Benjamin D. Killeen

JOHNS HOPKINS
UNIVERSITY

CONTACT

Department of Computer Science
Johns Hopkins University
3400 North Charles Street
Baltimore, MD 21218

Cell: +1 (314) 651-6809
Office: Hackerman 137
Mail: killeen@jhu.edu
Web: benjamindkilleen.com

SUMMARY

A researcher in medical robotics, I strive to advance intelligent surgical systems to complement surgeons' technical knowledge with superhuman capabilities in image acquisition and surgical action. Outside of my research, I work to build community in my local network and 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,   09/2015 – 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.

AWARDS

Personal Awards

3. DAAD AInet Fellow in the **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 of the **Link Foundation Fellowship in Modeling, Simulation, and Training**   2023
   One year renewable fellowship for Ph.D. students to research full time.
   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

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

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

– **Sports Officer**, MICCAI Student Board 12/2021 – now
   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.

Journal Reviewer
– IEEE Transactions on Medical Imaging (TMI)
– Journal of Machine Learning Research (JMLR)
– Quantitative Imaging in Medicine and Surgery (QIMS)
– 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/CVF Computer Vision and Pattern Recognition (CVPR)

TALKS AND PRESS

Invited Talks and Demos

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.

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.

TEACHING

Computer Integrated Surgery II EN.601.456/656, Project Mentor
Johns Hopkins University
Recreating Pelvic Trauma Surgery in Virtual Reality for the Development of Novel C-arm Interfaces Spring 2023
   – Voted to receive the **Best Project Award**
Making 2D/3D Registration Accessible Spring 2023
3D Segmentation of Hard and Soft Tissue for Simulating X-ray Image Formation with Deep Learning Spring 2022

Computer Integrated Surgery I EN.601.455/655, Teaching Assistant
Johns Hopkins University
TA quality: 4.32/5.00 (sample size: 86) Fall 2022
TA quality: 4.13/5.00 (sample size: 63) Fall 2021

Introduction to Computer Science CMSC 14100/14200, Course Assistant
Department of Computer Science, University of Chicago
Summer 2019

Machine Learning and Large Scale Data Analysis STAT 37601/CMSC 25025, Teaching Assistant
University of Chicago
Spring 2019

Scientific Visualization CMSC 23710, Course Assistant
Department of Computer Science, University of Chicago
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

9. **Xu "Lance" Lian**, Johns Hopkins University 09/2023 – now

8. **Bohua Wan**, Johns Hopkins University 06/2023 – now

7. **Hengyu Cao**, Johns Hopkins University   08/2023 – now

6. **Shreayan Chaudhary**, Johns Hopkins University   05/2023 – now

5. **Han Zhang**, Johns Hopkins University   01/2023 – now

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

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

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

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

Undergraduates

7. **Asmitha Sathya**, Johns Hopkins University,   09/2023 – now

6. **Darren Shih**, Johns Hopkins University   09/2023 – now

5. **Liam Wang**, Johns Hopkins University   01/2023 – now

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

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

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

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

PUBLICATIONS   I have (first/co)-authored 3/3 journal articles, 4/2 conference papers, and 2/0 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-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.
Awarded **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.M. 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**.

[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-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 December 1, 2023. An up-to-date version is available at https://benjamindkilleen.com/files/cv_killeen.pdf.