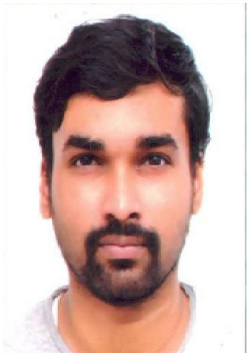
# IIIT Hyderabad - Robotics Research Center Faculty Profile

## K Madhava Krishna:

Robotic Vision, Mobile & Aerial Robotics, ML in Robotics



## Spandan Roy:

Adaptive Control, Robotics and Control

## Harikumar k:

Aerial Robotics, Multi Robotic Systems, RL

## Nagamanikandan G:

Dynamics, Mechanism Design and Control

## Associated Faculty:

**Vineet Gandhi** : Computer Vision, DL, Language and Vision

**Avinash Sharma**: Computer Vision, Graph Theory

**Ravi Kiran:** Computer Vision, Deep Learning

**Startup Collaborators:**

Marut Drones

Thanos Technologies

**Industry Collaborations:**

Mathworks

TCS

Rockwell Collins

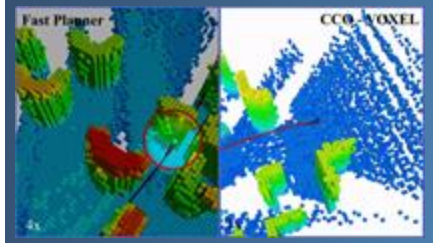
AIRBUS

# Robotics Research Center

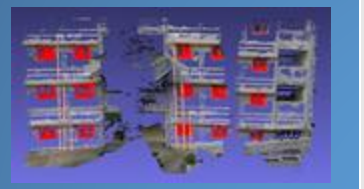
R&D Showcase 2022

## Research Highlights

ROBUSTIFYING PAYLOAD CARRYING OPERATION UNDER TIME VARYING STATE CONSTRAINTS AND UNCERTAINTY *(IROS 2020) (IROS 2021) (RA-L 2021)*




CCO-VOXEL: Chance Constrained Optimization over Uncertain Voxel-Grid Representation for Safe Trajectory Planning*(ICRA 2022)*



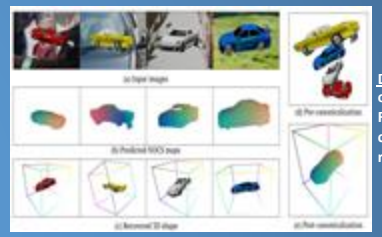
Identifying and estimating salient parameters of a building using UAV-based remote sensing

### Areas of Work

- 3D Reconstruction
- Aerial Robotics
- Autonomous Navigation
- Novel Mechanisms
- Robotic Perception
- Robust SLAM
- Trajectory Planning
- Non Linear Control

Lidar based perception system for self driving

visual servoing framework for long-range obstacle avoidar Micro Air Vehicles (MAV) flying amongst tall skyscrap



Dense Reconstruction And Canonicalization of Object shape (DRACO) from one or more RGB images estimates 3D object shape in a coordinate space canonicalized for scale, rotation, and translation parameters

### Design and Synthesis of Mechanisms


**Gripper & Perching mechanism:**
A mechanically actuated soft gripper that, in addition to being able to pick and place, can throw objects away. A mechanism that enables functionalities such as perching, grasping and landing to a regular drone.

**Pipe climbing:**
The pipe climber is a robot that can move through pipes, acting as a surveillance equipment.

An End-to-end Framework for Table-Top Rearrangement


RoRD: Rotation-Robust Descriptors and Orthographic Views for Local Feature Matching *(IROS 2021)(MATHWORKS)*

## Sponsored Projects

Heavy Payload Transfer in Outdoors using Aerial Drone(MeITy)

