Inter-IIT

TechMeet

Madras2018

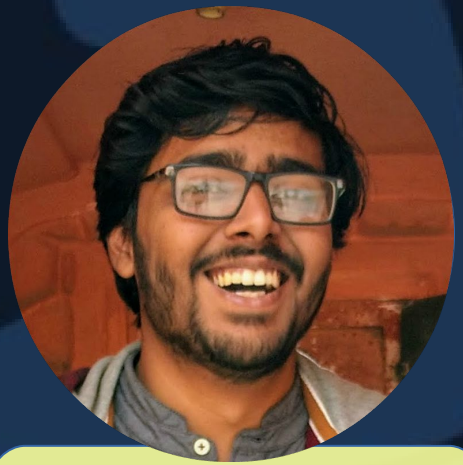
Warehouse Inventory Check

MEMBERS

Krishnraj Singh Gaur
7752894450

Jay Patrikar
7752846441

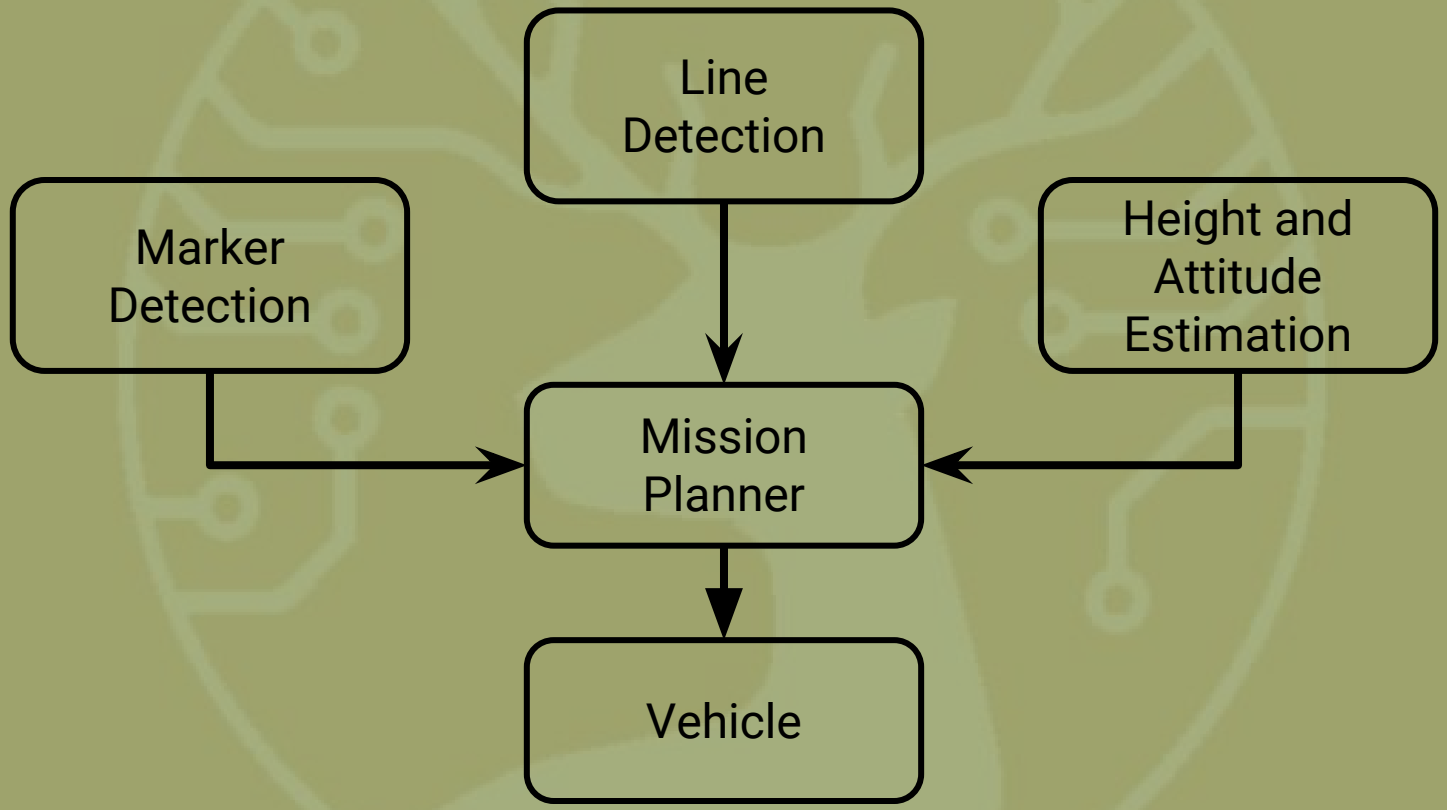
Gajendra Nagar
7054178413



