Akash Karthikeyan

Student Researcher

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Education

Thiagarajar College of Engineering *Madurai, IN*

Bachelor of Mechanical Engineering Jun. 2019 - May. 2023

CGPA : 9.33/10.00

Government Aided (Autonomous) Institution and affiliated to Anna University, India

Lalaji Memorial Omega International School *Chennai, IN*

Higher Secondary 2017 - 2019

All India Secondary School Examination - 92.4% **All India Secondary School Examination -** 10 **GPA**

Research Interest

Robotics Perception | Multi-Agent Robotic Systems | Optimal Control | Neural Radiance Fields | Motion Forecating/ Path Planning

Technical Skills

Programming	Python, Robotic Operating System, MATLAB, Pytorch & TensorFlow, C
Design and Analysis Softwares	SolidWorks, CREO, Ansys Fluent, Ansys Workbench, COMSOL Multiphysics, HyperWorks
Animation & Typesetting	Unreal Engine, Blender, Gazebo,LaTeX
Miscellaneous	GCP, Docker, Singularity, SLURM
Languages	Tamil (Native), English, Hindi

Publications

[1] Tianshu Kuai, **Akash Karthikeyan**, Yash Kant, Ashkan Mirzaei, Igor Gilitschenski "CAMM: Building Category-agnostic and Animatable 3D Models from Monocular Videos" *Under Review*, 2023

[2] **Akash Karthikeyan**, Saravana Perumaal Subramanian. "Automated Annotation and Classification of Catheters in Chest X-Rays" *International Conference on Computer, Communication, and Signal Processing*, 2022 [Link]

Research Experience

Summer Research Intern *Toronto, CA*

Intelligent Systems Lab, University of Toronto Feb. 2022 - Present

- ***Guide: Prof. Igor Gilitschenski***
- Kinematic chain-based Animatable and Class-agnostic meshes from casual monocular videos without any priors or camera poses
- Design of forward and backward warping neural blend skinning functions to allow differentiable and invertible deformations.
- Introduced DINO features based class agnostic features to improve long range correspondences and thereby optimize camera poses
- Use of COLMAP and other off-shelf SfM based approaches to initialize camera poses and optimize the same with the feature correspondences
- **Keywords: NeRF Neural Blend Skinning Camera pose optimisation** [Link]

Student Researcher *Madurai, IN*

Vision Systems Lab, TCE Feb. 2020 - Present

- ***Guide: Prof. S.Saravana Perumaal***
- Depth/3D Shape estimation of objects using multi-view posed RGB images
- Obtain system information and camera poses of videos based on the learned correspondences.
- Reconstruct the same in CAD and allow future redesigning from scans
- Implementation of SLAM + RRT based approaches for autonomous navigation in GPS denied regions rendered the experiments with the help of AIRSIM and ROS Wrapper
- **Keywords: SLAM Motion Forecasting Physics and Social Aware Trajectory Generation** [Link]

Yukta Racing *Madurai, IN*

Lead Steering Sub-system Jun. 2020 - May. 2022

- ***Faculty Coordinator: Prof. A. Samuel Raja***
- Developing Numerical G-G diagram for design parameter exploration and to better understand vehicle dynamics (primarily on cornering - avoiding oversteer via adjusting lateral grip)
- Design and Manufacture with high degree of precision for the following components: steering wheel, steering column tie rod, C-Clamps; pedal tray, braking system, and safety gear for the car and drivers
- In-house assembly of Kart and testing [Report] [Link]

Summer Research Intern *Ropar, IN*

Indian Institute of Technology Jun. 2021 – Jul. 2021

- ***Faculty Coordinator: Prof. Neeraj Goel***
- AI - CPS for Agriculture Automation
- Developed mobile based application for indigenous plant disease classification and develop CPS framework to automate the same.
- **Tech Stack** : Python [Tensorflow/ TFLite] | Flutter [Dart] [Link] [More info]

Science Residency Program *Chennai, IN*

Indian Institute of Technology May. 2018 – Jun. 2018

- Device and characterization of environmental friendly material in Exploit.
- Metal-Organic Frameworks as advanced moisture sorbents for energy-efficient high temperature cooling
- Design and Fabrication of Sustainable Air cooler
- **Tech Stack** : Solidworks and COMSOL Multi-physics [More info]

