

# UPINDER KAUR

(+1)765-775-3177  $\diamond$  kauru@purdue.edu

## EDUCATION

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### **Purdue University**

Ph.D. Candidate, School of Engineering Technology

Advisor: Dr. Richard M. Voyles

West Lafayette, USA

*August 2019 - present*

*GPA: 3.96/4.00*

### **Indira Gandhi Delhi Technical University**

Masters of Technology, Robotics and Automation

Thesis Advisor: Dr. N. K. Chauhan, Dr. Sudipto Mukherjee

Delhi, India

*August 2015 - June 2017*

*Score: 90.05%*

### **Amity University**

Bachelors of Technology, Mechanical and Automation Engineering

Thesis Advisor: Dr. Gaurav Gupta

Noida, India

*August 2011 - June 2015*

*GPA: 8.82/10*

## RESEARCH EXPERIENCE

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### **Research Assistant and Lab Manager**

*Purdue University*

Aug 2019 - present

#### **Cyber-Physical Systems with Robot at the Edge**

- Created the novel RoboMal dataset for malware detection in robots. Developed a supervised and a semi-supervised malware detection framework in cyber-physical system with robot edges.
- Implemented a multi-hop two-stage network with LoRa and BLE with custom built edge and smart collar for real-time animal health tracking using ultra low-power embedded based circuitry.
- Built a 3D animal model using photogrammetry and pointcloud stitching to characterize the channel response for in-body to out-of-body communication.
- Conceptualized the optimization problem for distributing computation across CPS fog nodes.
- Actively working on an adversarial learning framework for robust malware detection and isolation in unauthenticated large-scale cyber-physical systems.
- Organized and managed the collaboration among multiple groups across three universities for timely realization of goals.

#### **Reinforcement Learning in Robots**

- Formulated an autonomous framework using the Contextual Multi-Arm Bandits (CMAB) algorithm for multimodal haptics tasks. Implemented using Python and Robot Operating System (ROS) for autonomous contour following using a Barrett gripper on the Baxter robot.
- Contributed to the conceptualization and implementation of a reinforcement learning framework for a contact intensive task without reward engineering.

#### **Machine Learning and Robotics**

- Implemented a Mask R-CNN based human detector for online path planning of a mobile robot.
- Engineered Haar-based classifier for facial authentication in a low-power wireless system.
- Created an FFT-based feature engineering framework for transfer learning among surgical robots.

### **Research Intern**

*Microsoft Research*

May 2021 - July 2021

#### **Traceability in Agricultural Supply Chains**

- Built a novel sensor-sparse system for tracking crop movement among key traceability points in agricultural supply chains.
- Designed a sensor pack with position and orientation tracking for large-volume small-grain crops for precision tracking.
- Developed a 3D simulator of the tracking system. The simulator was validated by on-field experiments.

## PROFESSIONAL EXPERIENCE

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### General Motors Technical Center

Bangalore, India

Senior Software Engineer, Electrification and Controls

August 2017-May 2019

- Developed and implemented verification and validation protocols for ECU software modules.
- Directed a team of four engineers in the design and execution of ECU memory software validation.
- Formulated algorithms for Ethernet protocol validation for vehicle ECUs.
- Trained a group of 65 colleagues in Mexico and USA in internal python-based tools.

## ACADEMIC AND PROFESSIONAL HONORS

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Chancellor's Gold Medal

2017

Vice Chancellor's Gold Medal

2017

Exemplary Performance Silver Plaque

2017

Ministry of Human Resource Development (MHRD) Scholarship

2015-2017

Academic Bronze Medal

2015

## KEY SKILLS

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- Languages: C/C++, Python, MATLAB
- ML/AI: Pytorch, Keras, Tensorflow, OpenAI Gym
- Computer Vision: OpenCV, ZED SDK
- Platforms: Linux, Windows
- Robotics: KUKA, Baxter, ROS
- Software: Gazebo, Solidworks

## MENTORING AND LEADERSHIP

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### Purdue Undergraduate Research Mentor

2019-present

- Mentored six undergraduates during Fall and Spring semesters on cyber-physical systems research.
- The research outcomes were published in international academic journals and conferences.

### Graduate Research Mentor

May 2021-August 2021

- Mentored two students under the *Purdue-Berea Undergraduate Research Internship* program.

## PUBLICATIONS

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### Book Chapter

- **Upinder Kaur**, Richard Voyles, and Shawn Donkin, 2020. "Future of Animal Welfare: Technological Innovations for Individualized Animal Care". In: Temple Grandin, ed., *Improving Animal Welfare: A Practical Approach*, 3rd ed. Wallingford: CABI.

### Journals

- **Upinder Kaur**, Xin Ma, Yunameng Huang, and Richard Voyles, "Augmented Haptic Perception with Multi-Modal Sensing for Purposeful Manipulation Using Inspection-on-the-Fly." Under review at *IEEE Robotics and Automation Letters*.
- Sangjun Eom, **Upinder Kaur**, Haozhe Zhou, David Kusuma, and Richard Voyles, "TupperwareEarth: Bringing Intelligent User Assistance to the "Internet of Kitchen Things", in *IEEE Internet of Things Journal*, doi: 10.1109/JIOT.2022.3141112.
- Chan Su Han, **Upinder Kaur**, Huiwen Bai, Barbara Roqueto dos Reis, Robin White, Robert A Nawrocki, Richard M. Voyles, Min Gyu Kang, and Shashank Priya, "Frontiers in Precision Dairy Technology I: Sensor technologies for real-time monitoring of the rumen environment", to appear in the *Journal of Dairy Science*.
- **Upinder Kaur**, Rammohan Sriramdas, Xiaotian Li, Xin Ma, Arunashish Datta, Barbara Roqueto dos Reis, Shreyas Sen, Kristy Daniels, Robin White, Richard M. Voyles, Shashank Priya, "Frontiers in Cyber-Animal Systems: Indwelling Robotics for Active Health Monitoring in Ruminants", to appear in the *Journal of Smart Agriculture Technology*.