Autonomous Landing

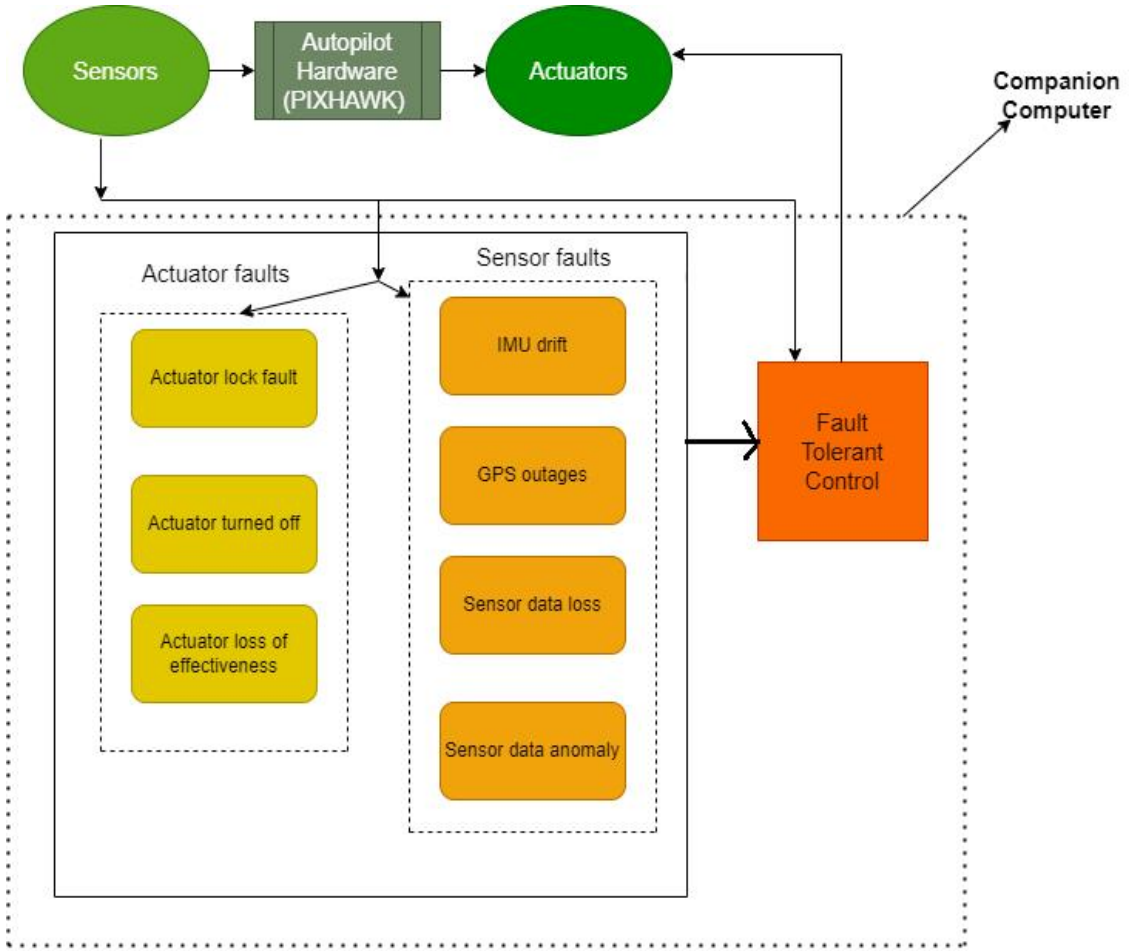
Autonomous WheelChair

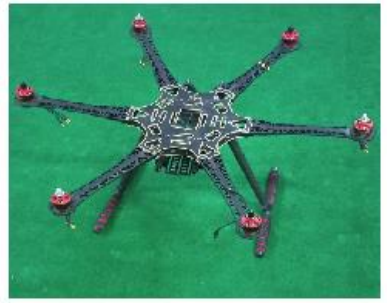
Unmanned Ground Vehicle

Autonomous Navigation

IHFC Project Aerial Manipulation in outdoor

# Active Fault-tolerant Control of UAVs



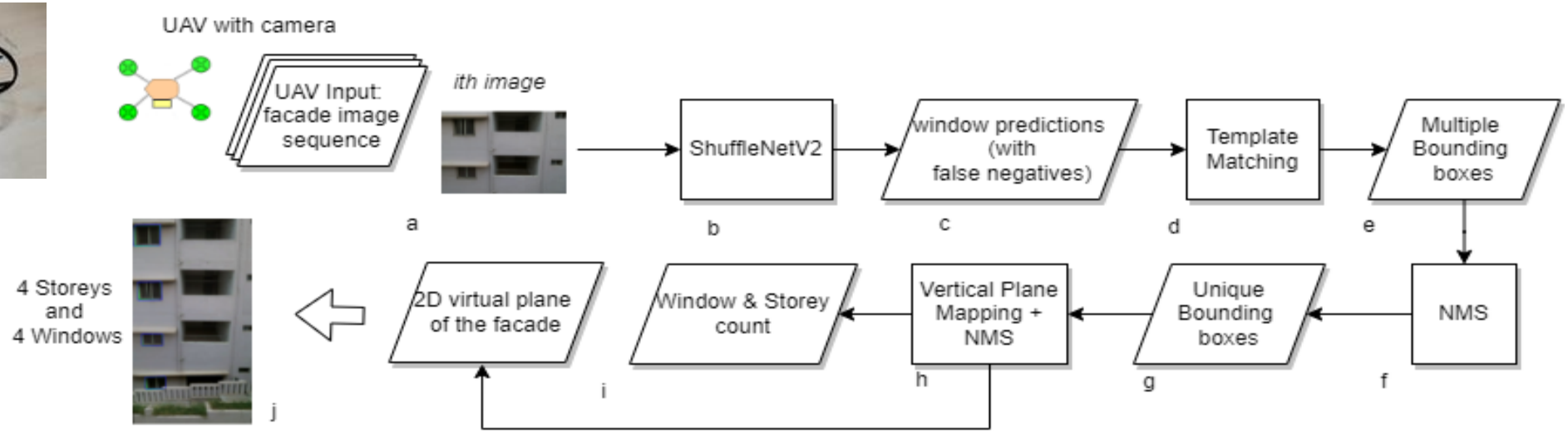



Hexacopter

Quadrotor

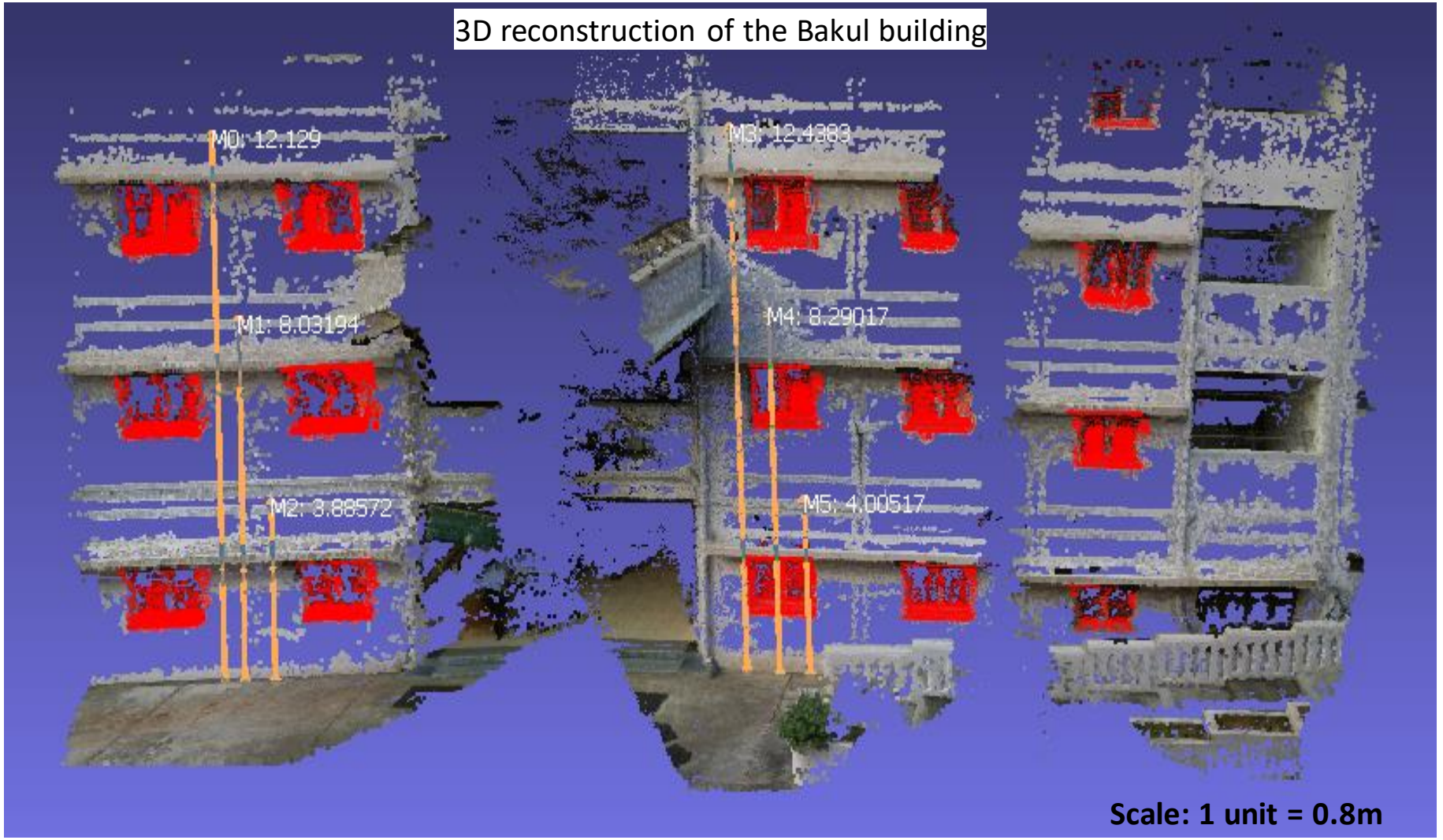
Contact: Harikumar

# UAV based remote sensing -Window and Storey Count




Contact:
Harikumar

# UAV based remote sensing - Storey height




Contact: Dr. Harikumar