Research Grants

Globalink Research Intern *[More info]*

MITACS & All India Council for Technical Education 2022

- Multi-modal and multi-sensory representation learning for robotics.
- Awarded a sum of **12,000 CAD** towards MITACS GRI internship [Link]
- Entitled for Global Graduate Fellowship worth **15,000 CAD** to pursue my graduate studies in Canada

Title Winner | India Academia Connect AI Hackathon *[Slides]*

NVIDIA 2021

- Realtime Pose, action recognition; Joint Detection and Embedding for fast multi-object tracking (Rendered @30 FPS)
- Won the coveted cash prize of **2 Lakhs INR** [Link]
- Over 500 teams from All over India

Tamil Nadu Student Innovator | Winner *Chennai, IN*

Entrepreneurship Development Institute of India 2020

- Won a seed grant of 1 lakh INR [Link]
- Designed and Fabrication of in-house Low cost ventilation system - Metal Organic Framework (amphiphilic) for high temperature cooling
- Pilot-project of the same undergoing in Thangalancheri - Madurai, IN

Rural Development Fund *Chennai, IN*

Ministry of Agriculture 2020

- Proposed Project under MRTI - Rural Development Fund - 4.6 lacs INR [Link]
- Innowah Finalist students were given a grant of 10,000 INR and provided support for incubation at IITM - Research Park

COVID 19 Research Grant *[Data]*

Google Cloud Platform 2020

- Awarded a sum of 1600 USD [Link]
- Automated annotation and classification of Catheters, Heatmap generation of catheter endtips for verification of insertions and placement via Chest X-Rays.
- This helps automating the labour intensive task of post-verification of catheter insertions by radiologist. This can also be extended to a instance segmentation task on CXR's or Ultrasound images to help autonomous catheter insertions.

Lyft - Level 5 *[Github]*

Build motion prediction models for self-driving vehicles 2020

- Awarded 300 USD for training and prototyping of NN models for motion forecasting in vehicles
- Also building of rasterizer to enable quickly process BEV images to process angent dynamics and forecast using convnets. [Link]
- Development of Vectornet architecture (vectorized agent dynamics and mapping) to forecast the motion (based on realtime datasets from Lyft) [Link] [Model]

Research Projects

Google Landmark Recognition Challenge *[Code]*

Google 2021

- Used DELF and DOLG based approches to find and extract features
- Use of Additive Angular Margin Loss (ArcFace), and other Bag-of-tricks from person re-identification
- Random Erasing, label smooth, triplet loss, IBN-extension.
- Hosted as a part of ICCV 2021 [kaggle]
- Placed 58/392 participants

Google Smartphone Decimeter Challenge *[Link]*

Google 2021

- Improve high precision GNSS positioning and navigation accuracy on smartphones [Model]
- Process and clean the GNSS logs to compute location down to decimeter or even centimeter resolution placed 94/810
- Making 2D image input with Short Time Fourier Transform, STFT, and then using ImageNet convolutional neural network
- Use of Kalman smoothening and constant velocity heading model to improve accuracy of GNSS data, more visualization in repo

ROS - Wrapper for Autonomous Landing

AirSim 2022

- I was involved in detection and tracking of helipad (Pose-estimation task based)
- Use of mpc-controller for giving setpoints to the firefly
- Ported the same environment to PX4 and AirSim with the help of ROS wrappers and thus extending the tasks to online segmentation, surveying and Simultaneous Localization and Mapping
- The above can still be extended to various application of field robotics and swarm based applications to execute surveying and for VIO and loop closure detections

Segment and label helmets in video footage *[Link] [Video]*

The National Football League 2022

- Detector to find helmets, Image2Map (BEV)
- Classifier to classify players into 2(H/V) teams and Registration of detected players on 2D map to provided tracking data. Later track detected bounding boxes and reassign players.
- Predict the 2022 College Men's Basketball Tournament
- Analyse the trend based on past 5 year's data

TensorFlow - Help Protect the Great Barrier Reef *[Link]*

TensorFlow 2022

- Use of Optical flow to track the detected objects in a video sequence to improve confidence
- Finding homography matrix and then apply the matrix to get the box in the current frame.
- Use of Weighted box fusion and augmentation techniques to get better scores

G2Net Gravitational Wave Detection

European Gravitational Observatory - EGO 2021

- Find gravitational wave signals from binary black hole collisions
- FFT pre-processsing and 1D-CNN model
- Placed 33/1219 participants

