

Praneet Chandrakant Bala

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EDUCATION

University of Minnesota - Twin Cities

Ph.D. Candidate, Computer Science

Minnesota, USA

Sep 2019 – May 2026 (Expected)

- Advisors: Dr. Hyun Soo Park and Dr. Jan Zimmermann

University of Minnesota - Twin Cities

M.S., Computer Science

Minnesota, USA

Sep 2017 – May 2025

- Advisors: Dr. Hyun Soo Park and Dr. Jan Zimmermann
- Thesis: *Multiview Supervision for Pose Estimation and Secondary Landmark Detection*

University of Mumbai

B.E., Electronics Engineering

Mumbai, India

Jun 2013 – May 2017

- Capstone project: *Automated Printed Circuit Board Fabrication*

WORK EXPERIENCE

Spring 2019

- Present

Graduate Research Assistant, *University of Minnesota – Twin Cities, USA*

- Built large-scale motion capture infrastructure including a 62-camera markerless system for high-fidelity 3D body tracking in unconstrained environments, releasing 3 public datasets totaling ~400,000 annotated body pose images.
- Developed real-time multi-view 3D skeleton reconstruction from synchronized camera streams, enabling live visualization of full-body motion sequences.
- Led research across 6 projects spanning 3D body pose estimation, self-supervised representation learning, generative motion modeling, and large-scale dataset creation, resulting in 4 published papers in *Nature Communications*, *IJCV*, and *eLife*.
- Designed and validated algorithms for articulated body pose estimation, 3D reconstruction, and motion across diverse subjects and environments.

Jun 2016

- Aug 2016

Student Intern, *Kaihatsu Techno Centre Pvt. Ltd., India*

- Explored options to find a cost effective and optimum microcontroller for storing large amount of data and which could be easily programmed.
- Designed and implemented a low-cost data logger system used for reading digital and analog inputs.

Dec 2015

- Jan 2016

Student Intern, *A-1 Fence Products Company Pvt. Ltd., India*

- Explored methods to detect and measure current fluctuations in a live fence.
- Designed a device to detect, amplify and measure the change in current.

PUBLICATIONS

PUBLISHED

4. P.C. Bala, J. Zimmermann, H.S. Park and B.Y. Hayden, “Self-supervised Secondary Landmark Detection via 3D Representation Learning”, *International Journal of Computer Vision*, 2023.
3. N. Desai, P. Bala, R. Richardson, J. Raper, J. Zimmermann and B.Y. Hayden, “OpenApePose: A Database of Annotated Ape Photographs for Pose Estimation”, *eLife*, 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*, 2023.
1. P. 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.

REVIEW

1. P. Bala, J. Zimmermann and H.S. Park, “Learning to Forecast Domain Aware 3D Body Motion by Watching Single View Videos”, *European Conference on Computer Vision (ECCV)*, 2026.

RESEARCH WORK

Learning to Forecast Domain Aware 3D Body Motion by Watching Single View Domain Videos 07/2024 - Present

- Developed a self-supervised framework to predict 3D body motion from monocular video without 3D annotations, enabling scalable motion forecasting across diverse domains.
- Combined a spatiotemporal transformer with latent diffusion to model realistic short and long-term body dynamics, reducing error accumulation in extended motion sequences.
- Extending current framework to incorporate SMPL-based body shape and pose priors for improved anatomical plausibility. (Submitted to ECCV and is under review)

OpenMonkeyChallenge: Dataset and Benchmark Challenges for Pose Estimation of Non-human Primates 01/2022 - 03/2023

- Designed and released a large-scale benchmark for articulated body pose estimation across diverse subjects and naturalistic conditions.
- Dataset contains 111,529 annotated images with 17 body landmarks, enabling community-wide progress on generalizable pose estimation models

Self-supervised Secondary Landmark Detection via 3D Representation Learning 09/2020 - 03/2023

- Developed a self-supervised method using 3D representation learning and contrastive learning to detect anatomically consistent secondary landmarks without manual annotation.
- Validated generalization across species and body configurations, demonstrating applicability to diverse articulated body models.

