

Benjamin D. Killeen



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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 Johns Hopkins University Affiliated with the Laboratory for Computational Sensing and Robotics . <i>Primary advisor:</i> Mathias Unberath <i>Secondary advisor:</i> Gregory D. Hager B.A. in Computer Science with Honors Minor in Physics University of Chicago <i>Honors thesis advisor:</i> Gordon Kindlmann .	08/2019 – now 06/2019
PROFESSIONAL EMPLOYMENT	Computer Vision / AI Intern , Intuitive Surgical Inc. Applied Research With Omid Mohareri . Software Development Intern , Epic Systems Center for Cognitive Computing Research Intern , International Business Machines IBM Research - Almaden With Geoffrey Burr .	06/2020 – 07/2020 06/2018 – 08/2018 06/2017 – 08/2017
SELECTED AWARDS	Personal Awards 5. Siebel Scholar Recognizes the most talented students at the world's leading graduate schools of business, computer science, bioengineering, and energy science 4. Finalist, WSE Excellence in Teaching, Advising, and Mentoring Award Honors JHU faculty and graduate students who excel in the arts of teaching, advising, and mentoring. 3. DAAD AI-Net Fellow, Postdoc-NeT-AI Networking Week on Human-	2024 2024

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.

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

Publication Awards

6. **Bench-to-Bedside Award** 2024
 For paper [J-7] at IPCAI 2024.

5. **Finalist, Best Paper Award** 2024
 For paper [J-9] 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

2. **IPCAI Outstanding Reviewer Award** 2024

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.

FUNDING

Fellowships and Small Awards

2. [DAAD Postdoc-Net-AI Travel Grant](#): \$ 2,000 2023
1. [Link Foundation Fellowship in MS&T](#): \$ 70,000 2023
 “Interactive Digital Twins for Simulating the Future of Work in AI- and Robot-assisted Operating Rooms”

SERVICE AND LEADERSHIP

Societies

- [TRU-UE 197 Steward](#), Dept. of Computer Science 2024
- 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
[Austin joined XtalPi as an Automation Engineer.](#)
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 Pistrutto 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

11. Engineering Innovation Special Lecture 07/2024
 Whiting School of Engineering, Johns Hopkins University, Baltimore, USA
 “Building Surgical AI One Simulation at a Time”
10. AIMS Lecture Series 06/2024
 Institute for Artificial Intelligence in Medicine (IKIM), Essen, Germany
 “Advancing Interventional Healthcare One Simulation at a Time”
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
 Institute of Image-guided Surgery (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](#)
 Technical University of Munich, 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 DIDS SR Seminar Series 05/2023
 Food and Drug Administration (FDA), 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

6. Our work [J-9], [J-8], and [J-7] were featured in a [JHU Computer Science News](#) article on the IPCAI 2024 conference.
5. Our work in [J-8], [J-5], and [J-3] using the [Brainlab Loop-X](#) was featured on [JHU Computer Science New](#).
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 5/7 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-12]. A. Marey, A. Saad, **B.D. Killeen**, C. Gomez, M. Tregubova, M. Unberath, M. Umair. “Gen-AI: Enhancing Patient Education in Cardiovascular Imaging,” *BJR|Open*, 2024.
- [J-11]. H. Ding, L. Seenivasan, **B.D. Killeen**, S.M. Cho, M. Unberath. “Digital Twins as a Unifying Framework for Surgical Data Science: The Enabling Role of Geometric Scene Understanding,” *Artificial Intelligence Surgery*, 2024.
[Invited submission to the special issue on Surgical Data Science](#)
- [J-10]. A. Marey, K.C. Serdysnki, **B.D. Killeen**, M. Unberath, M. Umair. “Applications and Implementation of Generative Artificial Intelligence in Cardiovascular Imaging with a Focus on Ethical and Legal Considerations: What Cardiovascular Imagers Need to Know!” *BJR/ Artificial Intelligence*, 2024.

- [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*
 Audience vote for **long oral** presentation at IPCAI’24.
 Finalist for the **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*
 Audience vote for **long oral** presentation at IPCAI’24.
- [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*
 Audience vote for **long oral** presentation at IPCAI’24.
 Honored with the **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, D. Dreizin, 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 September 22, 2024. A complete, up-to-date version is available at https://benjamindkilleen.com/files/cv_killeen.pdf.