Skanda Bharadwaj

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Research Interests

Computer Vision, Representation Learning, Object Detection and Tracking

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Education

M.S., Computer Science, The Pennsylvania State University, Pennsylvania, USA, 2021

- Thesis: Motion Estimation in Ultrasound Image Sequences: A Deep Learning Approach
- Advisor: Professor Mohamed Almekkawy
- GPA: 3.96/4.0

B.E., Telecommunication Engineering, PES Institute of Technology, Bangalore, India, 2015

- Final year Project: Detection and Localization of Dynamite Fishing
- Advisor: Professor Koshy George
- GPA: 9.39/10.0

Graduate Research Work

Master's Thesis

- Landmark Tracking in Ultrasound Images Using Similarity Learning *(Publication)*
  - Performed motion estimation in ultrasound image sequences using a deep learning-based object tracker.
  - Employed a linear and non-linear motion models for accurate tracking.
  - Designed Linear and Extended Kalman Filter to incorporate the aforementioned motion model for robust landmarking tracking.
  - Novelty of this project is that we prove that a Siamese architecture-based deep learning network can be used to track objects in ultrasound images, which are not RGB images but are RF data. Further, we propose enhancements to the existing deep learning tracker to increase accuracy of tracking.

- Faster Search Algorithm for Speckle Tracking in Ultrasound Images *(Publication)*
  - Improved on exhaustive search strategy, which is the most commonly used search technique for similarity matching in ultrasound images.
  - Adopted a faster search algorithm called the Adaptive Rood Pattern Search (ARPS) along with sub-pixel accurate matching to enhance the performance.
  - Novelty of this project was in bridging the gap between techniques used by the computer vision community and the ultrasound community.

Interdisciplinary Research Work

- Analysis of Crack Damage in Alloy Structures Using Deep Learning *(Publication)*
  - This work was in collaboration with the Mechanical Department of Penn State. Fatigue crack damage analysis in poly-crystalline alloy structures is done manually, which requires a tremendous amount of man-power. In addition, manual inspection of cracks are often erroneous.
  - Automated the process of crack identification and classification with the use of convolutional neural networks. In addition, classified crack were reported as high risk or low risk.
  - Novelty of this project was bringing computer vision techniques to eliminate the need of man-power in addition to improving the accuracy of classification of cracks damage.

Teaching

- **Teaching Assistant** CMPEN454 — Fundamentals of Computer Vision — Fall 2020
- **Teaching Assistant** CMPEN454 — Fundamentals of Computer Vision — Spring 2020
- **Teaching Assistant** CMPSC101 — Introduction to Programming in Python — Fall 2019

Graduate Projects

Improving SiamFC

- Considered limitations of SiamFC (Fully-Convolutional Siamese Networks) such as missing motion model and sensitivity towards drastic changes to the appearance model.
- Implemented modules to overcome the aforementioned limitations. Linear Kalman Filter was used to incorporate motion model. Anchoring based reference image update was employed to make the tracker robust towards drastic changes of the reference object.

Augmented Reality Viewer

- Displayed artificial objects overlaid on images of a real 3D scene.
- Key aspects of the projects were, 3D reconstruction to recover point cloud, RANSAC-based plane fitting, creating and placing virtual object in the scene, 3D-to-2D camera projection with Z-ordering.

Unit Lattice Identification in Symmetric Wallpapers

- Performed detection and localization of unit lattices in symmetric images without foreground background distinction. Region proposal network was used to achieve the goal.
- Key aspects of the project were, transfer learning, localization, NMS and t-SNE analysis.

Work Experience

LinkedIn Profile: https://www.linkedin.com/in/skandabharadwaj/

Executive Engineer, Continental,
Dept. of Computer Vision, ADAS, Bangalore, India Jul 2015 – Dec 2018

- Played a key role in the development of multi-object tracking using Extended Kalman Filter for Traffic Sign Recognition component for automotive cameras.
- Extended technical support to BMW, Toyota and Honda projects for tracker based issues.
- Developed mathematical models for road-marking sign recognition, uncertainty estimation and automation tools to evaluate tracker performance for accurate depth estimation.
- Contributed significantly for the invention disclosure "Road Marking Recognition System for Automated Driving using Deep Learning".

Research Fellow, PES Institute of Technology
PES Center for Intelligent Systems, Bangalore, India Dec 2014 – May 2017

- Developed real-time pattern classification models using neural networks without feature extraction.
- Developed cognitive and meta-cognitive systems based on the human cognitive learning model.