Automated Markerless Pose Estimation in Freely Moving Macaques with OpenMonkeyStudio 09/2018 - 06/2020

- Engineered a 62-camera markerless motion capture system for high-fidelity 3D body tracking in unconstrained environments.
- Built a public dataset of 195,228 multi-view pose annotations across diverse motion sequences, supporting research in 3D body reconstruction and behavior analysis.

SELECTED PROJECTS

3D Scene Reconstruction via Gaussian Splatting (Independent Project) 10/2025 - Present

- Built a video-to-3D reconstruction pipeline using COLMAP and Gaussian Splatting, enabling high-fidelity neural rendering and scene-level optimization from monocular turntable sequences.
- Evaluated novel view synthesis quality against NeRF-style baselines.

CLIP-Guided Pose-Conditioned Image Generation with ControlNet (Python, PyTorch) 03/2024 - 10/2024

- Fine-tuned Stable Diffusion via ControlNet on 80,000 body pose images, conditioning generation on 2D pose control signals and CLIP text embeddings.
- Demonstrated pose-conditioned generative modeling of articulated body configurations across appearance variations.

Ray Tracer 09/2019 - 12/2019

- Implemented a physically-based ray tracer from scratch, simulating light transport including shadows, reflections, and refractions on 3D surfaces.
- Demonstrated understanding of rendering fundamentals directly applicable to photorealistic 3D human visualization.

Visual Odometry using a Stereo Camera 02/2018 - 05/2018

- Developed a *stereo visual odometry* pipeline to estimate camera pose and motion using image features.
- Implemented feature extraction, matching, triangulation, and pose estimation with 2D-3D correspondences.
- Validated on the *KITTI* dataset and tested with real-world data from a *ZED* camera.

SKILLS

Generative & Foundation Models: Diffusion Models, ControlNet, CLIP-guided generation, Spatiotemporal Transformers, Contrastive Learning, Self-supervised Learning, Domain Adaptation, Multimodal Learning, Motion Forecasting, Generative Human Motion Modeling

3D Vision & Rendering: Gaussian Splatting, NeRF-style neural rendering, COLMAP (SfM), 3D Reconstruction, Multi-view Geometry, Pose Estimation, Parametric Body Models (SMPL), Visual Odometry, Depth Estimation, Scene Understanding, Computer Graphics

Systems & Frameworks: Python (NumPy, Pandas, Matplotlib, Scikit-learn), C/C++, PyTorch, TensorFlow, Keras, CUDA C, OpenCV, OpenGL, Blender, Unreal Engine, MATLAB, Git

TEACHING EXPERIENCE

Spring 2024	CSCI 3081W: Program Design & Development, Teaching Assistant
Fall 2023	CSCI 3081W: Program Design & Development, Teaching Assistant
Spring 2021	CSCI 5561: Computer Vision, Teaching Assistant
Spring 2019	CSCI 4611: Programming Graphics and Games, Teaching Assistant
Spring 2019	CSCI 2021: Machine Architecture and Organization, Teaching Assistant

PROFESSIONAL SERVICE

Reviewer: CVPR '24 '23 '22, IJCV '22 '24 '25, TPAMI '25 (Recognized with certification)

Invited talks:

- Delivered a seminar on *Automated Markerless Pose Estimation in Freely Moving Macaques with OpenMonkeyStudio* at University of Minnesota, Twin Cities as part of the *Center for Neuroengineering* seminar series
- Delivered a talk on *Automated Markerless Pose Estimation in Freely Moving Macaques with OpenMonkeyStudio* at University of Minnesota, Twin Cities as part of the *UMN Visual Computing & AI* seminar series.

SCHOLASTIC ACHIEVEMENTS

- Secured 3rd position at the *International Symposium on Internet of Things* organized by Lab-X foundation in collaboration with *IEEE*.
- Drafted patent application for an automated food preparation system; received college grant of Rs.10,000 for development.
- Received J.R.D. Tata Trust Meritorious Performer Scholarship.