Control System of Self Driving Cars

State Estimation & Localization Using SLAM

Learning Objectives

AUGMENTED STARTUPS
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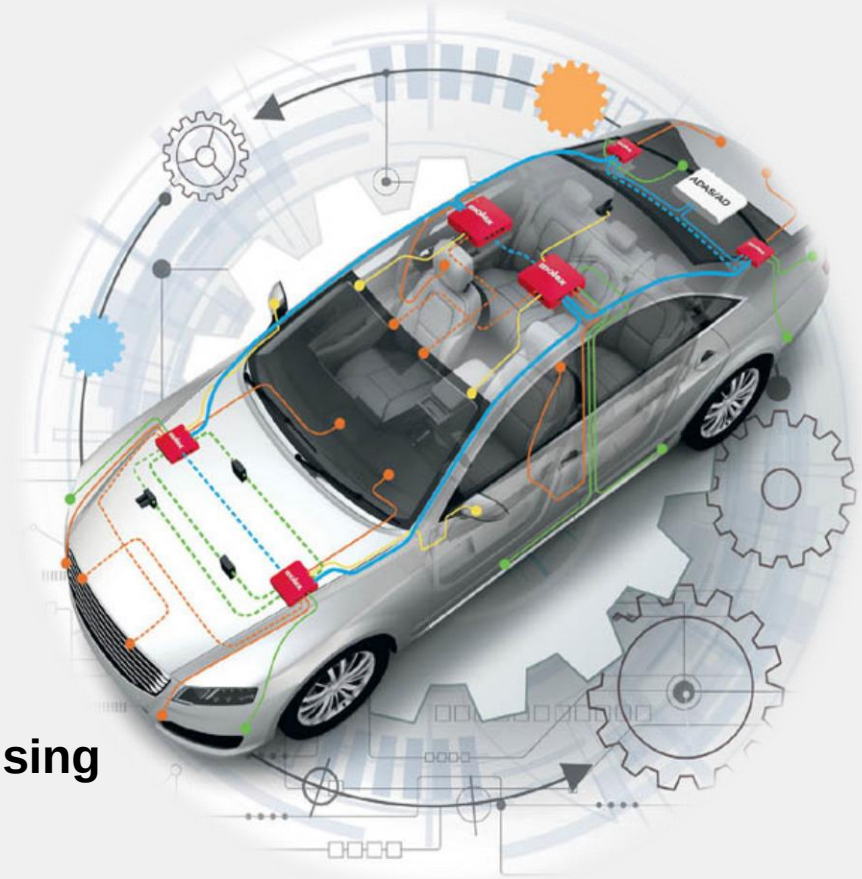
- **Basic Introduction to SLAM**
  - What is SLAM?
  - Why Simultaneous?
  - Role of Localization
  - Role of Mapping
  - Why SLAM is needed?
  - Methods of Implementation of SLAM
- **Introduction to State Estimation**
- **Localization**
  - GNSS
  - Odometry
  - LIDAR
  - Cameras
  - INS
- **Estate Estimation and Localization Using SLAM Workflow & Examples**



What is SLAM?

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- SLAM – Simultaneous Localization & Mapping
- Builds a global map to navigate or deduce the location at any point in the time.

Why Simultaneous?

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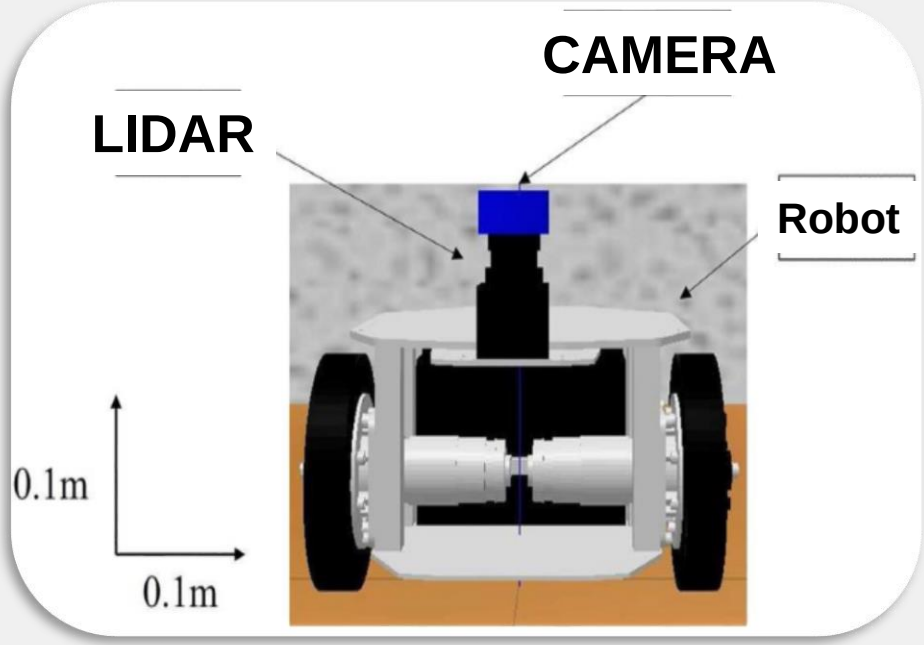
- Autonomous Navigation
- Building a Map
- Simultaneously Localizing