- **Upinder Kaur**, Victor M.R. Malacco, Arunashish Datta, Lei Xin, Kristy Daniels, Robin White, Shreyas Sundaram, George Chiu, Shreyas Sen, Shawn Donkin and Richard M. Voyles, “Frontiers in Cyber-Animal Systems 4: Implementation and Integration of Precision Dairy Systems” (tentative title), in preparation for Journal of Animal Science.
- **Upinder Kaur**, Victor M.R. Malacco, Arunashish Datta, Lei Xin, Kristy Daniels, Robin White, Shreyas Sundaram, George Chiu, Shreyas Sen, Shawn Donkin and Richard M. Voyles, “IoT Systems for Sustainable Animal Agriculture and Welfare: A Survey” (tentative title), in preparation for IEEE Internet of Things.
- Haoguang Yang, Mythra V. Balakuntala, **Upinder Kaur**, Jhon J. Qui noneb, Abigayle E. Moserb, Ali Doosttalab ,Antonio Esquivel-Puentes, Tanya Purwar, Luciano Castillo, Xin Ma, Richard M. Voyles (2022). “Occupant-centric robotic air filtration and planning for classrooms for Safer school reopening amid respiratory pandemics”. Robotics and Autonomous Systems, 147, 103919.
- **Upinder Kaur**, Glebys Gonzalez, Md Masudur Rahman, Vishnunandan Venkatesh, Natalia Sanchez, Gregory Hager, Yexiang Xue, Richard Voyles, and Juan Wachs, “From the DESK (Dexterous Surgical Skill) to the Battlefield - A Robotics Exploratory Study” in Military Health System Research Symposium (Military Medicine), 2020.
- Masadur Rahman, Mythra V. Balakuntala, Glebys Gonzalez, Mridul Agarwal, **Upinder Kaur**, Vishnunandan Venkatesh, Natalia Sanchez-Tamayo, Yexian Xue, Richard Voyles, Vaneet Aggarwal, and Juan Wachs, “SARTRES: a semi-autonomous robot teleoperation environment for surgery”. Computer Methods in Biomechanics and Biomedical Engineering: Imaging Visualization, pp.1-8. 2020.
- **Upinder Kaur**, Urfi Khan, Nathi Ram Chauhan, and Sudipto Mukherjee, “Collision Detection and Inverse Dynamics Control of KUKA LBR IIWA Robot”, in International Journal of Mechatronics and Automation (IJMA), Inderscience Publishers, 2020.

#### Conferences and Workshops

- **Upinder Kaur**, Z. Berkay Celik, and Richard M. Voyles, “Robust and Energy Efficient Malware Detection for Robotic Cyber-Physical Systems”, in 13<sup>th</sup> International Conference on Cyber-Physical Systems (ICCPS), 2022.
- **Upinder Kaur**, Xin Ma, Richard M. Voyles, and Byung-Cheol Min, “Malware Detection Using Pseudo Semi-Supervised Learning”, submitted to International Conference of Pattern Recognition and Artificial Intelligence (ICPRAI), 2022.
- Datta, Arunashish, **Upinder Kaur**, Victor Malacco, Mayukh Nath, Baibhab Chatterjee, Shawn S. Donkin, Richard M. Voyles, and Shreyas Sen. ”In-body to Out-of-body Communication Channel Modeling for Ruminant Animals for Smart Animal Agriculture.” In 2021 43rd Annual International Conference of the IEEE Engineering in Medicine Biology Society (EMBC), IEEE, 2021.
- **Upinder Kaur**, Haozhe Zhou, Xiaxen Shen, Byung-Cheol Min, and Richard M. Voyles, “Robo-Mal: Malware Detection for Robot Network Systems”, in 5th Annual IEEE Robotics Computing (IRC), 2021.
- **Upinder Kaur**, Praveen Abbaraju, Harrison McCarty, and Richard Voyles, “Clutter Slices Approach for Identification-on-the-Fly of Indoor Spaces”, in Proceedings of PRAConBE, International Conference on Pattern Recognition (ICPR), 2020. (available on arxiv)
- Mythra V. Balakunthala, **Upinder Kaur**, Xin Ma, Juan Wachs and Richard Voyles, “Learning Multimodal Contact-Rich Skills from Demonstrations Without Reward Engineering”, in IEEE International Conference on Robotics and Automation (ICRA), 2021.
- Glebys Gonzalez, Mridul Agarwal, Mythra V. Balakunthala, Md Masudur Rahman, **Upinder Kaur**, Yexian Xue, Richard Voyles, Vaneet Aggarwal, V. and Juan Wachs, “DESERTS: Delay-Tolerant Semi-Autonomous Robot Teleoperation for Surgery” in IEEE International Conference on Robotics and Automation (ICRA), 2021.
- Yuanmeng Huang, Jonathan Miller, **Upinder Kaur**, Ram M.S. Ramdas, Shashank Priya, and Richard M. Voyles, “Hybridization Through Modularity: Exploring Complex Modes of Locomotion with a “Bag of Robotic Modules”, submitted in ReMAR 2021.