TARUN SHARMA

LinkedIn: https://www.linkedin.com/in/tarun-sharma1/ Phone: (401)-954-8483
Website: https://tarunsharma1.github.io/ Email: tarunsharma.pes@gmail.com
Google Scholar: http://tinyurl.com/tarunsharma1

About: I am a PhD student at Caltech working on computer vision research and applications to animal monitoring, tracking, and behavior. I have extensive experience in programming, experimental design, and field work. I often work on noisy real world and long tailed image and video datasets. I have served as an instructor/TA for multiple years for the Computer Vision for Ecology (CV4E) workshop providing hands on mentorship to students working on various computer vision applications for ecology and have also organized the Computational Sustainability (CompSust) workshop at NeurIPS.

EDUCATION

Caltech, Pasadena Sept 2018 – Present
PhD in Computation and Neural Systems GPA: 4.2/4.0
Research: Computer vision, self-supervised learning, detection, multi-object tracking, animal behavior

PESIT, Bangalore, India Aug 2013 – May 2017
B.E in Computer Science and Engineering GPA: 9.4/10.0
Relevant Courses: Design and Analysis of Algorithms, Advanced Machine Learning, Software Engineering, Advanced Data Structures.

SKILLS

Skills: Computer vision - object detection, multi-object tracking, self-supervised learning, weak supervision, human in the loop training, long tailed distribution; machine learning, NLP, temporal data analysis and visualization, animal behavioral analysis.
Languages and Technologies: Python, Java, Matlab, LATEX, Inkscape, Blender, Unity.
Frameworks and Libraries: PyTorch, Tensorflow, Keras, OpenCV, ROS, NumPy, Scikit-learn, Matplotlib.
Cloud Platforms: AWS Sagemaker, AWS EC2.
Hardware: Raspberry Pi and add-on boards, sensors and cameras; Arduino and IMUs, CircuitPython, I2C protocol, G-code.

WORK EXPERIENCE

Intern, Monterey Bay Aquarium Research Institute (MBARI) June 2023 – Aug 2023

- Compared multiple self-supervised and semi-supervised computer vision approaches for making use of unannotated data for animal detection in real world underwater datasets exhibiting long tail distributions.
- Trained a robust generalized animal detector currently being used by the in-house team. Achieved a 100 % increase in balanced accuracy score for classification of animals when unlabeled data is used for contrastive pretraining. Published our results in a CVPR workshop paper.

Research Assistant, Brown University Aug 2017 – June 2018

- Worked in the lab of Professor Thomas Serre to study memory guided changes in attention in children by analyzing eye tracker video data using computer vision methods such as object detection. This involved multiple rounds of collecting data, training computer vision pipelines, evaluating, bootstrapping, and refining performance.
- Worked with a team on deployment and active maintenance of a computer vision pipeline for the automated behavioral analysis of mice for ALS research on the university cluster.
- Worked on a range of other computer vision projects like automated analysis of zebrafish behavior on a Raspberry Pi, predicting action potentials from video data, and comparing computer and human visual saliency maps. Resulted in publishing 3 papers and 1 preprint.
- Compared performance of different deep neural networks trained to reconstruct 3D surface normal maps at different resolutions using rendered data. Used visualization tools to investigate representations learned.

Intern, SAP Labs, Bangalore, India Jan 2017 – June 2017

- Worked on the thematic segmentation of text data using recurrent neural networks in order to automatically break up company onboarding and training videos into short chapters for maximizing engagement.
- Proposed a strategy to combine the results of our machine learning model with additional contextual cues. This prototype project resulted in a company patent.

Intern, MadStreetDen, Chennai, India May 2015 – Aug 2015

- Worked on using machine vision to make a navigational assistive system for the visually impaired that would run on a smartphone. Used traditional image processing algorithms such as dense optic flow and motion parallax cues to estimate approaching obstacles from a single camera. Also worked on object identification using feedforward neural networks and face recognition algorithms.
- We were successfully able to demonstrate a working prototype with real-time obstacle detection and classification using a single camera resulting in a published paper.

Dissertation Projects

Ant monitoring using computer vision, Prof. Joseph Parker 2023-Present

- Working on the design, assembly, modification and deployment of custom Raspberry Pi based multi-sensor field camera units positioned in front of ant colonies in the Angeles National Forest.
- Using weak supervision, object detection and multi-object tracking to gain insights into ant behavior and ecology with minimal human labeling. Research in weak supervision, domain generalization, detection in densely crowded scenes.