Harsh Sinha
9198263225

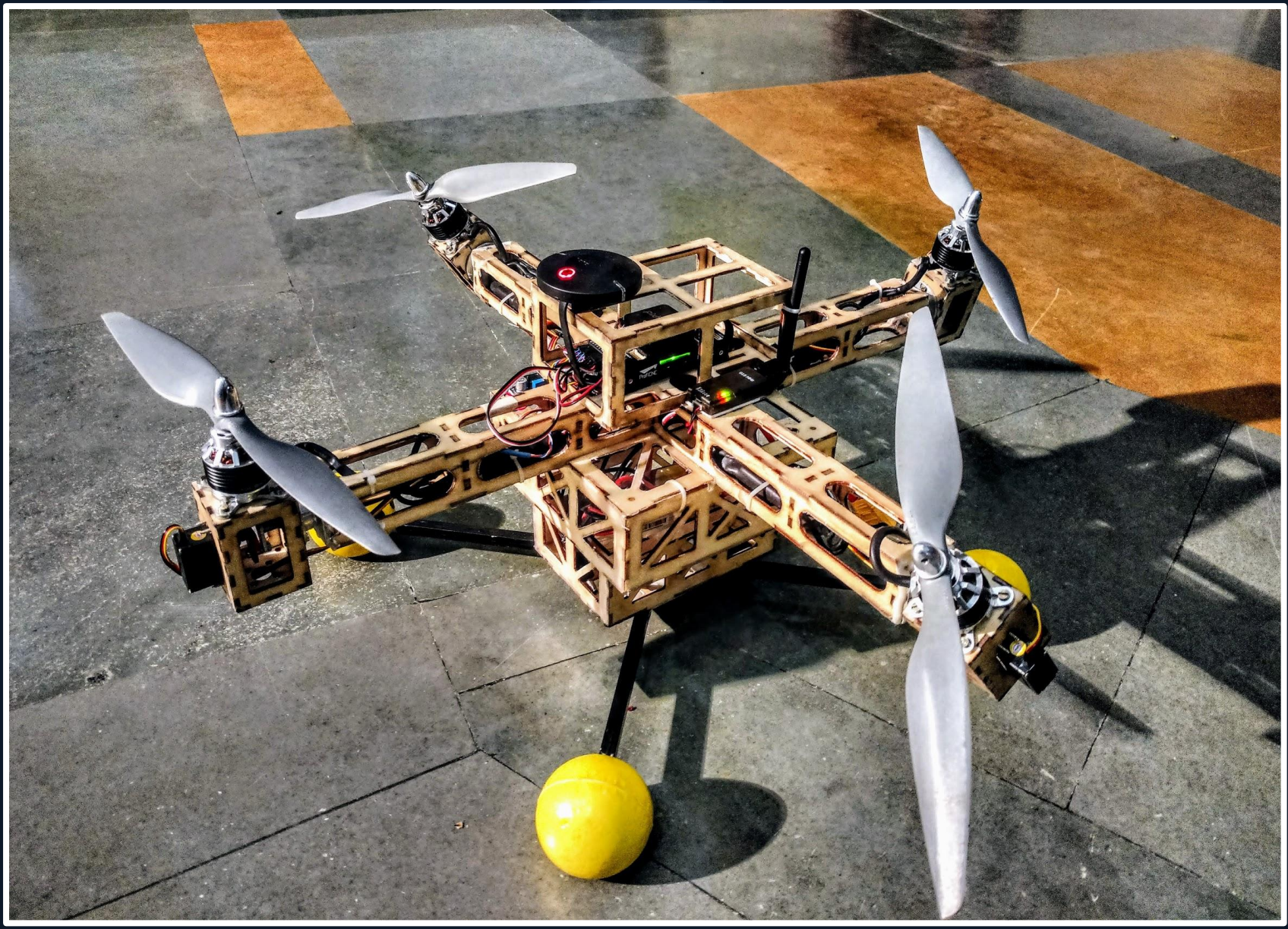
Prashant Singh
7054124045

OVERALL PIPELINE

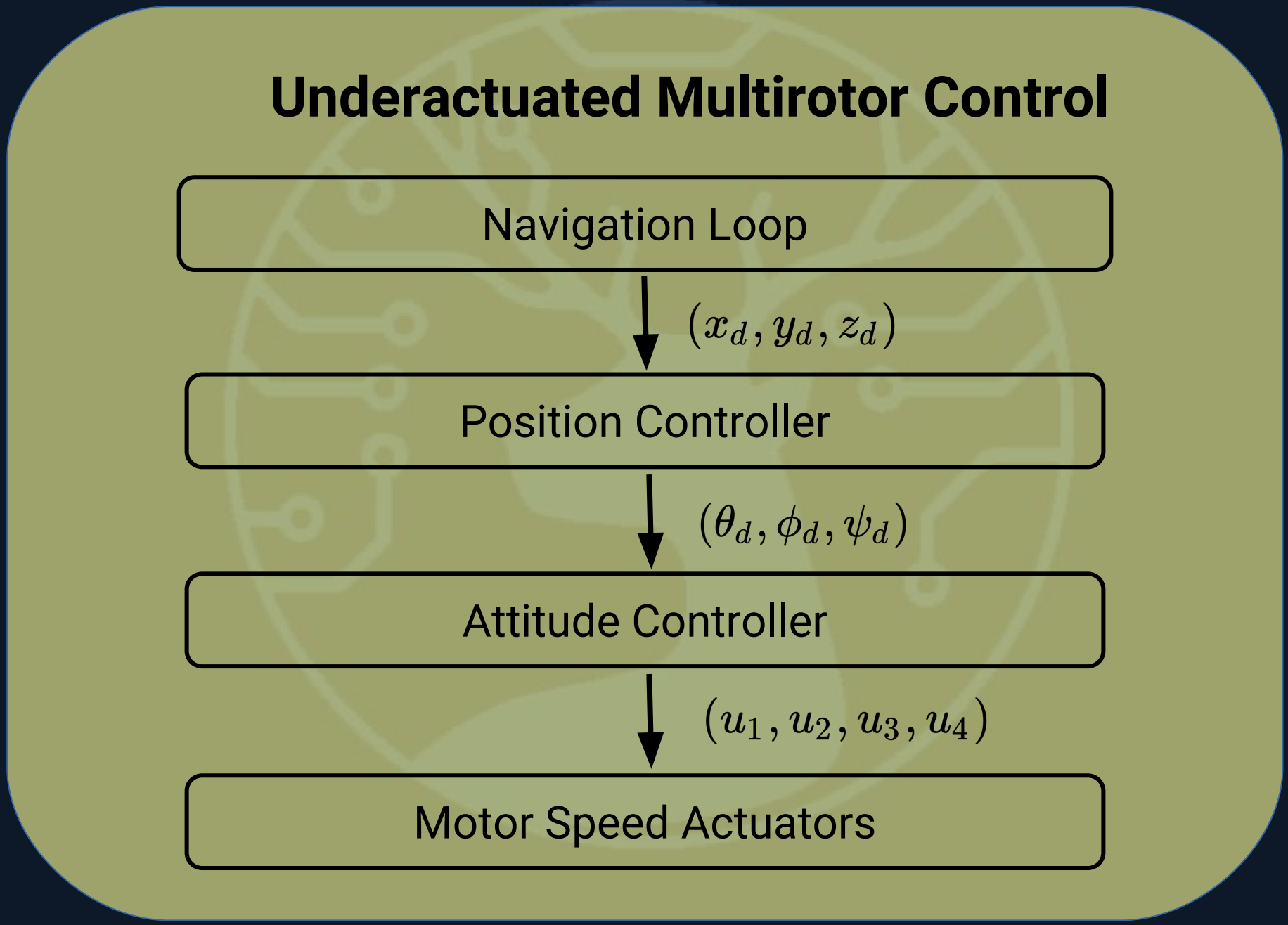


Asynchronous Communication using ROS between different independently functioning modules.

