# Benjamin D. Killeen


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| Contact | Department of Computer Science | *Cell:* | +1 (314) 651-6809 |
| | Johns Hopkins University | *Desk:* | Hackerman 137 |
| | 3400 North Charles Street | *Mail:* | killeen@jhu.edu |
| | Baltimore, MD 21218 | *Web:* | benjamindkilleen.com |



Summary

As a final-year Ph.D. candidate at Johns Hopkins University, I am researching the future of AI- and robot-assisted interventional healthcare through the creation and integration of sophisticated simulation environments. Outside of the lab, I work to build community in the classroom, in my local network, and through professional societies, with the ultimate goal of fostering an inclusive environment for all.


## Education

**Ph.D. in Computer Science** 08/2019 – now
**Johns Hopkins University**
Affiliated with the Laboratory for Computational Sensing and Robotics.
*Primary advisor:* Mathias Unberath
*Secondary advisor:* Gregory D. Hager

**B.A. in Computer Science** with Honors 06/2019
Minor in Physics
**University of Chicago**
*Honors thesis advisor:* Gordon Kindlmann.

## Professional Employment

**Computer Vision / AI Intern**, Intuitive Surgical Inc. 06/2020 – 07/2020
Applied Research
With Omid Mohareri.

**Software Development Intern**, Epic Systems 06/2018 – 08/2018
Center for Cognitive Computing

**Research Intern**, International Business Machines 06/2017 – 08/2017
IBM Research - Almaden
With Geoffrey Burr.

## Selected Awards

**Personal Awards**

4. Finalist, **WSE Excellence in Teaching, Advising, and Mentoring Award** 2024
   Honors JHU faculty and graduate students who excel in the arts of teaching, advising, and mentoring.

3. DAAD AInet Fellow, **Postdoc-NeT-AI Networking Week on Human-centered AI** 2023
   Postdoctoral networking tour in Germany supported by the German Academic Exchange Service (Deutscher Akademischer Austauschdienst).

2. Recipient, **Link Foundation Fellowship in Modeling, Simulation, and Training** 2023
Two-year fellowship for Ph.D. students to fund their research.
Proposal: *Interactive Digital Twins for Simulating the Future of Work in AI- and Robot-assisted Operating Rooms*

1. **LCSR Fellowship for Outstanding Incoming Ph.D. Students** 2019

### Publication Awards

6. Finalist, **Best Paper Award** 2023
For paper [J-9] at IPCAI 2024.

5. Finalist, **Bench-to-Bedside Award** 2023
For paper [J-7] at IPCAI 2024.

4. Honorable Mention, **Bench-to-Bedside Award** 2023
For paper [J-5] at IPCAI 2023.

3. Runner Up, **Best Paper Award, Physics of Medical Imaging** 2022
For paper [C-5] at SPIE Medical Imaging 2022.

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

1. **Kaggle COVID-19 Dataset Award** 2020
For our US county-level dataset described in [M-1].

### Reviewer Awards

1. Honorable Mention, **MICCAI Outstanding Reviewer Award** 2023

### Coursework Awards

3. **Best Presentation Award** 2021
Reviewing IronFleet: Proving Practical Distributed Systems Correct Reliable Software Systems, Johns Hopkins University.

2. **Best Graduate Project Award** 2020
Resulted in our US county-level dataset described in [M-1].
Computer Integrated Surgery II, Johns Hopkins University.

1. **Intuitive Surgical Best Project Award** 2019
*Enriching Unsupervised Feature Learning via Intermediate Subtasks* Deep Learning, Johns Hopkins University.

## Service and Leadership

### Societies

Social Events Officer, MICCAI Student Board 10/2023 – now

President, LCSR Graduate Student Association 08/2022 – 12/2023
Established an executive board managing $8,000/yr in student resources.

Sports Officer, MICCAI Student Board 12/2021 – 09/2023
Organizer for athletic events at the MICCAI conference.
On-site representative and MICCAI Educational Challenge reviewer.

Head of Student Resources 09/2020 – 08/2022
LCSR Graduate Student Committee

**Academic Services**

Seminar Course Assistant 2023
*Future Faculty: Preparing a New Generation of PIs for the Academic Job Search*
Department of Computer Science, Johns Hopkins University

Organizer 2023
*Focus Group on Graduate Student Space*
Laboratory for Computational Sensing and Robotics, Johns Hopkins Univ.

Brainlab Loop-X Trainer and Coordinator 2022 – now
Laboratory for Computational Sensing and Robotics, Johns Hopkins Univ.

Robotorium and Mock OR Tours 2022, 2023
Laboratory for Computational Sensing and Robotics, Johns Hopkins Univ.