Flight and gaze stabilization system of fruit flies, Prof. Michael Dickinson 2018-2023

- Worked on modifying and testing a rotating experimental arena consisting of a servo motor, IMU sensors and wing and head tracking cameras.
- Used a multi-slice scan of a fly head to create a 3D model in Blender and generated synthetic rendered data to predict 3D head position from a single view.
- Worked on data collection and subsequent analysis using computer vision pose estimation, edge-based wing tracking algorithms and Fourier transforms to analyze and quantify temporal data, to provide direct evidence that the magnitude of head and wing stabilization behavioral response is a direct function of the number of mechanosensory cells silenced.

Selected Publications

- **Tarun Sharma**, Danelle E. Cline, Duane Edgington (2024) **Making use of unlabeled data: Comparing strategies for marine animal detection in long-tailed datasets using self-supervised and semi-supervised pre-training**. CVPR workshop proceedings 2024, pp. 1224-1233.
- **Tarun Sharma**, Julian M. Wagner, Sara M. Beery, William B. Dickson, Michael H. Dickinson, Joseph Parker (2024) **Monitoring Social Insect Activity with Minimal Human Supervision**. CVPR workshop proceedings 2024, pp. 1244-1253.
- Elijah Cole, Suzanne Stathatos, Bjorn Lutjens, **Tarun Sharma**, Justin Kay, Jason Parham, Benjamin Kellenberger, Sara Beery, (2023) **Teaching Computer Vision for Ecology**. arXiv:2301.02211
- Linsley, D., Eberhardt, S., **Sharma, T**., Gupta, P., Serre, T., (2017) **What Are the Visual Features Underlying Human Versus Machine Vision?** Proceedings of ICCV Workshops 2017, pp. 2706-2714
- **Sharma, T.**, Apoorva, J.H.M, Lakshmanan, R., Gogia, P., Kondapaka, M., (2016) **NAVI: Navigation aid for the visually impaired**. IEEE Xplore, doi:10.1109/CCAA.2016.7813856
- Kotri, J., **Sharma, T**., Kejriwal, S., Dasari, Y., Abinaya, S., (2019) **Thematic Segmentation of Long Content using Deep Learning and Contextual Cues.** US Patent. Patent number: US 10,339,922 B2
- Govindarajan, L., **Sharma, T.**, Colwill, R., Serre, T., (2018) **Neural Computing on a Raspberry Pi: Applications to Zebrafish Behavior Monitoring**. Proceedings of VAIB 2018, Corpus ID: 52950335
- Suresh, S., **Sharma, T.**, Prashanth, T.K, Subramaniam, V., Sitaram, D., Nirupama, M., (2016) **Towards quantifying the amount of uncollected garbage through image analysis**. Proceedings of ICVGIP 2016, doi:10.1145/3009977.3010061

Awards

- Chen Graduate Innovator Grant (2020), Chen Institute, Caltech
- Runner up at "What the Hack 2.0" (2014), SAP Labs India
- Best Out of the Box Idea (2015), SimpliLearn Solutions India
- Certificate of Recognition (2014), Microsoft Corporation India for computer vision app with 30k+ downloads.
- Certificate of Appreciation (2015), MIT Media Labs and L.V Prasad Eye Institute

Leadership Roles and Teaching Experience

- Co-organizer of NeurIPS Workshop on Computational Sustainability: CompSust (2023), NeurIPS
- President of Neurotechers (2022 – 2023), Caltech
- Co-organizer and TA for Computer Vision for Ecology Summer School (2022 and 2023), Caltech
- TA for BE/Bi 106: Comparative Biomechanics (2021), Caltech

Presentations and Invited Talks

- Making use of unlabeled data (2024), Scripps Institute of Oceanography Machine Learners Group seminar series.
- Analyzing data using Machine Learning (2023), DataSAI for Neuroscience Summer School, Caltech
- Machine Learning for Conservation (2022), HumaniTech class, Georgia Tech
- Monitoring Social Insect Activity with Minimal Human Supervision (2022), CompSust, Caltech
- Naturalistic behavior repertoires of the praying mantis (2021), Chen Graduate Innovator Symposium, Caltech
- Towards Quantifying the Amount of Uncollected Garbage through Image Analysis (2016), ICVGIP, India