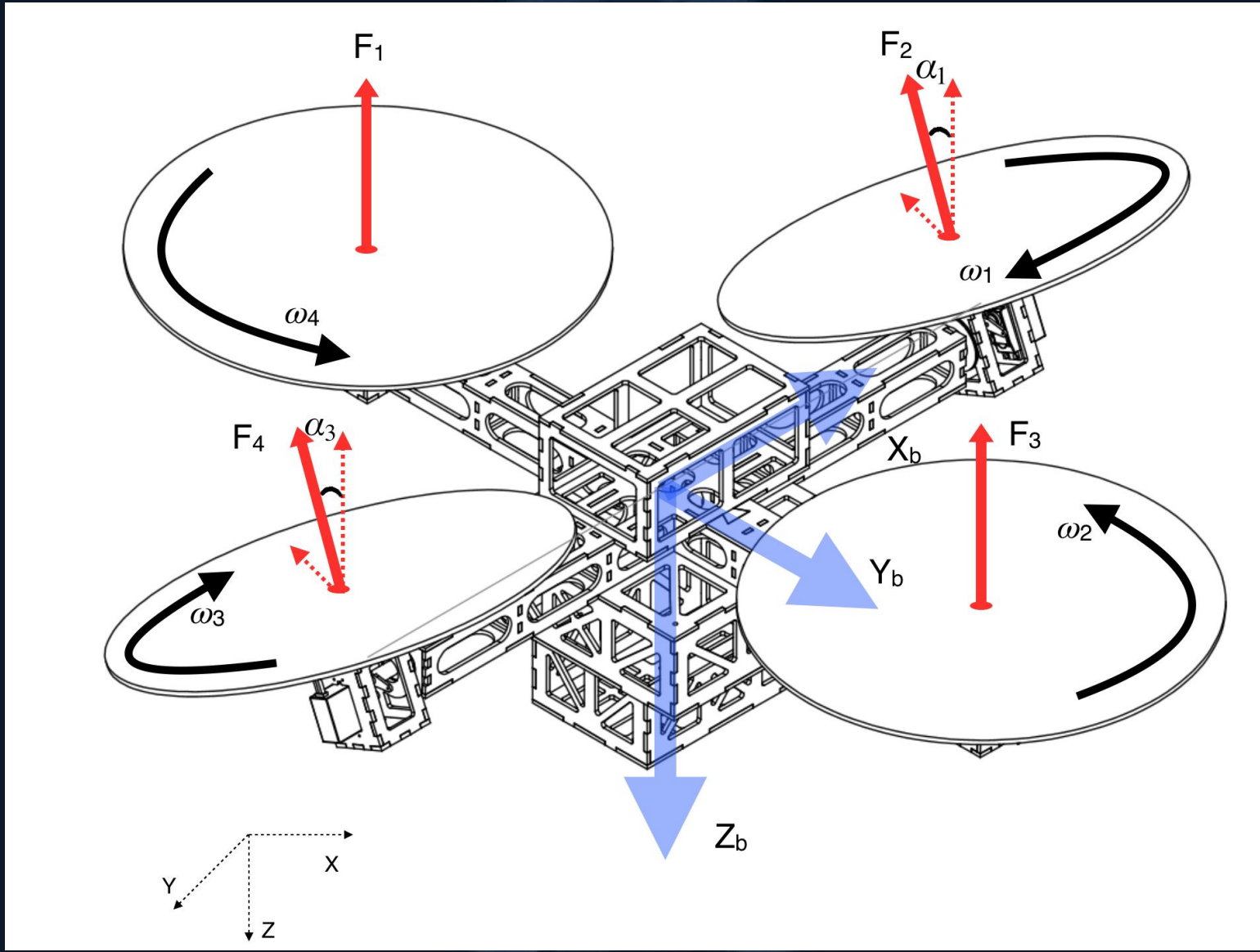
ASTAiRE



Autonomous Tilt Augmented Aerial Rotary Vehicle (ASTAiRE)

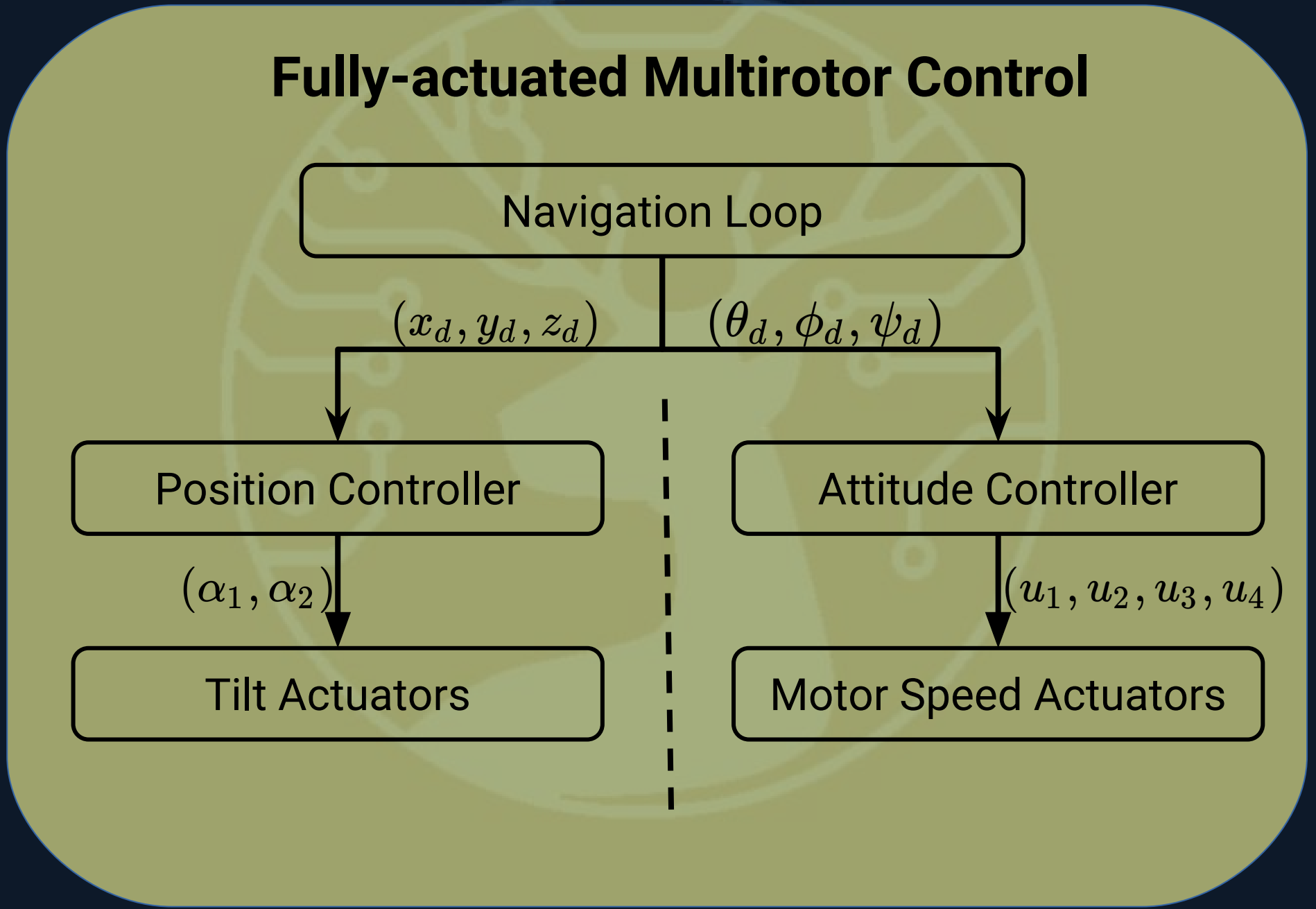

Underactuated Multirotor Control
Navigation Loop
(x_d, y_d, z_d)
Position Controller
$(\theta_d, \phi_d, \psi_d)$
Attitude Controller
(u_1, u_2, u_3, u_4)
Motor Speed Actuators