Optical Characterises of Low power solar cell for space application *[XRD]*

Interdisciplinary Nano Research Centre - SVCE 2020

- DC/ RF sputtering for fabrication of **ZnO thin-film** semi-conductor devices with custom mask.
- Investigation or study or analysis of Structural and optical characteristics of **sputtered MoS_2 thin film** with annealing for PV applications or for flexible opto-electronic devices

Under Actuated robotic hand *[Video]*

TCE - Mechanical Engineering 2020

- Modeling and fabrication of a new 3D printable robotic hand for the humanoid robot
- 7 DOF and cost economic solution

Nanophotonic-Enabled Solar Membrane Distillation *[Slides]*

Off-grid Purification 2021

- Design and Fabrication of Membrane bound distillation
- XRD and RAMAN analysis of thus fabricated membrane and to perform characterization of the same.
- The same membrane bound approach was further tried out with a help of cross-flow shell type heat-exchanger to improve efficieny

Indian National Space Settlement Design Competition *[Link]*

ARSSDC & NASA 2018

- Design and build the first space settlement to establish large-scale industrial operations in cis-lunar space
- Acted as team lead and succesfully submitted proposal for a complete design comprising of sub-system level innovations ranging from thrusters to initial habitat establishment at Moon's largest crater.

Bag-Valve Mask ventilator *[Slides] [Assembly]*

Automatic pressure controlled Ventilator 2022

- Design and prototype a slider-crank based actuation mechanism to automate the compression in BVM ventilator.
- Performed Pressure trajectory analysis to achieve required PIP and PEEP values at outlet with the help of COMSOL multiphysics module

MMDet Toolkit *[Link]*

Sartorius - Cell Instance Segmentation 2022

- Detect single neuronal cells in microscopy images.

Awards and Honors

May.-Sep. 2022	**Fellowship**: "MITACS GRI "	*Toronto*
Nov. 2021	**Contest**: First Place in "India Academia Connect AI Hackathon"	*India*
Nov. 2020	**Contest**: Finalist in "Innowah IIT Madras"	*Chennai*
Aug. 2020	**Honorary Title**: "Tamil Nadu Student Innovator"	*Chennai*
Jun. 2018	**Honorary Title**: "Young Environmental Scientist"	*Chennai*
2017, 2018	**Honorary Title**: "Student of the Year"	*Chennai*

Position of Responsibilities

MITACS Global Research Fellow

Globalink Reseach Fellow 2022 - Present

- Alumnus of MITACS GRI program help incoming interns to have a better onboarding experience and help guide them towards smooth start of their projects and collaborations

TCE- TBI *Madurai, IN*

Mentorship and Teaching 2020 - 2023

- Mentoring of various potential interdisciplinary projects, helping students to build proof of concept, later develop market ready products.
- Institute Student Mentorship Programme (mentored 12 freshmen)
- **18ES390 – DESIGN THINKING :** Department Academic Mentorship Programme (mentored 6 sophomores)

National Cadet Corps *Chennai, IN*

Pilot Sergent 2015 - 2017

- Best outgoing cadet 2017
- Participated and won in cross-country marathons in CATC/RDC camps.

References

MITACS - Globalink *Toronto, CA*

Toronto Intellignet Systems Lab

Director - Thiagarajar College of Engineering

- **Prof. Igor Gilitschenski**
  Ph. D, Assistant Professor, Department of Computer Science, University of Toronto,
  ✉ igor@gilitschenski.org

Thiagarajar Business Incubator *Madurai, IN*

Director - Thiagarajar College of Engineering

- **Prof. V.Abhaikumar**
  Ph. D, Professor (Retd.), Department of Electronics and Communication Engineering, Thiagarajar College of Engineering
  ✉ tbi@tce.edu

Department of Mechanical Engineering *Madurai, IN*

Head of Department

- **Prof. A. Valan Arasu**
  Ph. D, Professor, Thiagarajar College of Engineering,
  ✉ avamech@tce.edu

Vision Systems Lab *Madurai, IN*

Principal Investigator

- **Prof. S. Saravana Perumal**
  Ph. D, Assistant Professor, Department of Mechanical Engineering, Thiagarajar College of Engineering,
  ✉ sspmech@tce.edu