# Drone-based Aerial Manipulation with Human-in-the-loop

•Objective: To develop a multirotor unmanned aerial vehicle (UAV) with manipulator capable of performing a task based on the supervisory inputs from the human operator.

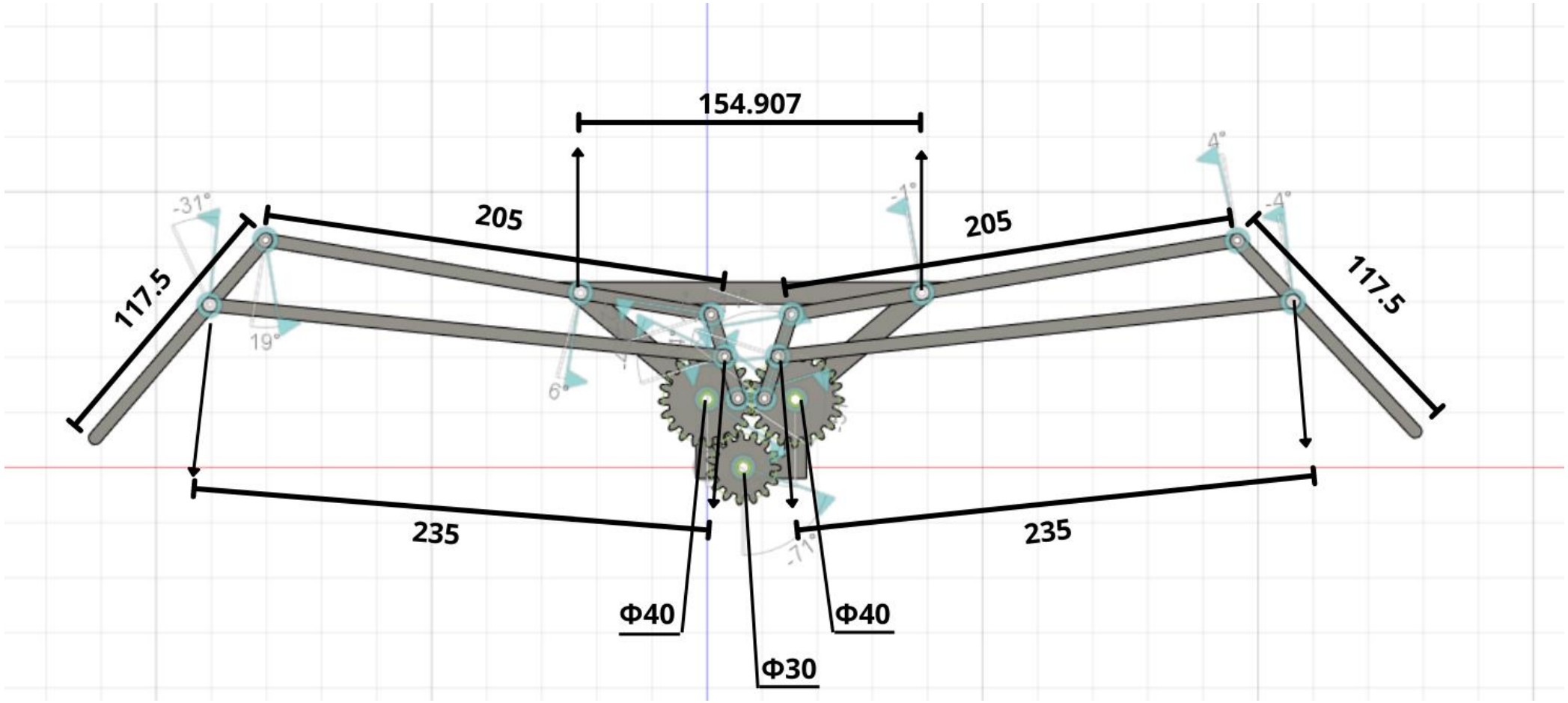
•**Industrial applications:**

•1. Targeted spraying of pesticides, fertilizer in precision farming and pollination.

•2. Pick and place of tools and objects in construction and other industries.

