Benjamin D. Killeen

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Summary

A Ph.D. Student at Johns Hopkins University, I am interested in intelligent surgical systems that improve patient outcomes. My recent work involves realistic simulation of interventional X-ray imaging for the purpose of developing AI-integrated surgical systems. I am a member of the Advanced Robotics and Computationally Augmented Environments (ARCADE) research group and the Computational Interaction and Robotics Laboratory (CIRL).

Education

Ph.D., Computer Science, Johns Hopkins University, Baltimore, MD, USA. 08/2019 - present
With Mathias Unberath and Gregory D. Hager.

B.A., Computer Science with Honors, Minor in Physics, University of Chicago, Chicago, IL, USA. 09/2015 - 06/2019
With Gordon Kindlmann.

Academic Experience

Research assistant, Department of Computer Science, Johns Hopkins University, Baltimore, MD, USA. 08/2020 - present
With Mathias Unberath, Gregory D. Hager.

Research Assistant, Laboratory for Computational Sensing and Robotics, Johns Hopkins University, Baltimore, MD, USA. 08/2019 - 06/2020
With Gregory D. Hager, Mathias Unberath, and Russel Taylor.

Research assistant, Department of Computer Science, University of Chicago, Chicago, IL, USA. 03/2018 - 08/2019
With Gordon Kindlmann.

Professional Experience

Computer Vision / AI Intern, Applied Research, Intuitive Surgical Inc., Sunnyvale, CA, USA. 06/2020 - 07/2020
With Omid Mohareri.

Software Development Intern, Cognitive Computing, Epic Systems, Verona, WI, USA. 06/2018 - 08/2018
Research Intern, IBM Research - Almaden, San Jose, CA, USA. 06/2017 - 08/2017
With Geoffrey Burr.

Selected Honors

Link Foundation Fellowship in Modeling, Simulation, and Training 06/2023
Proposal: Interactive Digital Twins for Simulating the Future of Work in AI- and Robot-assisted Operating Rooms

Nominated, **Intuitive/IPCAI Bench to Bedside Award** 06/2023
For paper [J-5] at IPCAI 2023.

Runner-up, **Physics of Medical Imaging Best Student Paper Award** 02/2022
For paper [C-5] at SPIE Medical Imaging 2022.

Best Paper Award in Bioengineering 10/2021
For paper [C-4] at IEEE BIBE 2021.

Best Presentation Award 04/2021
In Reliable Software Systems at Johns Hopkins University.

Best Graduate Project Award 05/2020
In Computer Integrated Surgical Systems and Technology II at Johns Hopkins University.

COVID-19 Dataset Award, Kaggle 04/2020
For the dataset in [M-1].

Intuitive Surgical Best Project Award. 12/2019
For Enriching Unsupervised Feature Learning via Intermediate Subtasks in Deep Learning at Johns Hopkins University.

LCSR Fellowship for Outstanding Incoming Ph.D. Students, Johns Hopkins University, Baltimore, MD, USA. 2019 - 2020

Services and Leadership

Academic Services

President, LCSR Graduate Student Association at Johns Hopkins University. 08/2022 - present
Established an executive board, annual operating budget, and election process.

Sports Officer, MICCAI Society Student Board. 12/2021 - present
Head of Student Resources, LCSR Graduate Student Committee at Johns Hopkins University. 09/2020 - 08/2022

Community

Family Member, Thread, Baltimore, MD, USA. 06/2021 - 2022
Volunteer Instructor, CompileHer, Chicago, IL, USA. 2019

Peer Review

Computer Assisted Surgery (CAS) 2023
International Conference on Computer Vision (ICCV)
Medical Imaging Computing and Computer Aided Interventions (MICCAI)
Journal of Machine Learning Research (JMLR)
IEEE Transactions on Medical Imaging (TMI)
IEEE Robotics and Automation Letters (RA-L)
International Symposium on Medical Robotics (ISMR)
International Conference on Information Processing in Computer-Assisted Interventions (IPCAI)

MICCAI Educational Challenge 2022
Medical Image Analysis
IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)

IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) 2021

Nature Scientific Data 2020

Supervision

Graduate Students

Fanghao Cheng, Masters, Johns Hopkins University, Baltimore, MD, USA. 05/2023 - present

Shreayan Chaudhary, Masters, Johns Hopkins University, Baltimore, MD, USA. 05/2023 - present

Han Zhang, Masters, Johns Hopkins University, Baltimore, MD, USA. 01/2023 - present

Aditya Kulkarni, Masters, Johns Hopkins University, Baltimore, MD, USA. 09/2022 - present

Qiyuan Wu, Masters, Johns Hopkins University, Baltimore, MD, USA. 08/2022 - 06/2023
Now a PhD student at Cornell University.

Zidi Tao, Research Assistant, Johns Hopkins University, Baltimore, MD, USA. 10/2021 - 06/2022
Now a PhD student at Rensselaer Polytechnic Institute.

Shreya Chakraborty, Masters, Johns Hopkins University, Baltimore, MD, USA. 08/2020 - 09/2021
Now at PathAI.

Philipp Nikutta, Visiting Masters, Technical University of Munich, Munich, Germany. 12/2019 - 03/2020
Now at Argo AI.

Undergraduates

Liam Wang, Bachelors, Johns Hopkins University, Baltimore, MD, USA. 01/2022 - present

Sambhav Chordia, Bachelors, Johns Hopkins University, Baltimore, MD, USA. 06/2022 - 12/2022

Sean Sebastian Darcy, Bachelors, Johns Hopkins University, Baltimore, MD, USA. 10/2021 - 10/2022
Now a PhD student at California Institute of Technology.

Nethra Venkatayogi, Bachelors, The University of Texas at Austin, Austin, TX, USA. 05/2021 - 10/2021
Now a PhD student at JHU with Muyinatu Bell.

Max Judish, Bachelors, Brown University, Providence, RI, USA. 01/2021 - 08/2021

Student Projects

Recreating Pelvic Trauma Surgery in Virtual Reality for the Development of Novel C-arm Interfaces 2023
Han Zhang, Zixuan Liu, Liam Wang. Computer Integrated Surgery II, Johns Hopkins Unviersity.
- Honored with the audience **Best Project Poster Award**.

Making 2D/3D Registration Accessible 2023
Jiaming Zhang, Zhangcong She. Computer Integrated Surgery II, Johns Hopkins Unviersity.
Python library available from PyPI and GitHub.

3D Segmentation of Hard and Soft Tissue for Simulating X-ray Image Formation with Deep Learning 2022
Qiyuan Wu, Zhiyuan Ding, Sean Darcy. Computer Integrated Surgery II, Johns Hopkins University.

Assistant Teaching

Computer Integrated Surgery, Department of Computer Science, Johns Hopkins University, Baltimore, MD, USA. Fall 2022

With Russ Taylor.
Wrote supplementary course material, led weekly office hours, and taught regular discussion sections.

Computer Integrated Surgery, Department of Computer Science, Johns Hopkins University, Baltimore, MD, USA. Fall 2021

With Russ Taylor and Emad Boctor.
Held weekly office hours and biweekly discussion sections. Managed grading together with Maia Stiber.

Machine Learning and Large Scale Data Analysis, Department of Computer Science, University of Chicago, Chicago, IL, USA. Spring 2019

With Yali Amit.
Wrote supplementary course material and held weekly lab sessions. Graded coursework.

Selected review: "Ben was incredibly patient during office hours and always responsive to student questions. In addition, he often presented demos during office hours or showed easier ways to handle the homework assignments; both were very helpful."
More reviews available at benjamindkilleen.com/teaching/2019-spring-lsda

Teaching Services

Course assistant. Department of Computer Science, University of Chicago, Chicago, IL, USA 01/2019 - 08/2019

- **Scientific Visualization**
- **Introduction to Computer Science I**
- **Introduction to Computer Science II**

Tutoring in Computer Science, Machine Learning, Baltimore, MD, USA. 06/2020 - 08/2022

Worked with middle and high school students.