Simultaneous Work

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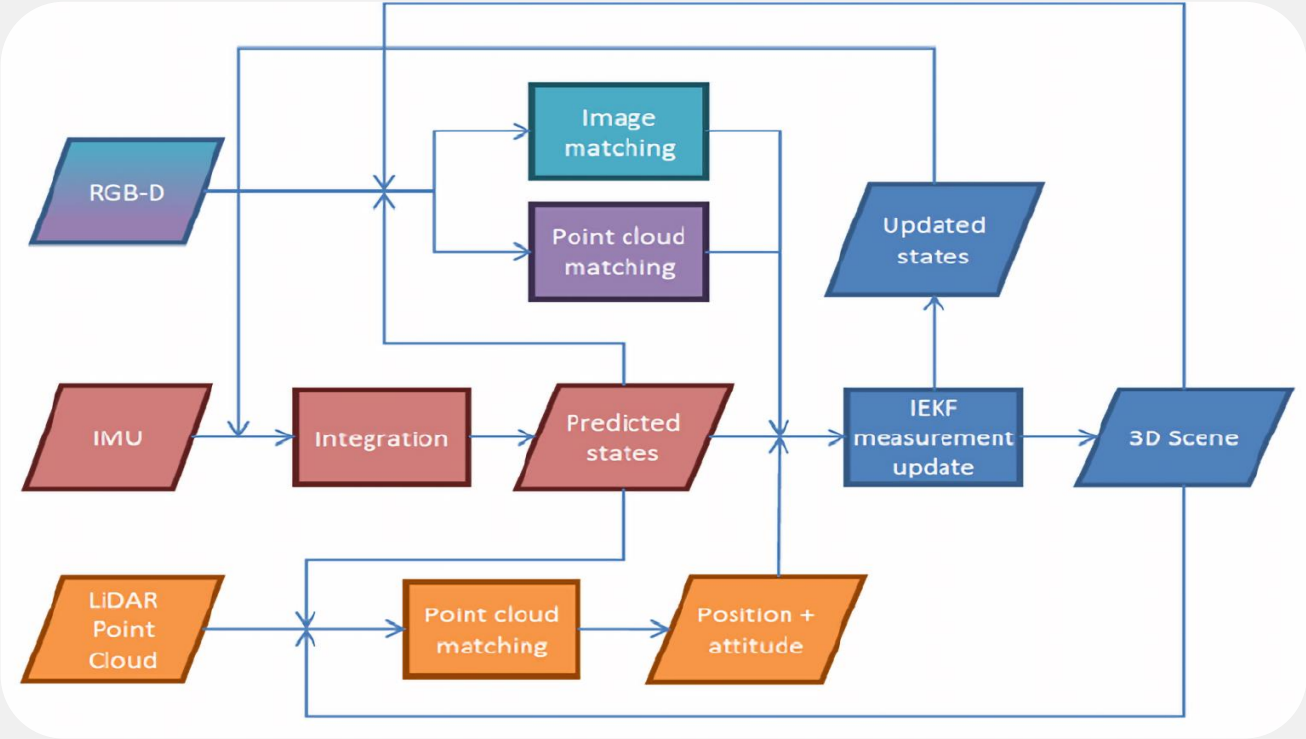
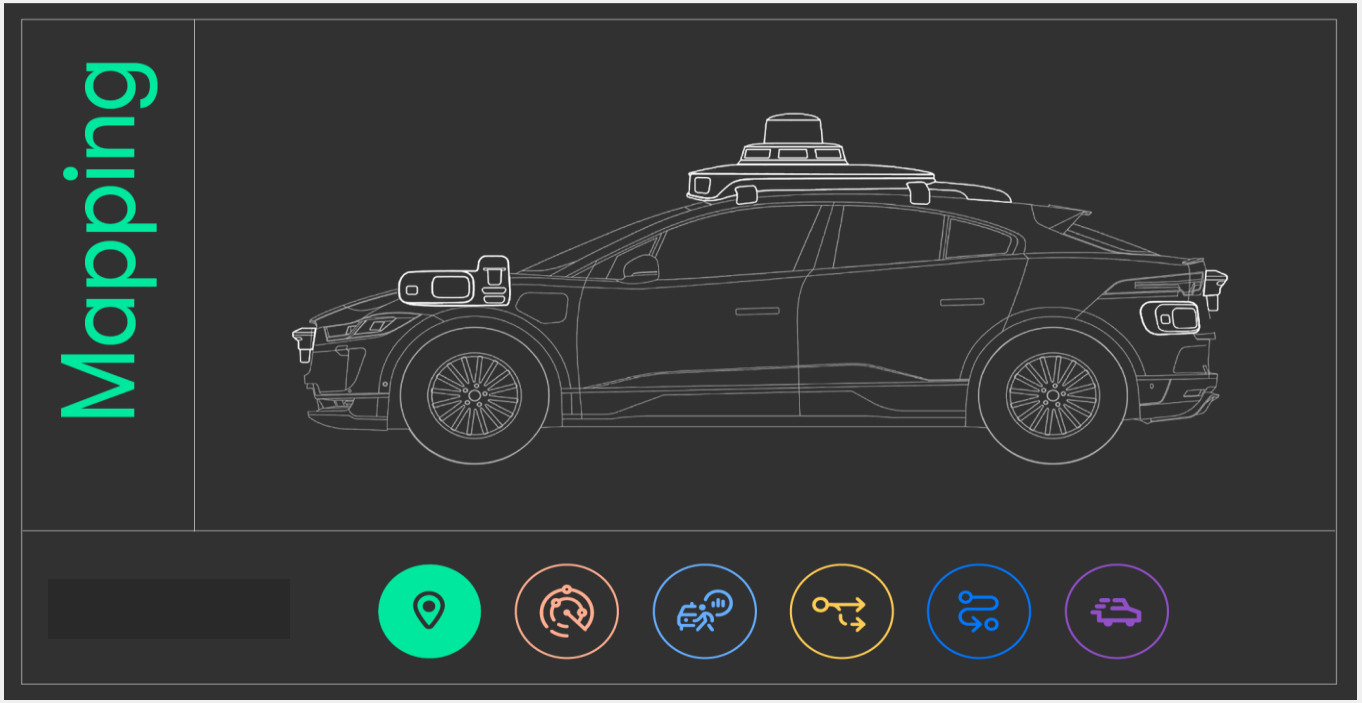


