwater robots from the air," **C Carver**, Q Shao, A Quattrini Li, X Zhou — *U.S. Patent 18209941*

"Speckle-suppressing lighting system," X Wang, **C Carver**, E Fossum, J Liu, X Zhou, N Shade — *U.S. Patent 17953129*

TALKS AND PRESENTATIONS

"Illuminating New Frontiers in Communication and Sensing with Laser Light." Columbia University, CS Dept. — *Jul 2024*

"Illuminating New Frontiers in Communication and Sensing with Laser Light." University of Pennsylvania, ESE Dept. — *Feb 2024*

"Sunflower: locating underwater robots from the air." ACM MobiSys. Video: youtu.be/hmLn4MgBs4E *Jun 2022*
"AmphiLight: direct air-water communication with laser light." Fordham University, Physics Dept. *Dec 2020*
"AmphiLight: direct air-water communication with laser light." USENIX NSDI. Video: youtu.be/red-Q16MYWU *Feb 2020*
"Extreme-High Frequency Communication: Visible Light." Dartmouth College, CS Dept. *Nov 2020*
"The Physics of Visible Light Communication." University of New Hampshire, Physics Dept. *Feb 2019*

PRESS

"Voices of CS: Charlie Carver and Hadleigh Schwartz." Columbia University. 2024. Source: cs.columbia.edu/2024/voices-of-cs-charlie-carver-and-hadleigh-schwartz

"A Sunflower Eye in the Sky." Dartmouth College. 2022. Source: home.dartmouth.edu/news/2022/06/sunflower-eye-sky

"Computer science professors create laser light system to detect robots underwater." The Dartmouth. 2022. Source: thedartmouth.com/article/2022/07/james-rodil-professors-create-sunflower-laser-light-system

"A Sunflower Eye in the Sky." Dartmouth College, Department of Computer Science. 2022. Source: web.cs.dartmouth.edu/news/2022/06/sunflower-eye-sky

"Poster session showcases CS and Engineering research." Dartmouth College, Department of Computer Science. 2022. Source: web.cs.dartmouth.edu/news/2022/05/poster-session-showcases-cs-and-engineering-research

"Work on Air-Water Laser Link Won NSDI Best Paper Award." Dartmouth College, Department of Computer Science. 2020. Source: web.cs.dartmouth.edu/news/2020/03/work-air-water-laser-link-won-nsdi-best-paper-award

PEER REVIEW

IEEE Photonics Technology Letters
IEEE Transactions on Mobile Computing
IEEE Journal of Oceanic Engineering
Computer Communications

LEADERSHIP AND ACTIVITIES

MS Applicant Reviewer, Columbia University *Mar 2023 – Jun 2023*
PhD Pre-Applicant Review Program, Columbia University *Nov 2022 – Dec 2022*
REU Alumni Panel, New York Institute of Technology *Jul 2022*
REU Alumni Panel, New York Institute of Technology *Jul 2021*
Vice President, Dartmouth Graduate Student Council *May 2021 – May 2022*

- Co-Chair of Benefits Ad-Hoc Committee
- Co-Chair/Co-Founder of Alumni Representation Ad-Hoc Committee
- Co-Chair/Co-Founder of Housing Ad-Hoc Committee
- Voting Member on College's Ad-Hoc Council of Work-Life Issues
- Graduate Representative on Board of Trustees Student Liaison Committee
- Graduate Representative on Jed Foundation Exploratory Committee
- Legislator for External Affairs Standing Committee

Wellness Coach, Dartmouth Wellness Center *Sep 2020 – Jun 2022*
Web Co-Chair, ACM MobiSys '21 *Dec 2020 – Jul 2021*
CS Department Representative, Dartmouth Graduate Student Council *Sep 2020 – May 2021*
Mentor, New York Academy of Sciences STEMU Program *Nov 2018 – May 2019*
Head of IT, Fordham University Department of Physics *Sep 2017 – May 2018*
Tutor, Fordham University Department of Physics *Sep 2015 – May 2018*

TEACHING EXPERIENCE

Columbia University, Department of Computer Science New York, NY
Topics in Mobile Computing, Head Teaching Assistant *Sep 2023 – Dec 2023*

Dartmouth College, Department of Computer Science Hanover, NH
Introduction to Programming and Computation, Head Teaching Assistant *Mar 2019 – Jun 2019*
Software Design and Implementation, Head Teaching Assistant *Jan 2019 – Mar 2019*
Discrete Mathematics in Computer Science, Teaching Assistant *Sep 2018 – Nov 2018*

Fordham University, Department of Physics Bronx, NY
Thermodynamics and Statistical Mechanics, Grading Assistant *Jan 2018 – May 2018*

Fordham University, Department of Mathematics Bronx, NY
Calculus II, Grading Assistant *Sep 2017 – May 2018*
Finite Mathematics, Grading Assistant *Sep 2016 – May 2017*

Fordham University, Department of Physics Bronx, NY
Physics I Lab, Lab Assistant *Sep 2016 – Dec 2016*

TECHNICAL SKILLS

Languages: Python, C/C++, MATLAB, SQL, Bash, Verilog, PHP, JavaScript, HTML, CSS.
Technologies: Zemax, Autodesk (CAD/EDA), SPICE, Vivado, Git/GitHub, Jupyter, Photoshop, LaTeX, gnuplot.
Frameworks: NumPy, Pandas, Dask, Matplotlib, OpenCV, SciPy, Scikit-learn, Tensorflow.
Hardware: Arduino, Raspberry Pi, OpenMV, NVIDIA Jetson, AMD FPGAs, ROS-based systems.
Prototyping: Analog/digital circuit design, PCB design, 3D-printed CAD modeling.