Publications

I have first- (co-) authored 7 (4) peer-reviewed papers and 2 (0) preprints. My publication list is also available on Google Scholar. (*) denotes equal contribution.

Peer-reviewed Journal Articles

B.D. Killeen, S.M. Cho, M. Armand, R.H. Taylor, M. Unberath. In Silico simulation: A key enabling technology for next-generation intelligent surgical systems. Progress in Biomedical Engineering, 2023. doi: 10.1088/2516-1091/acd28b. J-6

B.D. Killeen, C. Gao, K. Oguine, S. Darcy, M. Armand, R.H. Taylor, G. Osgood, M. Unberath. An autonomous X-ray image acquisition and interpretation system for assisting percutaneous pelvic fracture fixation. International Journal of Computer Assisted Radiology and Surgery, 1–8, 2023. doi: 10.1007/s11548-023-02941-y. J-5

- Nominated for the Intuitive/IPCAI **Bench to Bedside Award**.

C. Gao, **B.D. Killeen**, Y. Hu, R.B. Grupp, R.H. Taylor, M. Armand, M. Unberath. Synthetic data accelerates the development of generalizable learning-based algorithms for X-ray image analysis. Nature Machine Intelligence, Mar. 2023, pp. 1–15, doi: 10.1038/s42256-023-00629-1. J-4

B. D. Killeen, J. Winter, W. Gu, A. Martin-Gomez, R. H. Taylor, G. Osgood, M. Unberath. Mixed reality interfaces for achieving desired views with robotic X-ray systems. Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization, 7 Dec. 2022, pp. 1-6, doi: 10.1080/21681163.2022.2154272. J-3

- Special issue: Augmented Environments for Computer Assisted Interventions (AE-CAI) 2022.

A. Hundt, **B. Killeen**, H. Kwon, C. Paxton, GD Hager. "Good Robot!": Efficient Reinforcement Learning for Multi-Step Visual Tasks with Sim to Real Transfer. IEEE Robotics and Automation Letters, vol. 5, no. 4, pp. 6724–6731, Oct. 2020. doi: 10.1109/LRA.2020.3015448. J-2

S. Ambrogio, P. Narayanan, H. Tsai, R. M. Shelby, I. Boybat, C. di Nolfo, S. Sidler, M. Giordano, M. Bodini, N. Farinha, **B. Killeen**, C. Cheng, Y. Jaoudi, G. W. Burr. Equivalent-accuracy accelerated neural-network training using analogue memory. Nature, vol. 558, no. 7708, p. 60, Jun. 2018. doi: 10.1038/s41586-018-0180-5. J-1

Peer-reviewed Conference Papers

B. D. Killeen, H. Zhang, J. Mangulabnan, M. Armand, R.H. Taylor, G. Osgood, and M. Unberath, Pelphix: Surgical Phase Recognition from X-ray Images in Percutaneous Pelvic Fixation. To appear: International Conference on Medical Image Computing and Computer Assisted Intervention, 2023. arXiv:2304.09285. C-6

B. D. Killeen, Shreya Chakraborty, Greg Osgood, Mathias Unberath. Toward perception-based anticipation of cortical breach during K-wire fixation of the pelvis. Medical Imaging 2022: Physics of Medical Imaging. SPIE. doi: 10.1117/12.2612989. C-5

- Runner-up, SPIE Medical Imaging **Physics of Medical Imaging Best Student Paper Award**

J. D. Opfermann*, **B. D. Killeen***, C. Bailey, M. Khan, A. Uneri, K. Suzuki, M. Armand, F. Hui, A. Krieger**, M. Unberath**. Feasibility of a Cannula-mounted Piezo Robot for Image-guided Vertebral Augmentation: Toward a Low Cost, Semi-autonomous Approach. 2021 IEEE 21st International Conference on Bioinformatics and Bioengineering (BIBE), Kragujevac, Serbia, 2021 pp. 1-8. doi: 10.1109/BIBE52308.2021.9635356. C-4

