

Our approach to the problem statement can be divided into the following sub-problems.

- Terrain recognition- The sensors aboard the UAV are capable of extracting vision and depth data from the given terrain.
- Road mapping- Processing the data enables us to identify feasible roadways in the region. The next step is then to control the UGV to follow the given path.
- UGV Controller- A basic controller is developed to instruct kinematic inputs to the UGV (position, orientation and velocity).
- Feedback- A reliable real-time feedback loop of the UGV's state is built. This achieves 2 things.
  - The controller's next instruction is based on the UGV's current state. Hence feedback allows the controller to publish optimal instructions.
  - It mitigates the chances of derailing of the UGV.

## Path Tracking and Controller for UGV

Low-level PID controller and a high-level Pure pursuit tracking. [link](#)

The pure pursuit method consists of geometrically calculating the curvature of a circular arc that connects the rear axle location to a goal point on the path ahead of the vehicle. The goal point is determined from a look-ahead distance from the current rear axle position to the desired path. The vehicle's steering angle can be determined using only the goal point location and the

Angle between the vehicle's heading vector and the look-ahead vector.

## Feedback Mechanism

For feedback mechanism, YOLO is basically an image detection algorithm running with the help of OpenCV which provides a live detection of a real time video feed.

Darknet is an open source neural network framework written in C and CUDA. It is fast, easy to install, and supports CPU and GPU computation. You can find the source on GitHub. [link](#)

The depth camera, which is onboard the iris drone, is used as the feed camera for the algorithm to work.

This gives us the bounding box of the prius model and that gives us the location of the center of the model. Using that we'll get the metric coordinates from the point cloud which is our feedback which we needed.

## Detection of roadways with UAV

Detecting roadways is the central problem of this project. For this we took inspiration from the autonomous car approaches and thought of using PCL for detecting roads.