ASTAiRE DYNAMICS



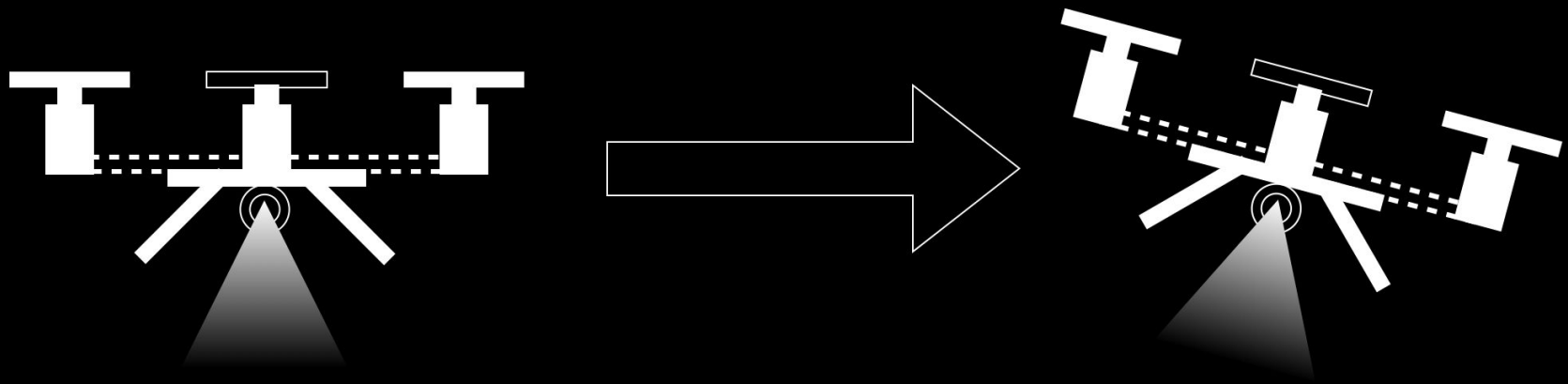
ASTAiR Fully Actuated Tilt-Quadrotor System