*Joint first authors; ** joint last authors.
- Honored with **Best Paper Award in Bioengineering.**

X. Liu*, **B. D. Killeen***, A. Sinha, M. Ishii, G. Hager, R. Taylor, M. Unberath. Neighborhood Normalization for Robust Geometric Feature Learning. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, 2021. C-3

C. Gao, X. Liu, W. Gu, **B. D. Killeen**, M. Armand, R. Taylor, M. Unberath. Generalizing Spatial Transformers to Projective Geometry with Applications to 2D/3D Registrationc. International Conference on Medical Image Computing and Computer Assisted Intervention, 2020, arxiv:2003.10987. C-2

X. Liu, Y. Zhang, **B. Killeen**, M. Ishii, G. Hager, R. Taylor, M. Unberath. Extremely Dense Point Correspondences using a Learned Feature Descriptor. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, pp. 4847-4856, 2020. C-1

Preprints

J. Y. Wu*, **B. D. Killeen***, P. Nikutta, M. Thies, A. Zapaishchykova, S. Chakraborty, M. Unberath. Changes in Reproductive Rate of SARS-CoV-2 Due to Non-pharmaceutical Interventions in 1,417 U.S. Counties. medRxiv preprint, Jun. 2020, doi: 10.1101/2020.05.31.20118687. M-2

B. D. Killeen*, J. Y. Wu*, K. Shah, A. Zapaishchykova, P. Nikutta, A. Tamhane, S. Chakraborty, J. Wei, T. Gao, M. Thies, M. Unberath. A County-level Dataset for Informing the United States' Response to COVID-19. arXiv preprint, 2020, arXiv:2004.00756. M-1

Patents

G. W. Burr and **B. D. Killeen**. 2020. Efficient Processing of Convolutional Neural Network Layers Using Analog-memory-based Hardware. 20200117986, filed March 25, 2019, and issued April 16, 2020, uspto.report/patent/app/20200117986. P-1

Selected Press

Patterson, Jaimie. **PhD student awarded Link Foundation Fellowship** Johns Hopkins Department of Computer Science. The Johsn Hopkins University, May 24, 2023. https://www.cs.jhu.edu/news/phd-student-awarded-link-foundation-fellowship/. 2023

Graham, Catherine. **"Synthetic Data for AI Outperform Real Data in Robot-Assisted Surgery."** The Johns Hopkins University Hub. The Johns Hopkins University, March 20, 2023. hub.jhu.edu/2023/03/20/synthetic-data-outperform-real-data-robot-assisted-surgery/. 2023

Dziarkach, Andrei. **"Details with Andrei Dziarkach."** Voice of America. November 21, 2020 Accessed November 26, 2020. golosameriki.com/a/detali/5671254.html. 2020

Rosen, Jill. **"Dog Training Methods Help JHU Teach Robots to Learn New Tricks."** The Johns Hopkins University Hub. The Johns Hopkins University, October 26, 2020. hub.jhu.edu/2020/10/26/positive-reinforcement-for-robots

Selected Coursework

Graduate

GPA: 3.82

Vision as Bayesian Inference
Reliable Software Systems
Theory of Computation
Parallel Programming
Nonlinear Optimization II
Computer Integrated Surgery II
Computer Integrated Surgery I
Deep Learning

Undergraduate

GPA: 3.81

Unsupervised Learning*
Computer Vision
Machine Learning and Large Scale Data Analysis
Operating Systems
Honors Combinatorics
Honors Algorithms
Honors Discrete Mathematics
Scientific Visualization
Programming Languages
Networks and Distributed Systems
Quantum Mechanics I \& II
Intermediate Mechanics
Electronics
Wizards

*Graduate level.

Memberships

International Society for Optics and Photonics (SPIE) Student Member
Institute of Electrical and Electronics Engineers (IEEE) Graduate Student Member

Extracurricular

In my free time, I enjoy bouldering, cycling, and running. I am an avid fan of art museums, and I write creatively:

Creative nonfiction: benjamindkilleen.com/blog
Science fiction.

Metadata

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