Project Intern, Indian Institute of Science (IISc)
Dept. of Electronic Systems and Engineering, Bangalore, India Jan 2015 – Jul 2015

- Implemented neural networks for acoustics signal classification.
- Specifically, designed neural networks to detect and localize dynamite blasts to curb blast fishing.

Honors and Awards

- HackPSU 2019 Runner up, *The Pennsylvania State Univeristy* November 2019
- MRD Scholarship for Academic Excellence, *PES Institute of Technology* May 2015
- Best Project Award, Intra-college Technical Fest, *PES Institute of Technology* January 2016
- Intel India Academic Forum 2015 - Intel Innovation Showcase, *Intel India* November 2015

Selected Presentations

Acoustics Virtually Everywhere Virtual Meeting, Dec 2020

- Our research on motion estimation of carotid artery wall has been selected for a presentation at *The 179th Meeting of the Acoustical Society of America*.
- Proposed method incorporates a Linear Kalman Filter along with SiamFC to track the longitudinal section of the carotid artery. It is shown that the proposed methods performs better the the conventional methods used in ultrasound imaging.

Carnegie Mellon Forum on Biomedical Engineering Carnegie Mellon University, Sept 2019

- Our research on faster search algorithm for ultrsound block matcing was selected for presentation held at the Carnegie Mellon Forum on Biomedical Engineering at the Carnegie Mellon University.

Publications

Google Scholar Profile: https://scholar.google.co.in/citations?hl=en&user=01sWB8sAAAAJ

1. **Skanda Bharadwaj**, Sumukha Prasad, Mohamed Almekkawy, "An Upgraded Siamese Neural Network for Motion Tracking in Ultrasound Image Sequences", *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control (UFFC)* 68(12):3515–3527, 2021.

2. **Skanda Bharadwaj**, Mohamed Almekkawy, "Arterial Wall Motion Estimation in Carotid Artery Using Deep Learning with Extended Kalman Filter," in *2021 IEEE Signal Processing in Medicine and Biology Symposium (SPMB)*. IEEE, 2021.

3. **Skanda Bharadwaj** and Mohamed Almekkawy, "Deep learning based motion tracking of ultrasound image sequences," in *2020 IEEE International Ultrasonics Symposium (IUS)*. IEEE, 2020.

4. **Skanda Bharadwaj** and Mohamed Almekkawy, "Faster search algorithm for speckle tracking in ultrasound images," in *2020 42nd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*. IEEE, 2020, pp. 2142–2146.

5. Hassan Alqahtani, **Skanda Bharadwaj**, and Asok Ray, "Classification of fatigue crack damage in polycrystalline alloy structures using convolutional neural networks," Engineering Failure Analysis (2020): 104908

6. **Skanda Bharadwaj**, R Chandan Kumar, BN Sumukha, and Koshy George, "Pattern classification with meta-cognition and online sequential learning algorithm," in *2017 International Joint Conference on Neural Networks (IJCNN)*. IEEE, 2017, pp. 1932–1939.

7. BN Sumukha, R Chandan Kumar, **Skanda Bharadwaj**, and Koshy George, "Online peak detection in photoplethysmogram signals using sequential learning algorithm," in *2017 International Joint Conference on Neural Networks (IJCNN)*. IEEE, 2017, pp. 1313–1320.

8. **Skanda Bharadwaj**, R Chandan Kumar, BN Sumukha, and Koshy George, "A self-monitoring online sequential learning mechanism for feedfoward neural networks," in *2016 2nd International Conference on Contemporary Computing and Informatics (IC3I)*. IEEE, 2016, pp. 23–28.

9. BN Sumukha, R Chandan Kumar, **Skanda Bharadwaj**, and Koshy George, "A novel approach to peak detection using sequential learning algorithm," in *2016 2nd International Conference on Contemporary Computing and Informatics (IC3I)*. IEEE, 2016, pp. 862–867.

10. R Chandan Kumar, **Skanda Bharadwaj**, BN Sumukha, and Koshy George, "Human activity recognition in cognitive environments using sequential elm," in *2016 Second International Conference on Cognitive Computing and Information Processing (CCIP)*. IEEE, 2016, pp. 1–6.

11. **Skanda Bharadwaj**, BN Sumukha, R Chandan Kumar, Sagar Simha, HS Jamadagni, and K George, "A methodology for detection and localization of dynamite fishing," in *2015 Annual IEEE India Conference (INDICON)*. IEEE, 2015, pp. 1–6.