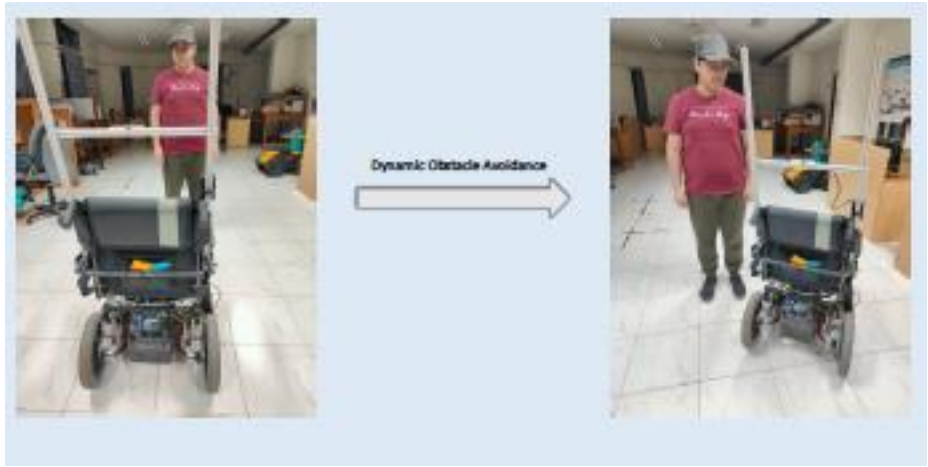
Contact: Harikumar

# Flapping Mechanism for UAVs

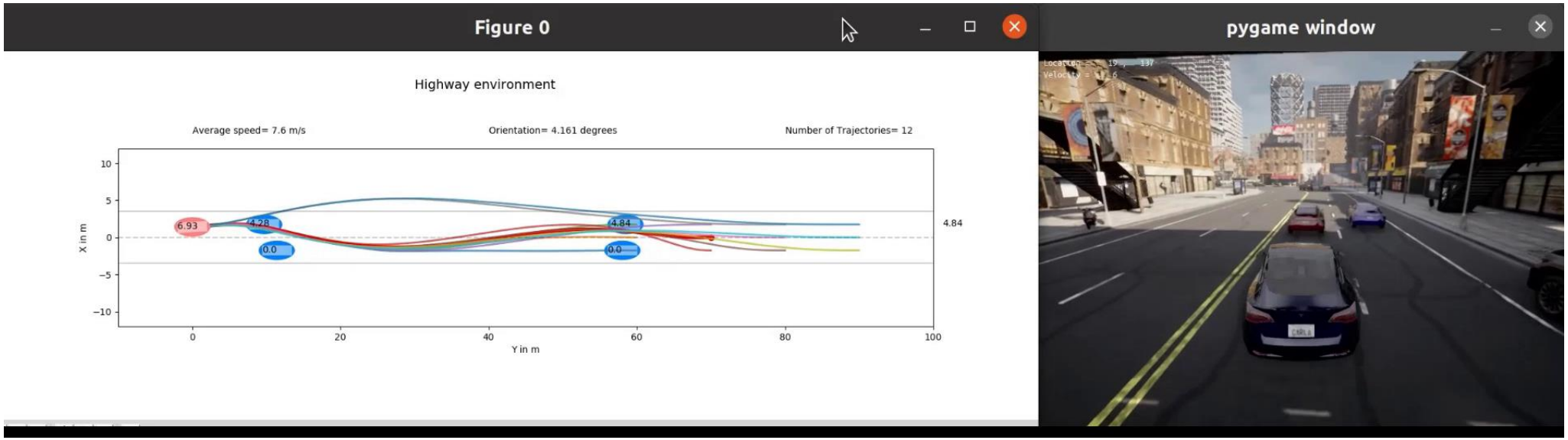


# Autonomous Driving Research


Self Driving Car at Test on Campus



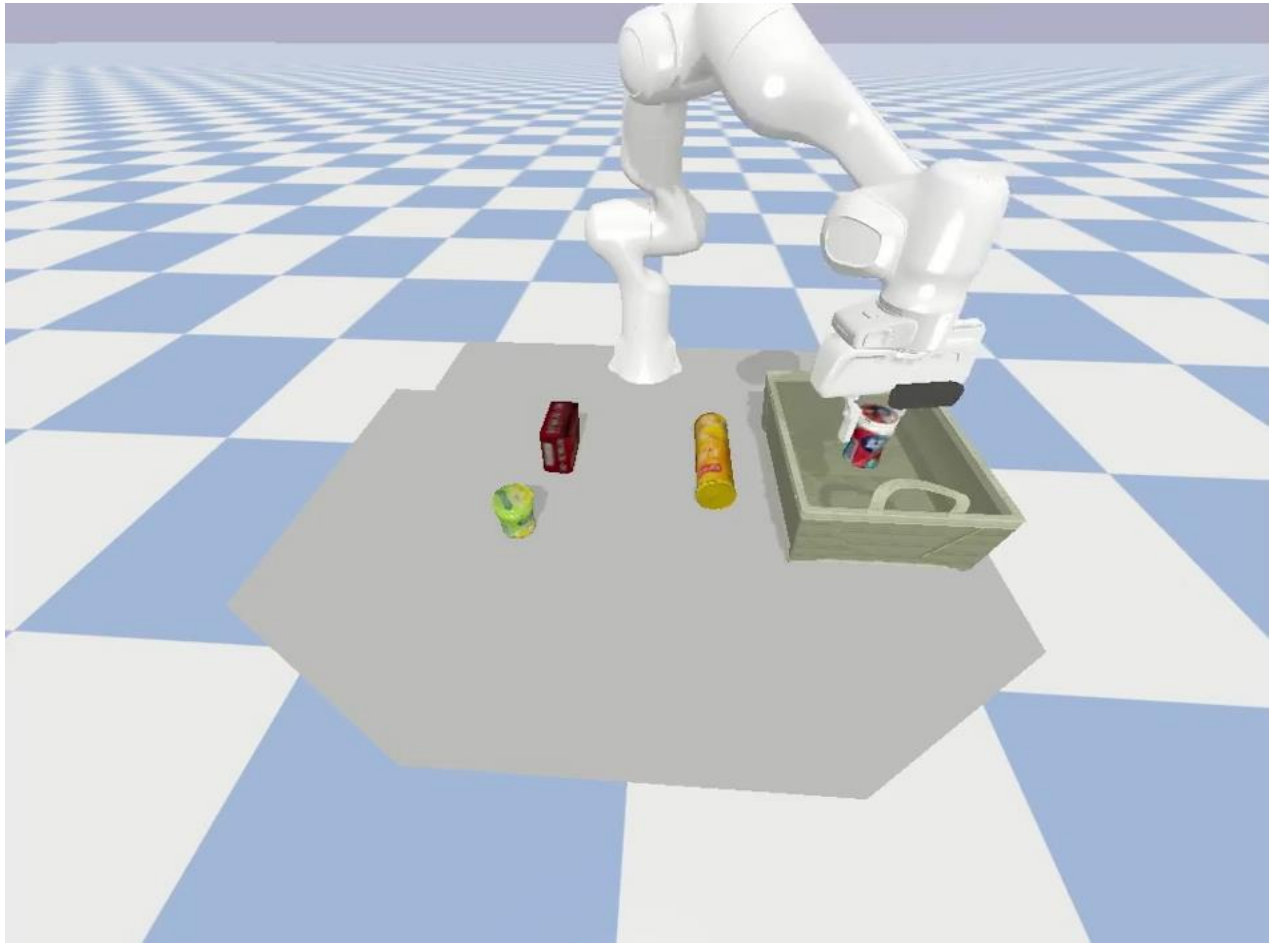

Autonomous Wheel Chair at Test in the Lab




Batch optimization of trajectories resulting in multiple homotopies **[RAL-22]**

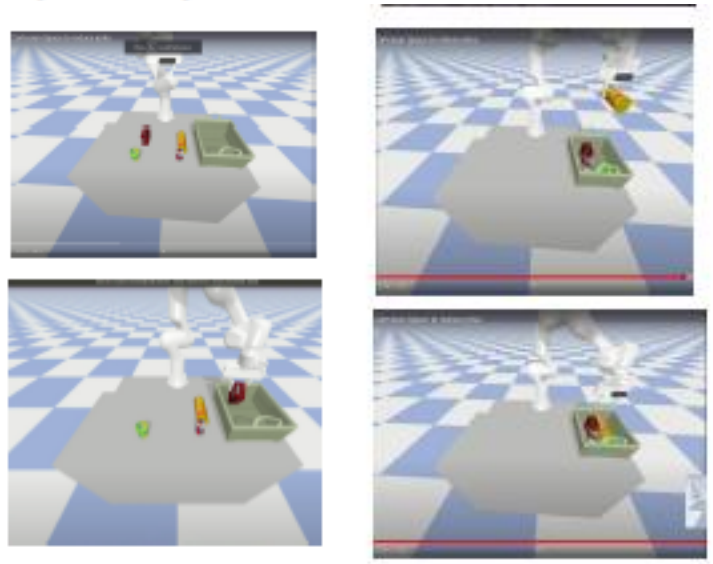
