Hammad F. Khan

Weldon School of Biomedical Engineering, Purdue University
Email: khan332@purdue.edu
GitHub: github.com/HammadFKhan
Website: www.hammadfkhan.com

I. Research Interest

Neuroengineering, calcium imaging, electrophysiology, bio-integrated devices, motor cortical circuits.

II. Education

2020–2026 **PhD in Biomedical Engineering, Purdue University**

2016–2020 **BS in Electrical Engineering, Montana State University**

III. Research Experience

Aug 2020 – Present **Graduate Research Assistant, Purdue University**
Research Advisors: Dr. Krishna Jayant

- Developed and optimized scalable thin-film electrodes to combine two-photon microscopy and high-density electrode recordings.
- Developed projects to understand motor circuits underlying skilled movement.
- Identified the first subcellular and cellular functional biomarker for early stage Lewy-pathology.

Jun 2018–Jun 2020 **Undergraduate Research Assistant, Montana State University**
Research Advisor: Dr. Anja Kunze

- Developed scalable and biocompatible cell assays revealing a paradoxical change in cytosolic calcium and mitochondrial interactions during cortical network maturation.
- Presented findings at national BMES conference and published first-author paper.

IV. Teaching and Mentoring Experience

Jul 2021 – Present **Research Mentor, Purdue Biomedical Engineering**
Mentored 13 students including undergraduates, masters, and medical students.

- Led scientific projects on neurotechnology and sensorimotor processing in rodents.
- Mentee projects led to presentations and publications.
- Placed students in competitive graduate and medical programs, and industry positions.

Aug 2021–May 2022 **Graduate Peer Mentor, Purdue Biomedical Engineering**
Mentored two incoming PhD students on devloping a plan of study.

- Facilitated transition into PhD programs for incoming students includinng research labs and classwork
- Provided guidance in student-advisor meetings and navigatiing stressors

Jul 2021–Apr 2022 **Undergraduate Mentor, Purdue Honors College**
Mentored three undergraduate students from the Honors College.

- Developed scientific projects and milestones related to neurotechnology development and testing.
- Facilitated high-impact research culminating in conference proceedings.
- Helped place students in top engineering graduate programs and Fortune 500 companies.

Aug 2021–Dec 2022 **Graduate Teaching Assistant, Purdue BME 301 Bioelectricity**
Managed grading and exams for 150+ students.
- Organized homework and lab content; coordinated with teaching assistants.
- Maintained weekly office hours for recitations and homework support.

Sep 2018–Dec 2019 **Teacher Assistant, Montana State University, Communications 201**
Facilitated freshman seminar discussions.
- Developed interactive lesson plans.
- Guided first-year students in academic adjustment and coursework management.

Sep 2017–Dec 2017 **Co-instructor, Montana State University, Department of Mathematics M121**
Lectured introductory algebra for non-traditional students.
- Facilitated coursework and quizzes.
- Provided one-on-one support during office hours.
- Developed supplemental instructional materials.

VIII. Selected Awards and Honors

Jan 2025 **Max Planck Florida Institute NeuroMEETS trainee**
One of only six trainees selected nationwide.

Jan 2025 **Nature Communication Highlight: Top 50 best papers in Brain to Behaviour**

Oct 2024 **Purdue Institute for Integrative Neuroscience Travel Award**

Apr 2024 **Purdue BME Research Symposium Best Oral Presentation**

Oct 2022 **Society of Neuroscience Professional Development Award**

Aug 2020 **Purdue Stephan Ash Fellow**
Only one student selected in the department.

Nov 2019 **Montana State College of Engineering Travel Award**

Aug 2018 **Montana State IM Flash Technology Scholarship**
One student selected in the department based on scholarly merit.

X. Patents

1. Krishna Jayant, Om T. Kolhe, Daniel L. Gonzales, and **Hammad F. Khan**. "2D and 3D Neural Electrodes and Methods Thereof." *US Patent #63/542,491*, 2024.

2. Anja Kunze, Connor L. Beck, and **Hammad F. Khan**. "Multi-Curvature Soft Matter Patterns and Methods for Lab-on-Chip Pharmaceutical Testing and Neurobiology Studies." *US Patent #63/143.701*, 2021.

V. Publications

1. **Hammad F. Khan***, Om Kolhe*, Meiseim Habibimatin, and Krishna Jayant. "Neural Delay Lines Synchronize Inter-areal Sequences" *Under Consideration.* *Equal contribution by Hammad F. Khan and Om Kolhe.

2. Brendan K. Ball*, **Hammad F. Khan***, Jee Hyun Park, Krishna Jayant, Deva D Chan, Douglas K Brubaker. "Integrated Cross-Species Translation and Biophysical Multi-Scale Modeling Links Molecular Signatures and Locomotory Phenotypes in Spaceflight-Induced Sarcopenia" *bioRxiv, (In review).* *Equal contribution. Corresponding author.