ASTAiRE CONTROL

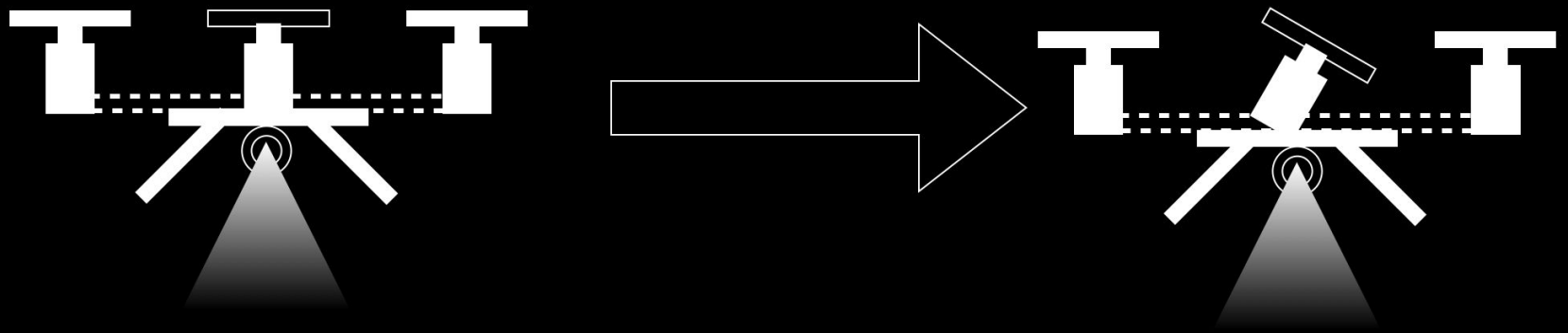


ASTAiRE ADVANTAGE

Conventional Mode

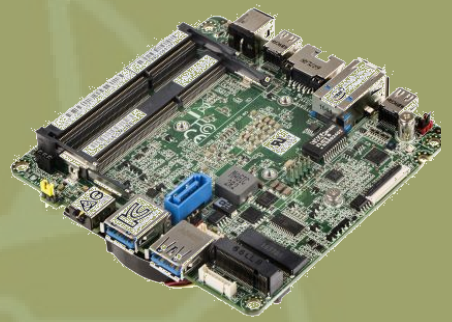


Tilt Mode



Components

Pixhawk 2



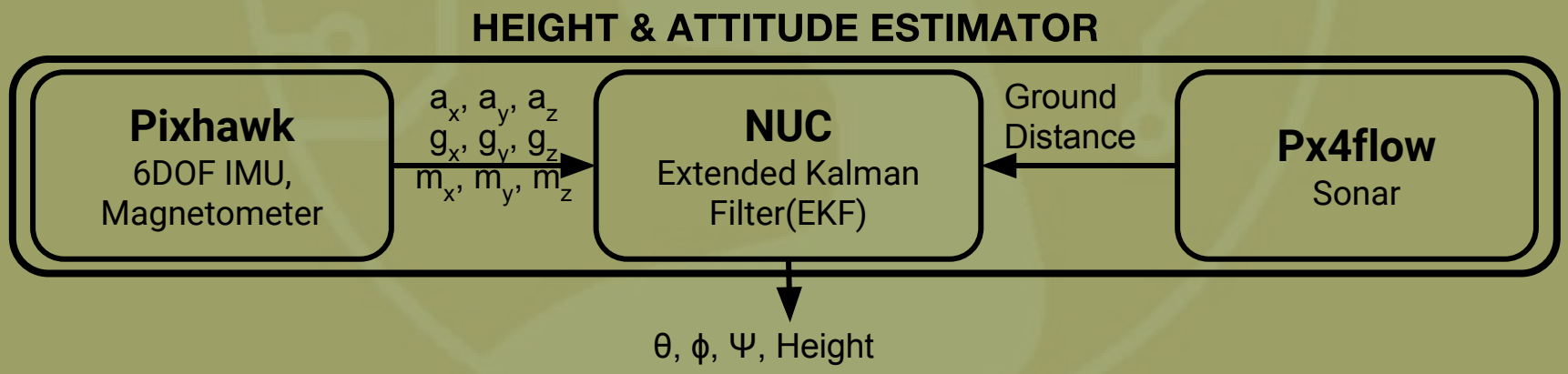
Intel NUC 7-Gen i5

Sonar

Genius Wide-Angle Cam

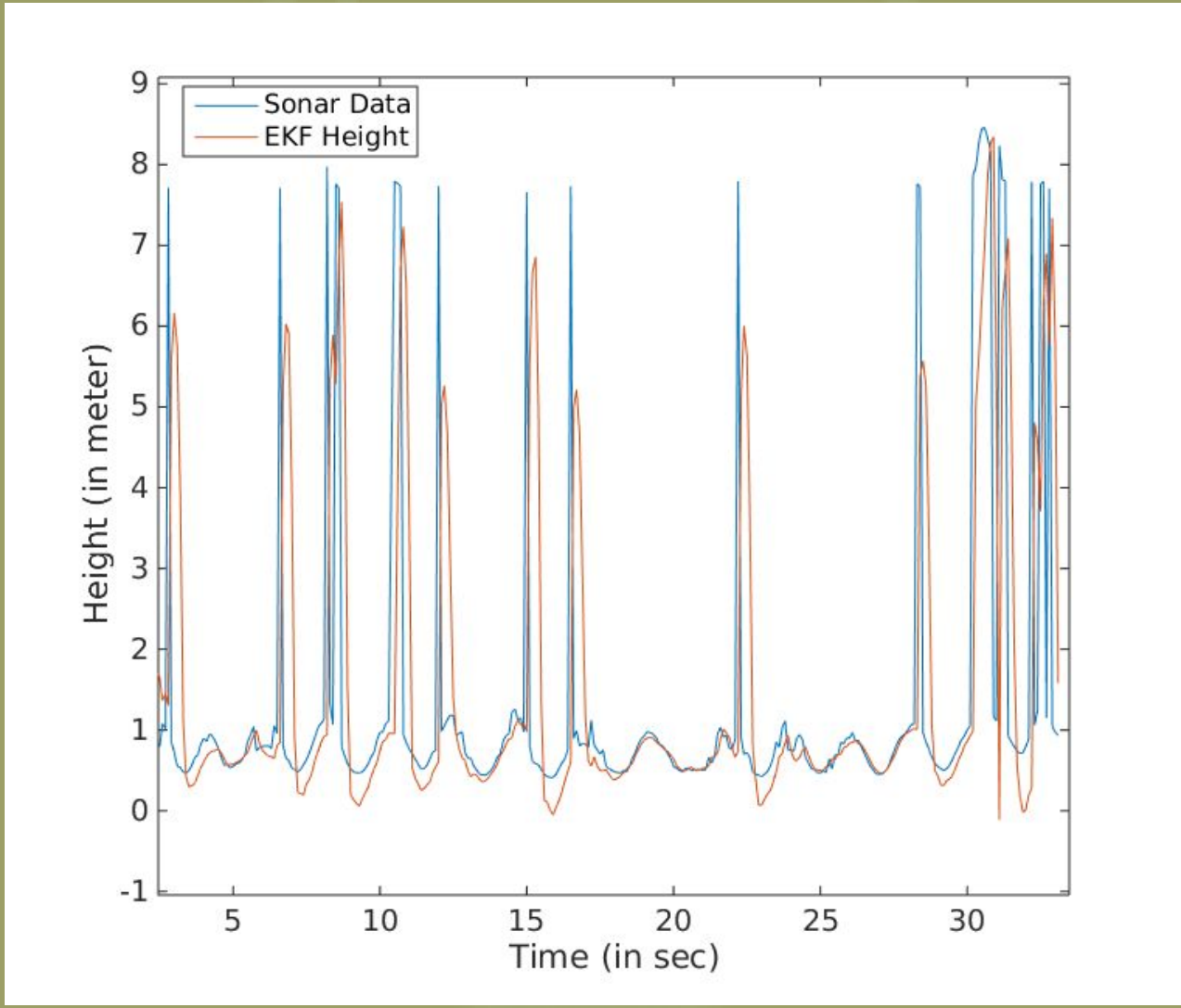
HEIGHT AND ATTITUDE ESTIMATION

- An Extended Kalman Filter fusion for attitude and height estimation.
- Fusion of accelerometer, gyroscope and magnetometer using quaternion based framework.
- Fusion of sonar and accelerometer data for height estimation.
- Median filter for sonar outlier value rejection.

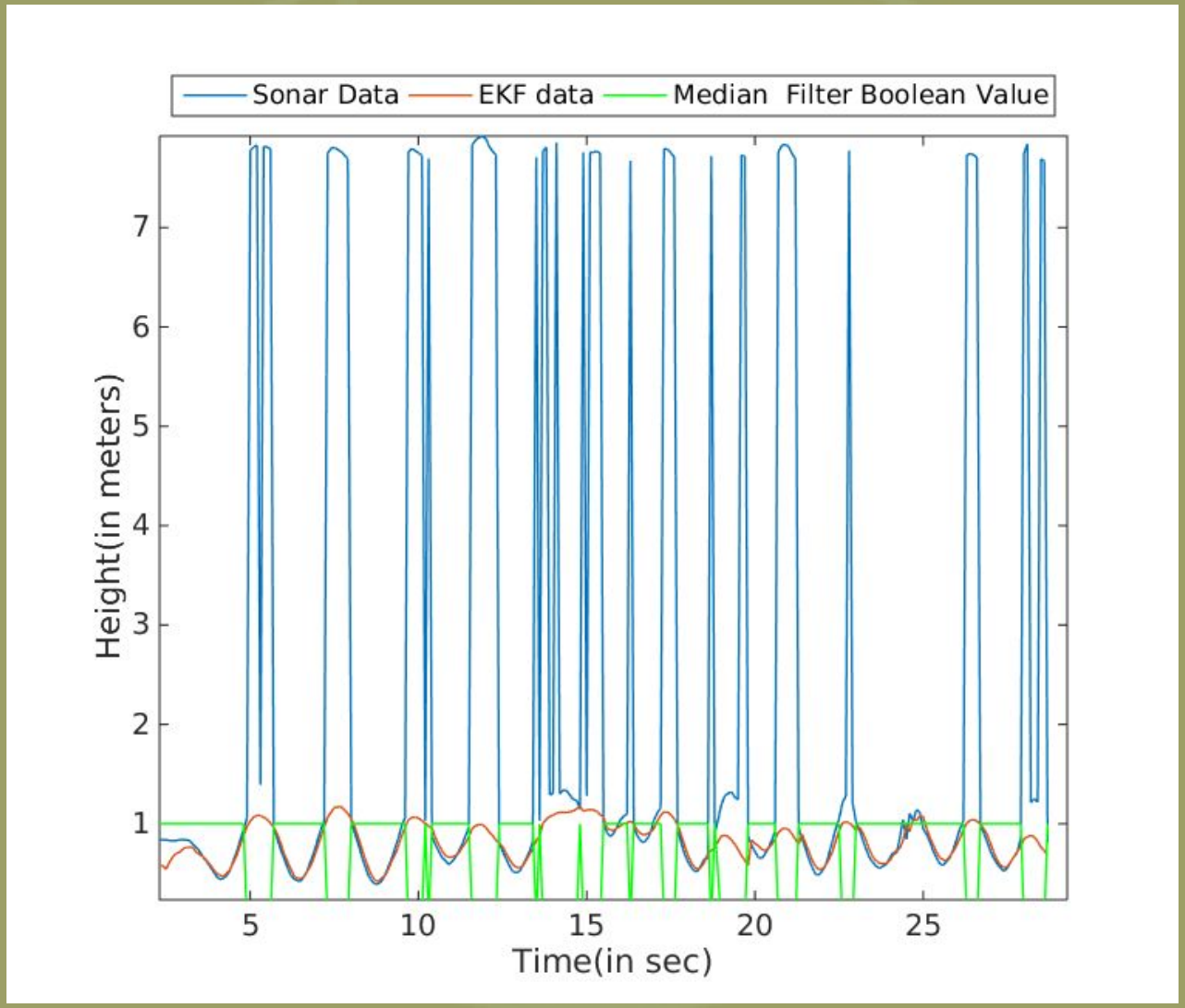


Ref: Krishnraj Singh Gaur, Hardik Parwana, Ajay Bhatt, Gaurav Pandey, Mangal Kothari, Low Cost Solution for Pose Estimation of Quadrotor, AIAA, SciTech, 2018