Contact: Prof. K Madhava Krishna

# Manipulation Planning and Object Rearrangement



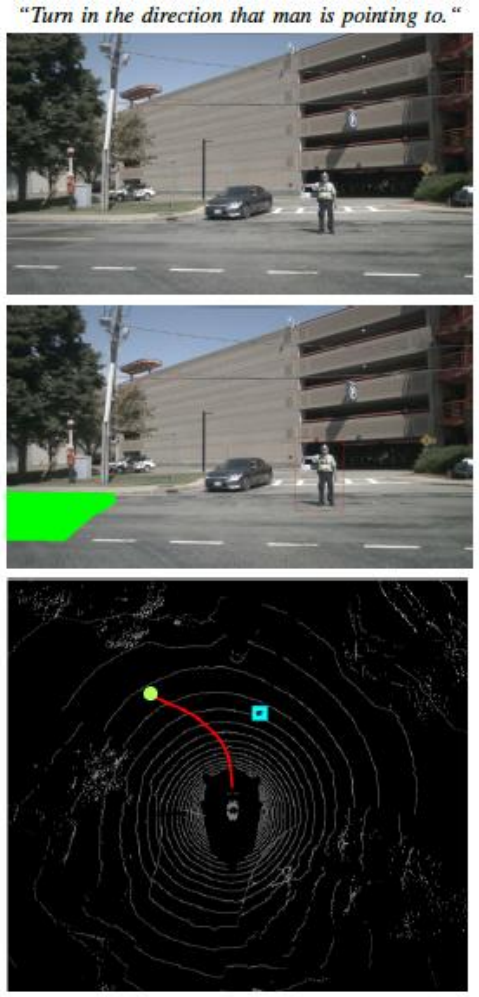
**Franka at work (Scene 1-1-1)**

Following is one of the basic scenes that we have. In these set of pictures, you will see the Franka arm pick and place 4 objects into a given tray successfully.



Contact: Prof. K Madhava Krishna

# Robotic Vision Research




Vision and Language Guided Navigation [IROS-21]