3. Om T. Kolhe, Alec C. Booth, **Hammad F. Khan**, Krishna Jayant. "A chronic multimodel platform for simultaneous electrophysiology and calcium imaging during motor behaviour." *23th International Conference on Solid-State Sensors, Actuators and Microsystems*, 2025.

4. Sanket Samal, Shulan Xiao, Samantha Nelson, Om Kolhe, **Hammad F. Khan**, Meiseim Habibimatin, Won-June Lee, Mustafa Ahmed, Decheng Wang, Tianqi Wang, Qing Deng, Elizabeth Parkinson, and Krishna Jayant, Jianguo Mei. "Blood-Catalyzed n-Doped Conducting Polymer for Reversible, Light-Induced Modulation of Neuronal Membranes" *Science (In revision)*, 2025.

5. Sayan Dutta, Jennifer Hensel, Alicia Scott, Rodrigo Mohallem, Leigh-Ana M Rossitto, **Hammad F. Khan**, Teshawn Johnson, Christina R Ferreira, Jackeline F. Marmolejo, Xu Chen, Krishna Jayant, Uma K. Aryal, Laura Volpicelli-Daley, Jean-Christophe Rochet. "Synaptic phosphoproteome modifications and cortical circuit dysfunction are linked to the early-stage progression of alpha-synuclein aggregation" *bioRxiv, (In review)*, 2025.

6. Daniel L. Gonzales, **Hammad F. Khan**, Hayagreev Keri, Saumitra Yadav, Lyle Muller, Scott Pluta, and Krishna Jayant. "A Translaminar Space-Time Code Supports Touch-Evoked Traveling Waves" *Science Advances 11, 5*, 2025.

7. **Hammad F. Khan**, Sayan Dutta, Alicia N. Scott, Shulan Xiao, Saumitra Yadav, Xiaoling Chen, Tamara L. Kinzer-Ursem, Jean-Christophe Rochet, and Krishna Jayant. "Site-Specific Seeding of Lewy Pathology Induces Distinct Pre-Motor Cellular and Dendritic Vulnerabilities in the Cortex" *Nature Communications 15, 10775*, 2024. **Featured in the top 50 best papers published in an area.**

8. A. Booth, **Hammad F. Khan**, Om T. Kolhe, and Krishna Jayant. "Implantation of Flexible Electrodes for Simultaneous In-Vivo Extracellular Recording and Two-Photon Imaging" *Proceedings of IMPRS 6* (1), 2023.

9. Y. Bari, **Hammad F. Khan**, and Krishna Jayant. "Tracking the Neurodegeneration and Behavioral Changes in Mice Model of Prodromal Phase Alpha-Synucleinopathy" *Proceedings of IMPRS 5* (1), 2022.

10. C. L. Beck, **Hammad F. Khan**, and Anja Kunze. "Biomechanical Modulation of Calcium Event Rates in Soft Matter Neuro Patterns" *Proceedings of the 25th International Conference on Miniaturized Systems for Chemistry and Life Science*, 2022.

11. **Hammad F. Khan**, C. L. Beck, and Anja Kunze. "Multi-Curvature Micropatterns Unveil Distinct Calcium and Mitochondrial Dynamics in Neuronal Networks" *Lab on a Chip*, 2021.

VI. Fellowships

Jul 2022–Jul 2027	**NSF Graduate Research Fellow (DGE-1842166)** Project: Large-scale mapping of somato-dendritic dynamics during skilled movement.
Jul 2021–Jul 2023	**NIH Graduate Training Fellow (NIH T32DC016853)** Project: Mapping intracellular rate code in CA1 neurons under auditory spatial cues.
Jan 2019–Jan 2020	**NIH Undergraduate Research Fellow (NIH P20GM103474)** Project: Using Agarose Hydrogel to Mimic Organized Neural Network Response and Mechanical Stimulus In Vitro.

VII. Conference Proceedings

1. **COSYNE (Poster)**, Montreal, QC, March 2025.
Hammad F. Khan*, Om T. Kolhe*, M. Habibimatin, E. F. Tanase, Krishna Jayant.*
Neural subspace communication across motor cortices is orgaized via traveling waves

2. **Biomedical Engineering Society Annual Meeting (Poster)**, Baltimore, MD, October 2024.
Lorenzo Cacciapuoti,***Hammad F. Khan****, S. Xiao, Krishna Jayant.*
Artificial Brains for Artificial Intelligence: Dendritic Integration Inspired Neural Networks.

3. **SfN Barrels Conference (Talk)**, Chicago, IL, October 2024.
Hammad F. Khan*, Om T. Kolhe*, M. Habibimatin, E. F. Tanase, Krishna Jayant.*
Traveling waves support dynamic rerouting of communication subspaces across the motor cortical hierarchy.

4. **SfN Conference (Poster)**, Chicago, IL, October 2024.
Om T. Kolhe, **Hammad F. Khan***, M. Habibimatin, E. F. Tanase, Krishna Jayant.*
Traveling waves enable reliable volitional motor movement.