HEIGHT ESTIMATION WITHOUT MEDIAN FILTER

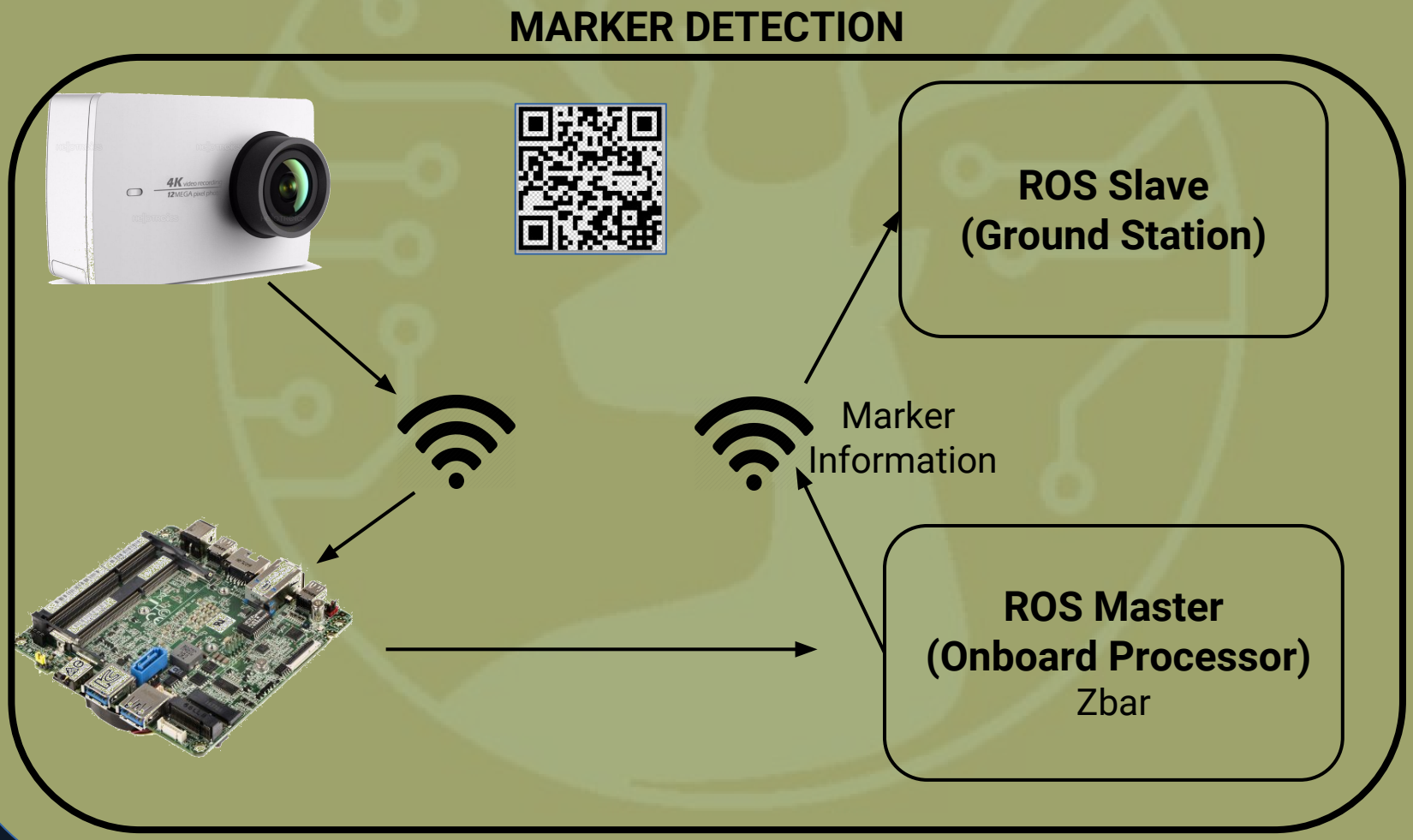


HEIGHT ESTIMATION MEDIAN FILTER



MARKER DETECTION

We use an external library(zbar) for QR and barcode detection



LINE DETECTION

Image Processing Pipeline for Line Detection

- Preliminary Image processing and color based thresholding.
- Probable points extraction from the binarized image.
- Coordinate transform and clustering of points into two sets, namely horizontal and vertical lines.
- Principal Component Analysis (PCA) to obtain best fit line for each set.
- Intersection of the two lines for Cross Detection.