**Organizer**

Co-organizer 2024
PENGWIN: Pelvic Bone Fragments with Injuries
MICCAI'24 Segmentation Challenge

**Journal Reviewer**

Nature Communications
IEEE Transactions on Medical Imaging (TMI)
Journal of Machine Learning Research (JMLR)
Quantitative Imaging in Medicine and Surgery (QIMS)
Journal of Visualized Surgery (JOVS)
IEEE Robotics and Automation Letters (RA-L)
Computer Assisted Surgery (CAI)
Nature Scientific Data
Medical Image Analysis (MedIA)

**Conference Reviewer**

Medical Image Computing and Computer Assisted Interventions (MICCAI)
International Conference on Information Processing in Computer-Assisted Interventions (IPCAI)
International Symposium on Medical Robotics (ISMR)
IEEE International Conference on Computer Vision (ICCV)
IEEE European Conference on Computer Vision (ECCV)
IEEE/CVF Computer Vision and Pattern Recognition (CVPR)

## Teaching

**Computer Integrated Surgery II** (EN.601.456/656)
Department of Computer Science, Johns Hopkins University

Project mentor: *Measuring Variability of Pelvic Standard Views in Virtual Reality* 2024
Voted runner-up, **Best Project Award**.
Project mentor: *A Cannula Marker Body for Tracker-free Surgical Navigation during Kirschner Wire Placement* 2024
Project mentor: *Bringing View-invariant X-ray Image Analysis into the Operating Room* 2024
Project mentor: *Recreating Pelvic Trauma Surgery in Virtual Reality for the Development of Novel C-arm Interfaces* Spring 2023
Voted **Best Project Award**.
Project mentor: *Making 2D/3D Registration Accessible* 2023
Project mentor: *3D Segmentation of Hard and Soft Tissue for Simulating X-ray Image Formation with Deep Learning* 2022

**Computer Integrated Surgery I** (EN.601.455/655)
Department of Computer Science, Johns Hopkins University
Teaching assistant. Quality: 4.32/5.00 (sample size: 86) Fall 2022
Teaching assistant. Quality: 4.13/5.00 (sample size: 63) Fall 2021

**Introduction to Computer Science** (CMSC 14100/14200)
Department of Computer Science, University of Chicago
Course assistant Summer 2019

**Machine Learning and Large Scale Data Analysis** (CMSC 25025)
Department of Computer Science, University of Chicago
Teaching assistant Spring 2019

**Scientific Visualization** (CMSC 23710)
Department of Computer Science, University of Chicago
Course assistant Winter 2019

## Supervision

As a member of the ARCADE Lab with Mathias Unberath, I supervise students' contributions to research. Where known, career steps after completing their research effort are provided.

### Graduate

13. **Iou-Sheng "Danny" Chang**, Johns Hopkins Univ. 02/2023 – 05/2023
12. **Ching-Yang "Austin" Huang**, Johns Hopkins Univ. 02/2023 – 05/2023
11. **Yuxuan Zhao**, Johns Hopkins Univ. 02/2023 – 05/2023
10. **Xu "Lance" Lian**, Johns Hopkins Univ. 09/2023 – 12/2023
9. **Bohua Wan**, Johns Hopkins Univ. 06/2023 – now
8. **Hengyu Cao**, Johns Hopkins Univ. 08/2023 – 12/2023
7. **Shreayan Chaudhary**, Johns Hopkins Univ. 05/2023 – 05/2024 Joined **Seagate Technology as a Machine Learning Engineer**
6. **Han Zhang**, Johns Hopkins Univ. 01/2023 – 12/2023
Joined **Johns Hopkins University as a Ph.D. Student**.

5. **Zixuan Liu**, Johns Hopkins Univ. 01/2023 – 09/2023
   Joined **Vanderbilt University as a Ph.D. Student**.

4. **Aditya Kulkarni**, Johns Hopkins Univ. 09/2022 – now

3. **Qiyuan Wu**, Johns Hopkins Univ. 08/2022 – 06/2023
   Joined **Cornell University as a Ph.D. Student**.

2. **Zidi Tao**, Johns Hopkins Univ. 10/2021 – 06/2022
   Joined **Rensselaer Polytechnic Institute as a Ph.D. Student**.

1. **Shreaya Chakraborty**, Johns Hopkins Univ. 08/2020 – 09/2021
   Joined **PathAI as a Machine Learning Engineer**.

**Undergraduates**

9. **Janya Budaraju**, Johns Hopkins Univ. 02/2024 – now
   Recipient of the Pistritto Fellowship based on her undergraduate research.