5. **SfN Conference (Poster)**, Chicago, IL, October 2024.
L. Cacciapuoti, ***Hammad F. Khan****, S. Xiao, Krishna Jayant.*
Artificial Brains for Artificial Intelligence: Dendritic Integration Inspired Neural Networks.

6. **SfN Barrels Conference (Poster)**, Baltimore, MD, November 2023.
Hammad F. Khan**, Om Kolhe*, Meiseim Habibimatin, Krishna Jayant.* Traveling waves gate reliable volitional motor movement.

7. **SfN Conference (Poster)**, San Diego, CA, November 2022.
Hammad F. Khan*, Sayan Dutta, Saumitra Yadav, Xiaoling Chen, Tamara L. Kinzer-Ursem, Jean-Christophe Rochet, Krishna Jayant.* Prodromal phase alpha synucleinopathy-induced motor circuit dysfunction in vivo.

8. **SfN Conference (Poster)**, San Diego, CA, November 2022.
Daniel L. Gonzales, ***Hammad F. Khan****, Hayagreev V. S. Keri, Saumitra Yadav, Scott R. Pluta, Krishna Jayant.*
Mapping the cellular and sub-cellular circuit motifs underlying sensory-driven traveling waves from the cortical surface.

9. **SfN Conference (Poster)**, San Diego, CA, November 2022.
Nico Masala, Gergely Tarcsay, ***Hammad F. Khan****, Daniel L. Gonzales, Laura A. Ewell, Krishna Jayant.*
Chronic dual optical-voltage recordings from hippocampus of awake head-fixed mice.

10. **CSHL Neuronal Circuits Conference (Poster)**, Cold Spring Harbor, NY, March 2022.
Hammad F. Khan*, Sayan Dutta, Saumitra Yadav, Xiaoling Chen, Tamara L. Kinzer-Ursem, Jean-Christophe Rochet, Krishna Jayant.* Examining the coupling between beta oscillations and functional cortical ensembles in an alpha-synuclein mouse model of dementia.

11. **CSHL Neuronal Circuits Conference (Poster)**, Cold Spring Harbor, NY, March 2022.
Daniel L. Gonzales, ***Hammad F. Khan****, Scott R. Pluta, Krishna Jayant.* Transparent, flexible electrodes for mapping sensory-driven activity from the cortical surface in awake animals.

12. **Annual NCUR Conference (Talk)**, Montana State University, MT, March 2020.
Hammad Khan*, Connor Beck, Anja Kunze.* Agarose Microchannels to Study Curvature Effects in Neuronal Calcium Signaling.

13. **Annual BMES Conference (Talk)**, Philadelphia, PA, October 2019.
Hammad Khan*, Connor Beck, Anja Kunze.* Soft-gel Microchannels to Study Curvature Effects in Neuronal Calcium Signaling.

14. **Annual BMES Conference (Poster)**, Philadelphia, PA, October 2019.
Jeneane Jaber, ***Hammad Khan****, Anja Kunze.* Quantifying Magnetic Nanoparticle Movement Under Micromagnetic Field Patterns.

15. **NSF NNCI Convocation (Talk)**, Cornell University, NY, August 2019.
Hammad Khan*, Connor Beck, Anja Kunze.* Agarose microchannels to study curvature effects in neuronal calcium signaling.

16. **NIH INBRE Convocation (Poster)**, Montana State University, MT, August 2019.
Hammad Khan*, Connor Beck, Anja Kunze.* Agarose microchannels to study curvature effects in neuronal calcium signaling.

17. **Undergraduate Scholars Research Celebration (Poster)**, Montana State University, MT, May 2019.
Hammad Khan*, Anja Kunze.* Fine-tuning Agarose Concentrations towards Soft-gel based Neuro-microfluidics.

18. **IEEE Neuroengineering Conference (Poster)**, San Francisco, CA, March 2019.
Derek Judge, ***Hammad Khan****, Anja Kunze.* Neural network growth under heterogeneous magnetic gradient patterns.

IX. Leadership & Community Service

Aug 2024–Present	**Project Director, Purdue Medical, Innovation, Networking, and Design**
Jul 2024–Present	**Booth Coordinator, Purdue Institute for Integrative Neuroscience Spring Fest**
Jul 2022–Jul 2024	**Treasurer, Auditory Neuroscience Association, Purdue Chapter**
Jul 2021–Jul 2022	**Treasurer, Biomedical Graduate Student Association, Purdue Chapter**
Aug 2020–Jul 2021	**Graduate Rep., Biomedical Graduate Student Association, Purdue Chapter**
Aug 2019–Jun 2020	**Undergraduate Program Lead, Sophomore Surge Program**
Aug 2017–Jun 2019	**Undergraduate Mentor, Sophomore Surge Program**
Aug 2016–May 2017	**Senator, Residence Hall Association**