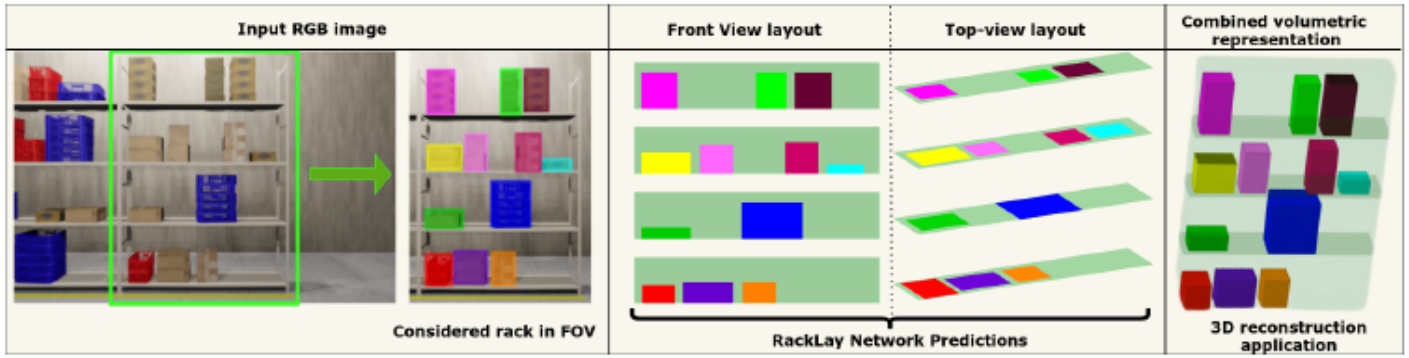


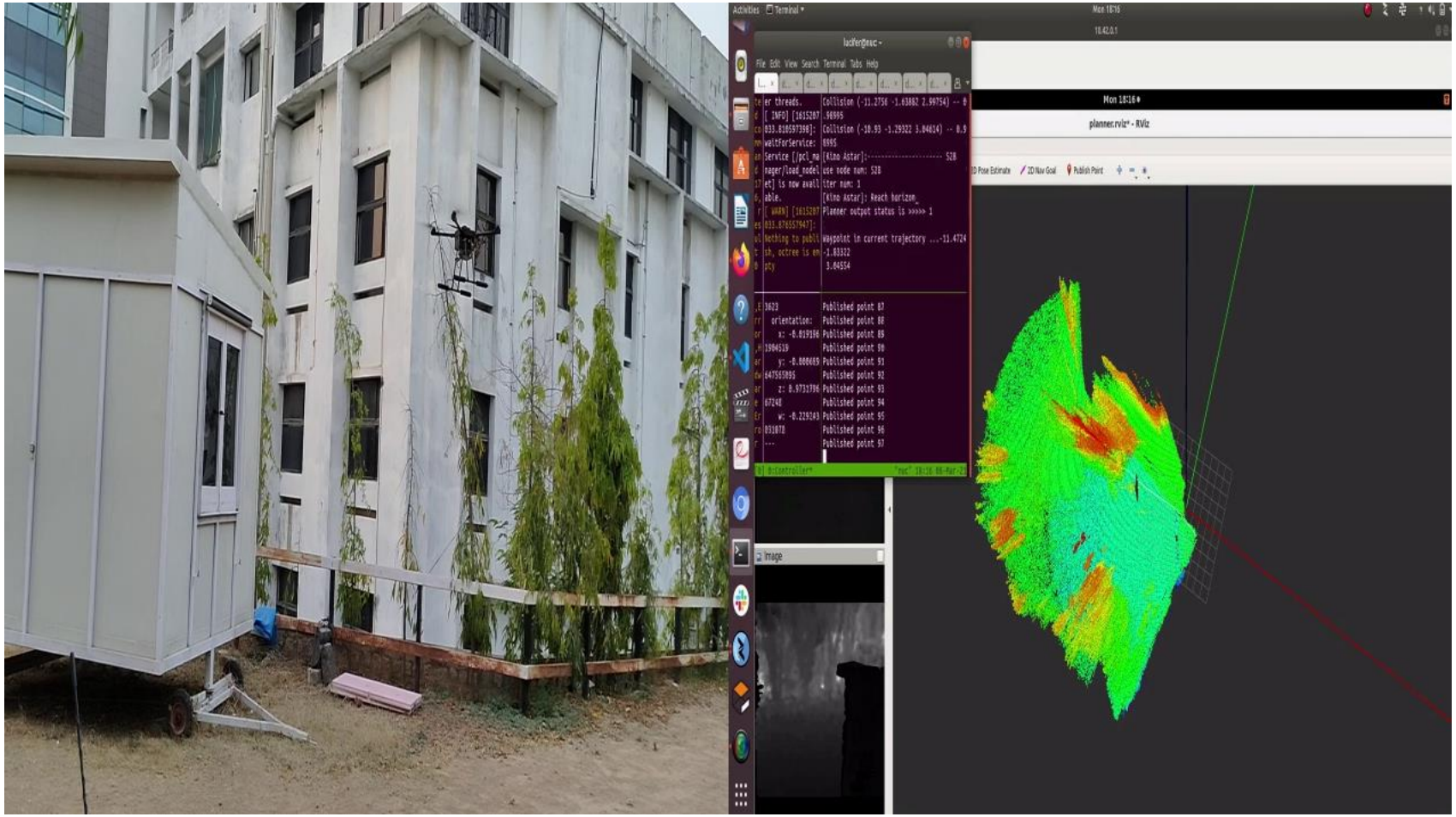

Fig. 1: Given a monocular RGB image of a warehouse rack, we propose **RackLay**, a deep neural architecture that generates the *top-view* and *front-view* semantic layout for rack shelves and items placed on each shelf. Fusing these layouts provides a volumetric reconstruction of the rack, enabling 3D reasoning. For the considered rack in the figure, our system can report "Rack has 4 shelves, 12 box stacks, and $830cm^3$ of free space available".

Rotation Robust Feature Descriptors [IROS-21]


Deep Visual Servoing – [IROS-21]

Contact: Prof. K Madhava Krishna

# Aerial Robotics



Real time state estimation, mapping and obstacle avoidance for drones

# Adaptive Control of Robotic Systems

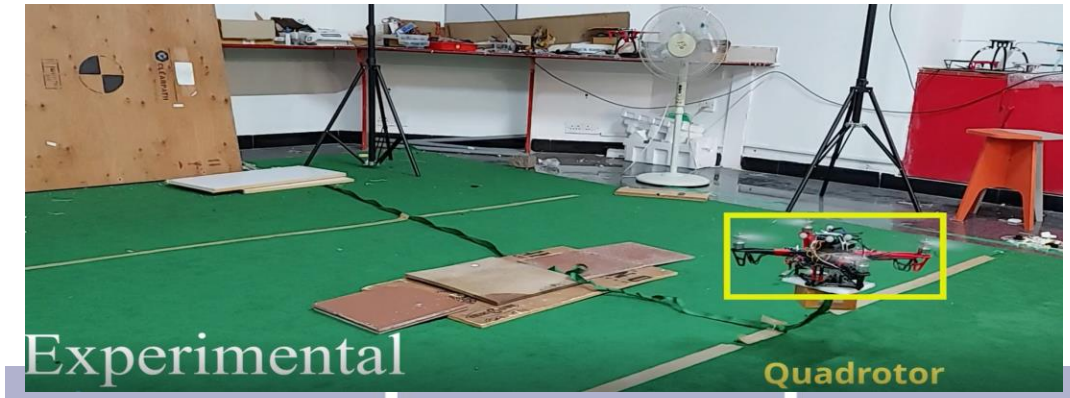
- Objective: *Adaptive control design for unknown dynamics and circumstances for robotic systems*