8. **Samhith Bhrugubanda**, Johns Hopkins Univ., 02/2024 – now

7. **Asmitha Sathya**, Johns Hopkins Univ., 09/2023 – 12/2023

6. **Darren Shih**, Johns Hopkins Univ. 09/2023 – 12/2023

5. **William "Liam" Wang**, Johns Hopkins Univ. 01/2023 – now
   Joined the **University of Michigan** as a **Ph.D. Student.**
   Fellow in the **NSF Graduate Research Fellowship Program**.

4. **Sambhav Chordia**, Johns Hopkins Univ. 06/2022 – 12/2022

3. **Sean Sebastian Darcy**, Johns Hopkins Univ 10/2021 – 10/2022
   Joined the **California Institute of Technology as a Ph.D. Student**.

2. **Nethra Venkatayogi**, Johns Hopkins Univ. 05/2021 – 10/2021
   Visiting from the University of Texas at Austin.
   Joined **Johns Hopkins University as a Ph.D. Student**.

1. **Max Judish**, Johns Hopkins Univ. 01/2021 – 08/2021
   Visiting from Brown University.

## Talks and Press

**Invited Talks and Demos**

9. End of Semester Social, **Selected Posters and Demos** 05/2024 JHU
   Data Science and AI Institute, Baltimore, USA
   "Neural Digital Twins"

8. Malone Center Research Lunch 05/2024
   Malone Center for Engineering in Healthcare, Baltimore, USA
   "Advancing Interventional Healthcare One Simulation at a Time"

7. Malone Center Trainee Mix and Mingle 04/2024
   Malone Center for Engineering in Healthcare, Baltimore, USA
   "The Future of Simulation-Driven Interventional Healthcare"
   Runner up, **Audience Choice for Best Presentation**.

6. IHU Seminar Series 03/2024
   IHU, Strasbourg, France
   "Advancing Interventional Healthcare One Simulation at a Time"

5. CAMP Seminar Series 03/2024
   In the Postdoc-NeT-AI Networking Week on Human-centered AI
   TUM, Munich, Germany
   "Advancing Interventional Healthcare One Simulation at a Time"

4. medPhoton Invited Talk Series 06/2023
   medPhoton, Salzburg, Austria
   "Robotic X-ray Imaging Interfaces"

3. FDA DIDSR Seminar Series 05/2023
   Food and Drug Administration, Silver Spring, MD
   "Simulating Image-guided Interventions: Interactive Digital Twins to Usher in Next-generation Surgical Suites"

2. The Artificial Intelligence Society (HopAI) 04/2023
   Johns Hopkins University, Baltimore, MD
   "Yet Another Deep Learning Introduction for Everyone"

1. LCSR Seminar Series 04/2023
   Johns Hopkins University, Baltimore, MD
   "An Autonomous X-ray Image Acquisition and Interpretation System for Assisting Percutaneous Pelvic Fracture Fixation"

**Selected Press**

4. Our work [C-6] presenting the first approach to surgical phase recognition in X-ray guided surgery with dynamic simulation was featured in the JHU Hub and Surgery International.

3. Our work [J-4] demonstrating the utility of synthetic data for training novel X-ray image analysis algorithms was featured in the JHU Engineering magazine, the JHU Hub, and Medical Xpress.

2. My proposal to the Link Fellowship on Simulation, Modeling, and Training was featured on JHU Computer Science News.

1. Our work [J-2] demonstrating efficient strategies for training robots using reinforcement learning was featured in the JHU Hub, TechCrunch, Psychology Today, BBC News, and Voice of America.

PUBLICATIONS I have (first/co)-authored 5/4 journal articles, 4/2 conference papers, and 3/0 preprints, and I am an inventor on 4 patents or patent applications in process. My publication list is also available on Google Scholar.

**Peer-reviewed Journal Articles**

[J-9]. **B.D. Killeen***, H. Zhang*, L. Wang, Z. Liu, C. Kleinbeck, M. Rosen, R.H. Taylor, M. Unberath. "Stand in Surgeon's Shoes: Virtual Reality Cross-training to Enhance Teamwork in Surgery," *International Journal of Computer Assisted Radiology and Surgery*, 2024.
Special Issue: *Information Processing in Computer-Assisted Interventions (IPCAI) 2024*
Finalist, **Best Paper Award** at IPCAI'24.