LINE DETECTION

Image Processing Pipeline for Line Detection

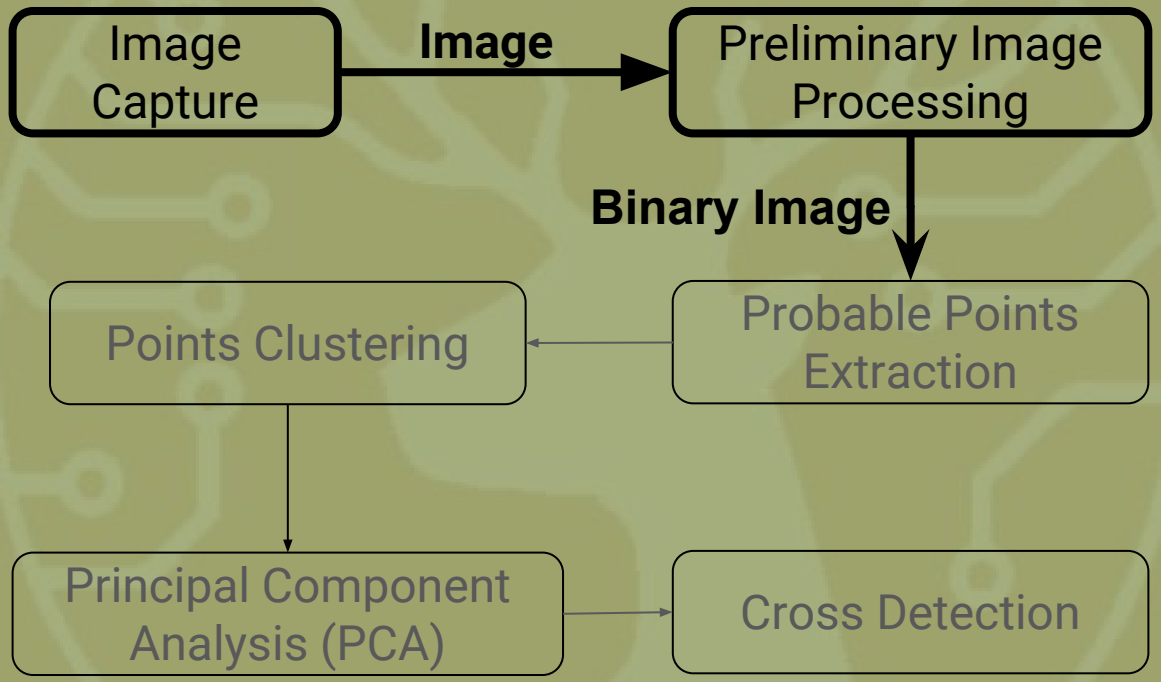
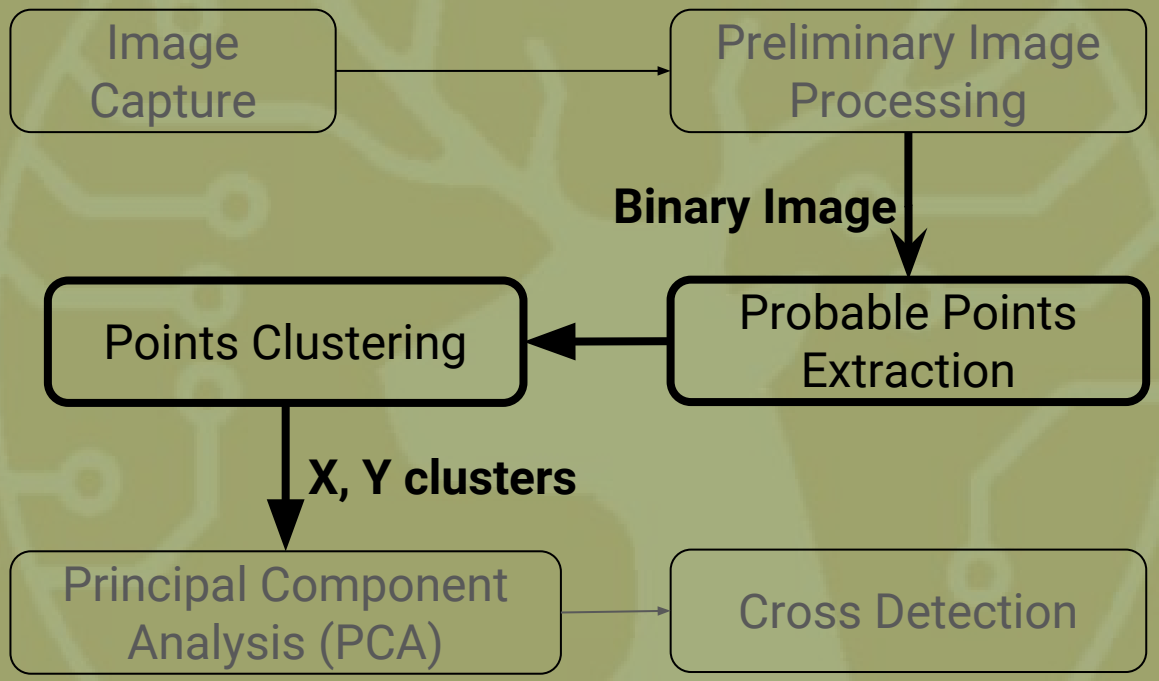


Image Capturing and Preliminary Image Processing followed by Color based thresholding generates a binary image.

LINE DETECTION

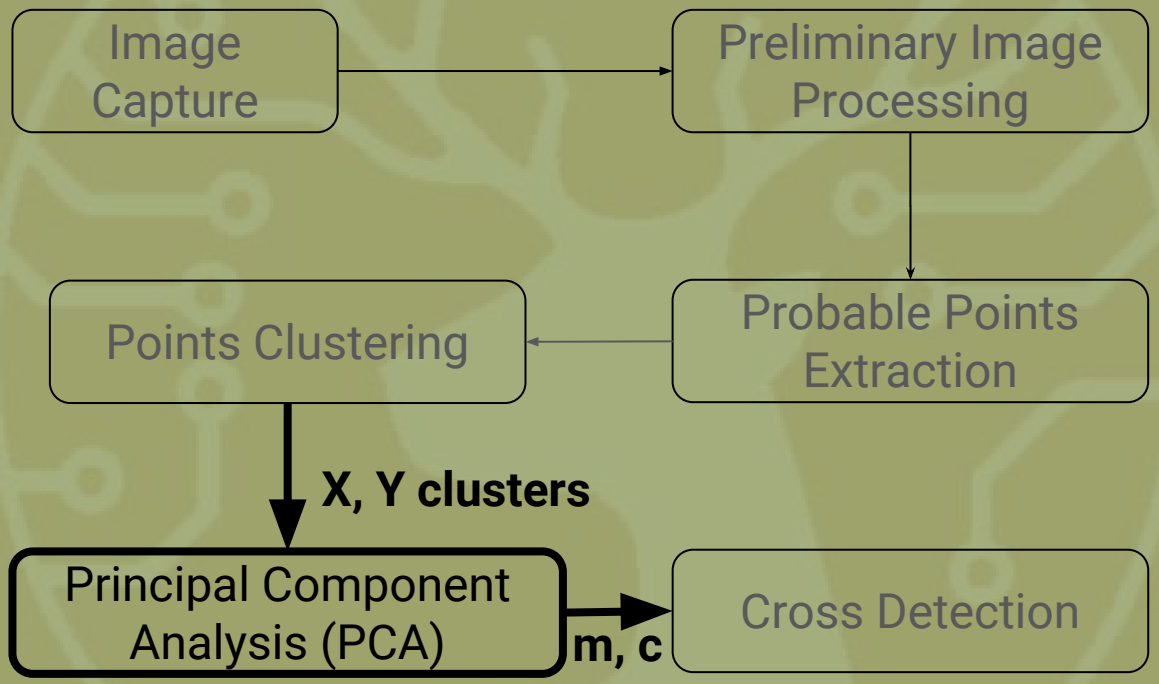
Image Processing Pipeline for Line Detection



Probable points are extracted using HoughLinesP with line length thresholds, which are then clustered based on orientation.