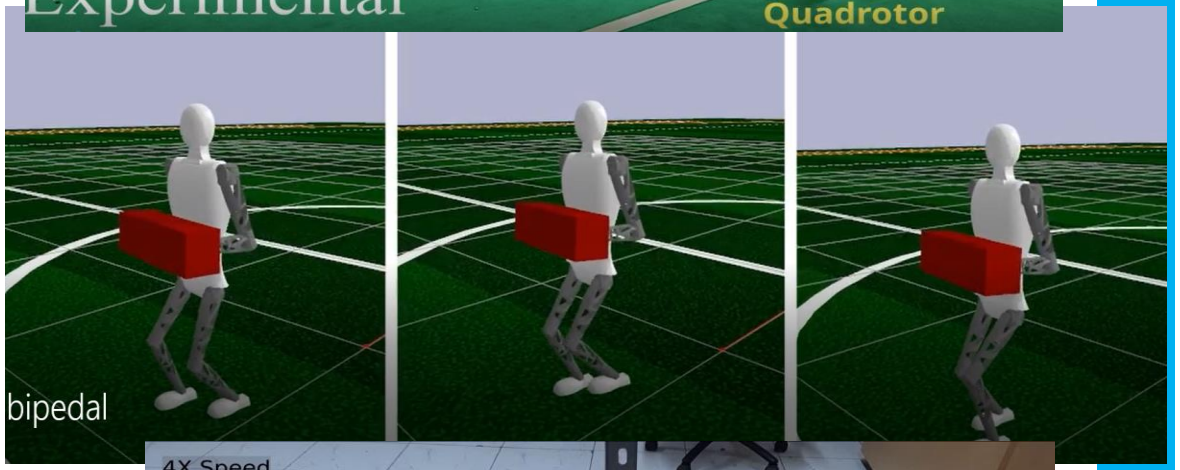
- Research: *Two interconnected threads*

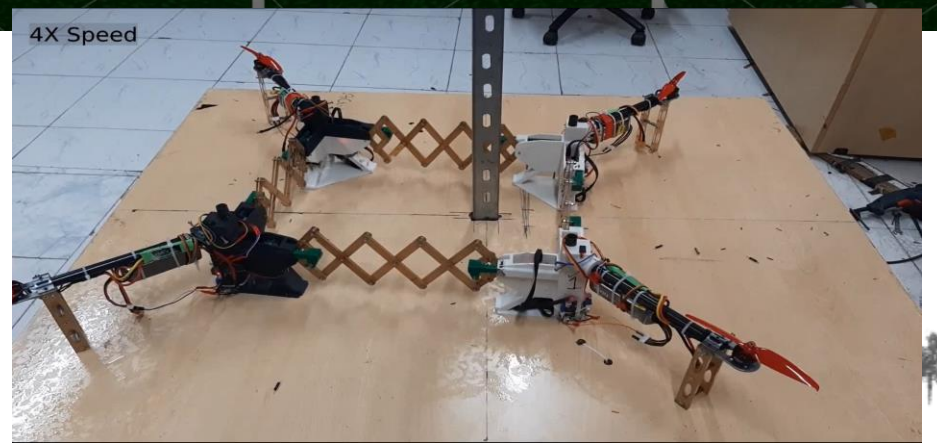
  Theoretical:
  *Adaptive-robust control*
  *Artificial delay control*
  *Switched dynamics*

  Experiment/Verification:
  *Drone based applications*
  *Legged robots*
  *Reconfigurable robotics*

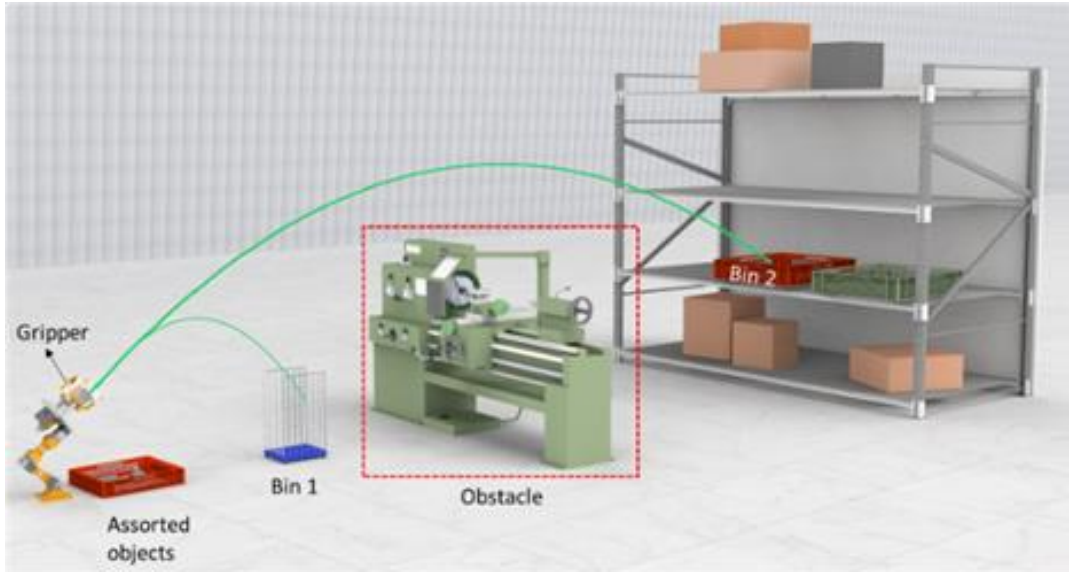
- Research Possibilities:
  contact: spandan.roy@iiit.ac.in &
  check Google Scholar for recent publications and
  various research domains