[J-8]. **B.D. Killeen**, S. Chaudhary, G. Osgood, M. Unberath. "Take a Shot! Natural Language Control of Robotic X-ray Systems for Image-guided Surgery," *International Journal of Computer Assisted Radiology and Surgery*, 2024.
Special Issue: *Information Processing in Computer-Assisted Interventions (IPCAI) 2024*

[J-7]. C. Kleinbeck, H. Zhang, **B.D. Killeen**, D. Roth, M. Unberath. "Neural Digital Twins: Reconstructing Complex Medical Environments for Spatial Planning in Virtual Reality," *International Journal of Computer Assisted Radiology and Surgery*, 2024.
Special Issue: *Information Processing in Computer-Assisted Interventions (IPCAI) 2024*
Finalist, **Bench-to-Bedside Award** at IPCAI'24.

[J-6]. **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, vol. 5, no. 3, pp. 032001.
**Invited submission** to the *Special Issue on In Silico Trials.*

[J-5]. **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*, 2023.
Special Issue: *Information Processing in Computer-Assisted Interventions (IPCAI) 2023*
Audience vote for **long oral** presentation at IPCAI'23.
Honorable Mention, **Bench-to-Bedside Award** at IPCAI'23.

[J-4]. C. Gao, **B.D. Killeen**, Y. Hu, R. 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*, 2023, vol. 5, no. 3, pp. 294-308.
Featured in the **JHU Hub**, the **JHU News Letter**, and the **Nature Robotics and AI collection**.

[J-3]. **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*, 2022.
Special Issue: *Augmented Environments for Computer Assisted Interventions (AE-CAI) 2020*

[J-2]. A. Hundt, **B.D. Killeen**, H. Kwon, C. Paxton, G.D. Hager. "'Good Robot!': Efficient Reinforcement Learning for Multi-Step Visual Tasks with Sim to Real Transfer," *IEEE Robotics and Automation Letters*, 2020, vol. 5, no. 4, pp. 6724-6731.
Featured in the **JHU Hub**, **Psychology Today**, **BBC News**, and **Voice of America**.

[J-1]. S. Ambrogio, P. Narayanan, H. Tsai, R. M. Shelby, I. Boybat, C. di Nolfo, S. Sidler, M. Giordano, M. Bodini, N. Farinha, **B.D. Killeen**, C. Cheng, Y. Jaoudi, G. W. Burr. "Equivalent-accuracy accelerated neural-network training using analogue memory," *Nature*, 2018, vol. 558, no. 7708, p. 60.

**Peer-reviewed Conference Papers**

[C-6]. **B.D. Killeen**, H. Zhang, J.E. Mangulabnan, M. Armand, R. Taylor, G. Osgood, M. Unberath. "Pelphix: Surgical Phase Recognition from X-ray Images in Percutaneous Pelvis Fixation," *Medical Image Computing and Computer Assisted Intervention (MICCAI)*, 2023.
Featured in the **JHU Hub** and Surgery International.

[C-5]. **B.D. Killeen**, S. Chakraborty, G. Osgood, **M. Unberath**. "Toward Perception-based Anticipation of Cortical Breach During K-wire Fixation of the Pelvis," *SPIE Medical Imaging*, 2022.
Selected for **oral** presentation.
Runner up, **Best Paper Award, Physics of Medical Imaging**

[C-4]. J. 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," *IEEE International Conference on BioInformatics and BioEngineering (BIBE)*, 2021.
* Joint first authors; † joint last authors.
Honored with a **Best Paper Award in Bioengineering**.

[C-3]. X. Liu*, **B.D. Killeen***, A. Sinha, M. Ishii, G. Hager, R. Taylor, M. Unberath. "Neighborhood Normalization for Robust Geometric Feature Learning," *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2021, pp. 13049-13058.
* Joint first authors.

[C-2]. 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 Registration," *Medical Image Computing and Computer Assisted Intervention*, 2020, pp. 329-339.
Code available on **GitHub** here.

[C-1]. X. Liu, Y. Zhang, **B.D. Killeen**, M. Ishii, G. Hager, R. Taylor, M. Unberath. "Extremely Dense Point Correspondences in Multi-view Stereo using a Learned Feature Descriptor," *IEEE Conference on Computer Vision and Pattern Recognition*, 2020, pp. 4847-4856.
Code available on **GitHub** here.

**Preprints**

[M-3]. **B.D. Killeen**, L.J. Wang, H. Zhang, M. Armand, R.H. Taylor, G. Osgood, M. Unberath. (2024). FluoroSAM: A Language-aligned Foundation Model for X-ray Image Segmentation. *arXiv preprint*, 2024, arXiv:2403.08059.

[M-2]. 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*, 2020.

[M-1]. **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.
The data described herein received a **Kaggle COVID-19 Dataset Award**.
Code available on **GitHub** here.

**Patents**

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

METADATA

This document was last updated on May 16, 2024. A complete, up-to-date version is available at `https://benjamindkilleen.com/files/cv_killeen.pdf`.