LINE DETECTION

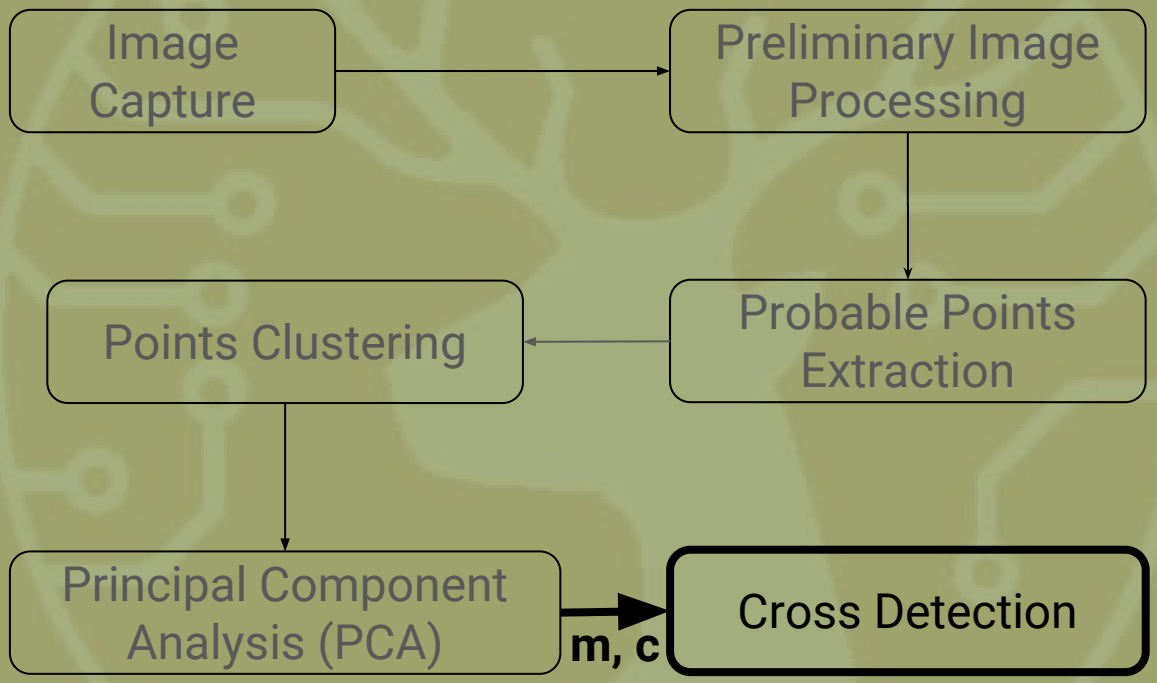
Image Processing Pipeline for Line Detection



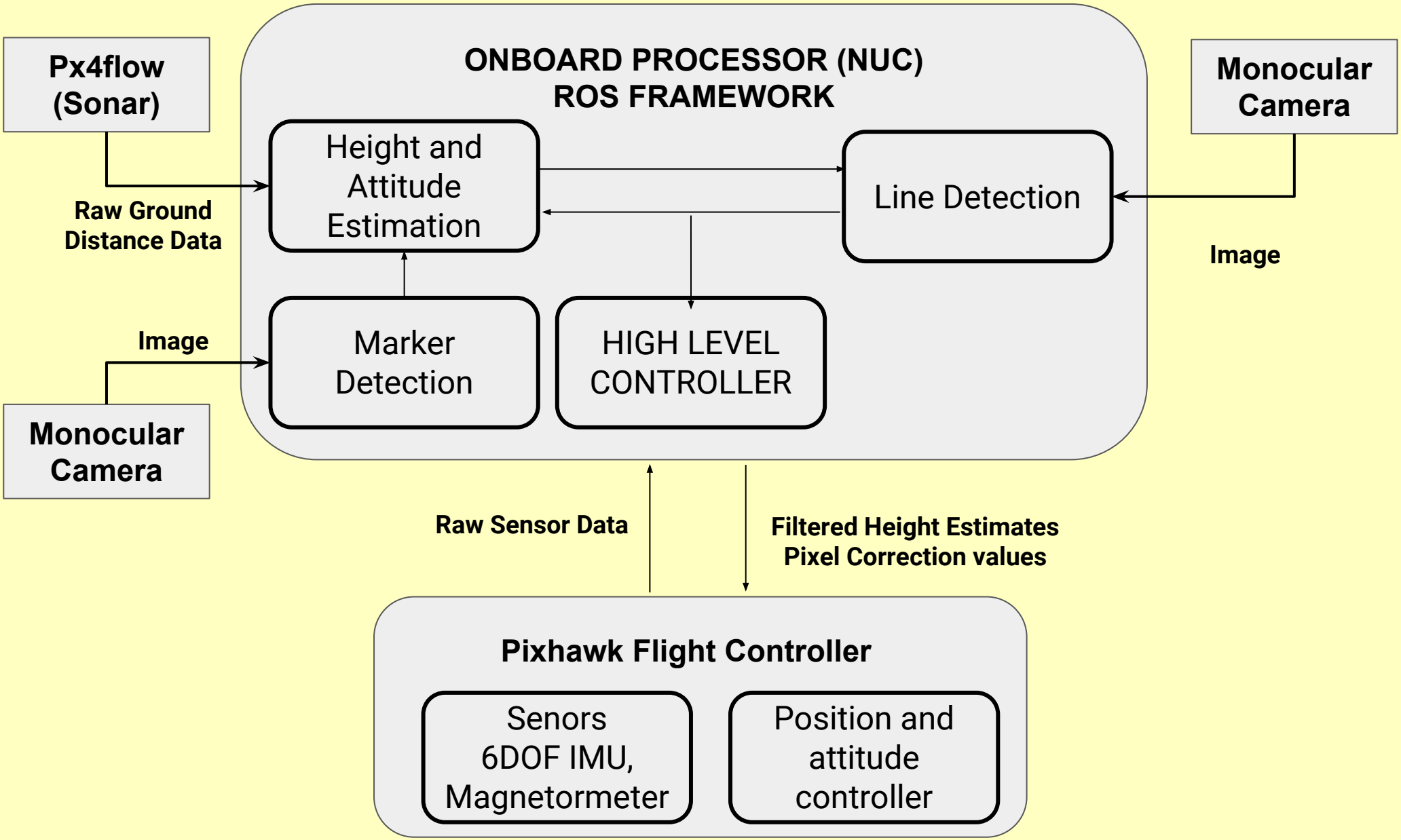
PCA ranks the directions in order of their variance, thus given us the slope and intercept for the line for each cluster.

LINE DETECTION

Image Processing Pipeline for Line Detection



Cross detection is done using the lines for both the clusters.


Px4flow
(Sonar)
ONBOARD PROCESSOR (NUC)
ROS FRAMEWORK
Monocular
Camera
Height and
Attitude
Estimation
Line Detection
Raw Ground
Distance Data
Image
Image
Marker
Detection
HIGH LEVEL
CONTROLLER
Monocular
Camera
Raw Sensor Data
Filtered Height Estimates
Pixel Correction values
Pixhawk Flight Controller
Senors
6DOF IMU,
Magnetormeter
Position and
attitude
controller

References

- Meier, Lorenz, Dominik Honegger, and Marc Pollefeys. "PX4: A node-based multithreaded open source robotics framework for deeply embedded platforms." *Robotics and Automation (ICRA), 2015 IEEE International Conference on*. IEEE, 2015.

- Johnson, Eric, Anthony Calise, and J. Eric Corban. "A six degree-of-freedom adaptive flight control architecture for trajectory following." *Proceedings of the AIAA Guidance, Navigation, and Control Conference*. 2002.

- Muraoka, Koji, Noriaki Okada, and Daisuke Kubo. "Quad tilt wing VTOL UAV: aerodynamic characteristics and prototype flight test." *AIAA Infotech@ Aerospace Conference*. 2009.

- Zurich, E. "Qgroundcontrol: Ground control station for small air land water autonomous unmanned systems." (2013).