

PRANEET BALA

Computer Science Ph.D. Candidate

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Graduate student pursuing a Doctoral degree in Computer Science from the University of Minnesota, Twin Cities. Dedicated to incorporating Computer Vision and 3D Vision in Neuroscience to study animal behavior and improve pose estimation and tracking techniques. Searching mainly for Computer Vision, Machine Learning, and Deep Learning research positions.

PUBLICATIONS

- [1] P.Bala, J.Zimmermann, H.S.Park and B.Y.Hayden. 'Self-supervised Secondary Landmark Detection via 3D Representation Learning'. *International Journal of Computer Vision (IJCV)*, 2023
- [2] Y.Yao, P.Bala, A.Mohan, E.Bliss-Moreau, K.Coleman, S.M.Freeman, C.J.Machado, J.Raper, J.Zimmermann, B.Y.Hayden and H.S.Park. 'OpenMonkeyChallenge: Dataset and Benchmark Challenges for Pose Estimation of Non-human Primates'. *International Journal of Computer Vision (IJCV)*, 2023
- [3] P.C.Bala, B.R.Eisenreich, S.B.M.Yoo, B.Y.Hayden, H.S.Park and J.Zimmermann. 'Automated Markerless Pose Estimation in Freely Moving Macaques with OpenMonkeyStudio'. *Nature Communications*, 2020.

RESEARCH WORK

- Recovering 3D Pose from Neural Data (Python, Pytorch, Matlab)** Nov 2021 - Present
- Currently working on discerning the underlying relationship between the brain signals and the 3D pose of a subject.
 - Brain signals of a freely moving macaque are used along with the 3D pose generated from OpenMonkeyStudio to understand the correlation between them.
- OpenMonkeyChallenge: Dataset and Benchmark Challenges for Pose Estimation of Non-human Primates (Python, Tensorflow)** Jan 2022 - July 2022
- Collaborated in establishing a benchmark challenge called OpenMonkeyChallenge that facilitates community efforts to build generalizable non-human primate pose estimation models.
 - Designed and provided a new public dataset consisting of 111,529 annotated (17 body landmarks) images of non-human primates in naturalistic contexts.
- Self-supervised Secondary Landmark Detection via 3D Representation Learning (Python, Tensorflow)** Sep 2020 - Mar 2023
- Implemented a method to learn spatial relationship of primary and secondary landmarks in three-dimensional space, which can in turn self-supervise the secondary landmarks.
 - 3D representation learning is generic and can be applied to various multiview settings across diverse organisms, including macaques, humans and flies.
- Automated Markerless Pose Estimation in Freely Moving Macaques with OpenMonkeyStudio (Python, Tensorflow, Matlab)** Sep 2018 - Jun 2020
- Developed a multi-camera system to track the motion of primates in 3D space and to study their behavior.
 - The setup comprises 62 cameras mounted around an enclosure that provides multi-view image streams capable of augmenting annotated data using computer vision theory of 3D geometry.

EDUCATION

- University of Minnesota, Twin Cities** Minneapolis, MN
Ph.D. Candidate in *Computer Science*, Advisor: Dr. H.S.Park and Dr. J.Zimmermann, GPA: **3.66/4.00** Sep 2019 - Present
- University of Minnesota, Twin Cities** Minneapolis, MN
M.S. in *Computer Science*, Advisor: Dr. H.S.Park and Dr. J.Zimmermann, GPA: **3.62/4.00** Sep 2017 - May 2023
- University of Mumbai** Mumbai, India
B.E. in *Electronics Engineering*, CGPA: **8.64/10.00** July 2013 - May 2017

WORK EXPERIENCE

- Graduate Research Assistant, University of Minnesota, Twin Cities** May 2019 – Present
- Designed and built a multi-camera system comprising 62 cameras mounted around an enclosure to track the motion of primates in 3D space.
 - Implemented a real-time camera system capable of capturing images from four views and capable of calculating and visualizing the reconstructed 3D skeleton of the subject.
- Graduate Teaching Assistant, University of Minnesota, Twin Cities** Jan 2019 – May 2022
- Course assignment: CSCI 2021 (*Machine Architecture and Organization*), CSCI 4611 (*Programming Interactive Computer Graphics and Games*), CSCI 5611 (*Computer Vision*) and CSCI 3081W (*Program Design and Development*).
- Student Intern, Kaihatsu Techno Centre Private Limited, India** Jun 2016 – Aug 2016
- Explored options to find a cost-effective and optimum microcontroller for storing large amounts of data that could be easily programmed.
 - Designed and implemented a low-cost data logger system used for reading digital and analog inputs.

NOTABLE PROJECTS

- Convolutional Neural Network Performance for Object Detection in Adverse Weather Conditions (Python)** Jan 2020 - May 2020
- Analyzed the performance of Yolov4 and PointPillars on KITTI dataset and CADC dataset that comprises object data in multiple weather conditions.
- Ray Tracer (C++)** Sep 2019 - Dec 2019
- Implemented a ray tracer in C++ capable of generating photo realistic objects in 3D space with implementation of physical properties like illumination, reflection, refraction and shadows.
- Robot Goalie (ROS)** Sep 2018 - Dec 2018
- Implemented image segmentation to guide the arm of a Baxter robot to block an incoming projectile.
 - Incoming objects were tracked using Kinect camera and joint angles of the robot arm were found using inverse kinematics.
- Visual Odometry using a Stereo Camera (Python)** Jan 2018 - May 2018
- Implemented a stereo visual odometry pipeline which includes feature extraction, feature matching, triangulation of landmarks, and pose estimation using 2D-3D correspondences to estimate the camera pose and motion.
- Dynamic Mode Decomposition using Cuda C (Cuda C)** Sep 2017 - Dec 2017
- Implemented Dynamic Mode Decomposition for foreground/background segmentation in a parallel computing environment capable of computing intensive matrix operations and Singular Value Decomposition using GPU.

SKILLS

- Programming:** Python, C/C++, Matlab, Cuda C
- Frameworks & Libraries:** Tensorflow, Pytorch, Keras, Scikit-learn, OpenCV, Numpy, Matplotlib
- Languages:** English, Hindi, Marathi