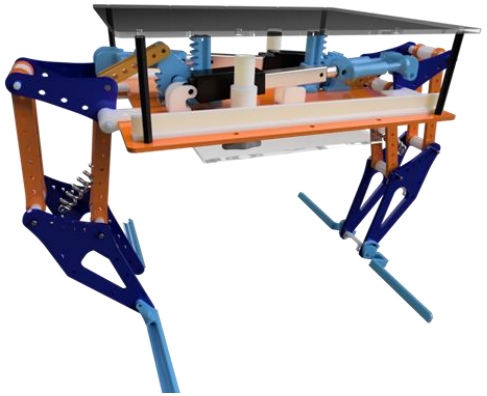



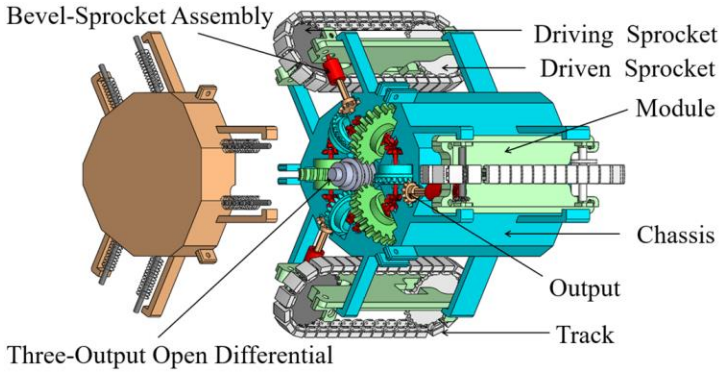
# Robot Mechanisms – Design and Synthesis




Multipurpose gripper for throwing objects



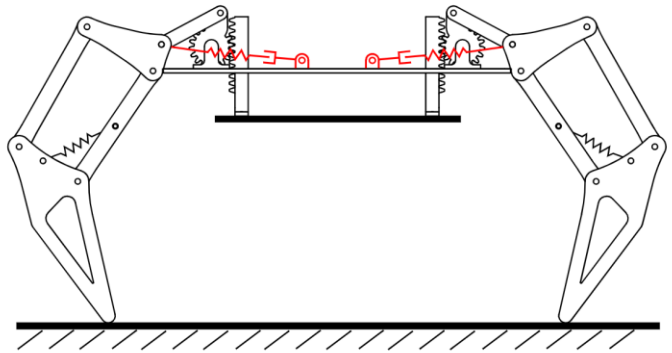
Perching mechanism for Drones

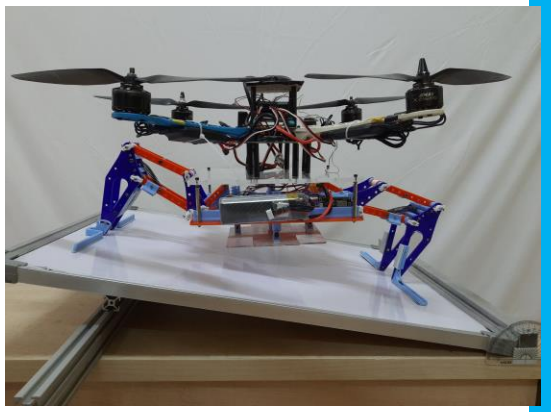



Modular Pipe Climber [IROS-21]

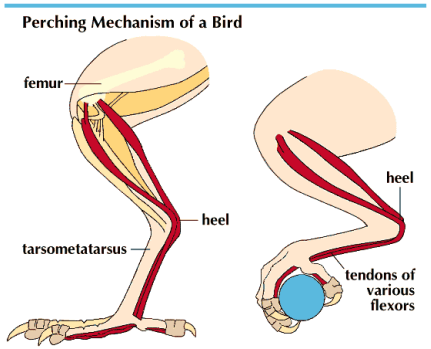
# Mechanisms - Drones

Adaptive landing gears

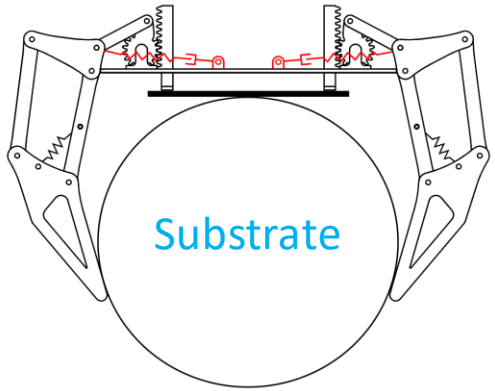


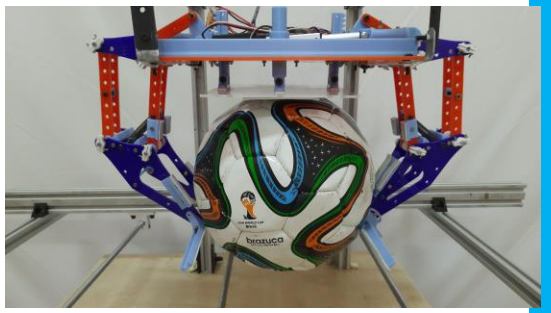


Perching

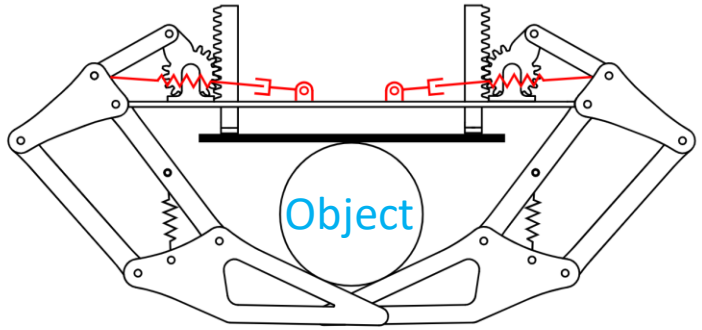


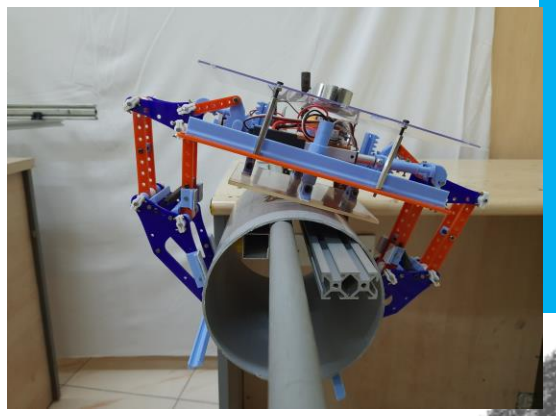




Grasping



Contact: Dr Nagamanikandan G