Overall Workflow of SLAM

Role of Mapping



To carryout tasks of path planning and obstacle avoidance.

Why SLAM is Needed?

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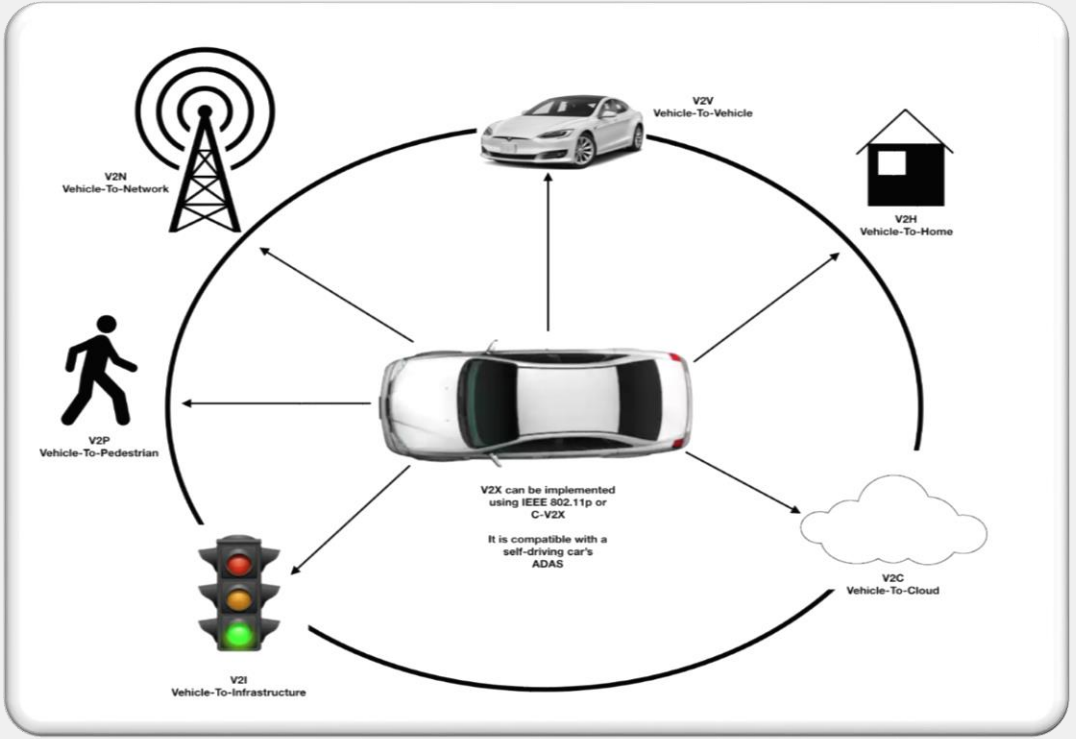
SLAM helps in:

- **To build a map within an unknown or known environment**
- **Keeps the track on current location**
- **Perform the safety measurements**



Role of Localization

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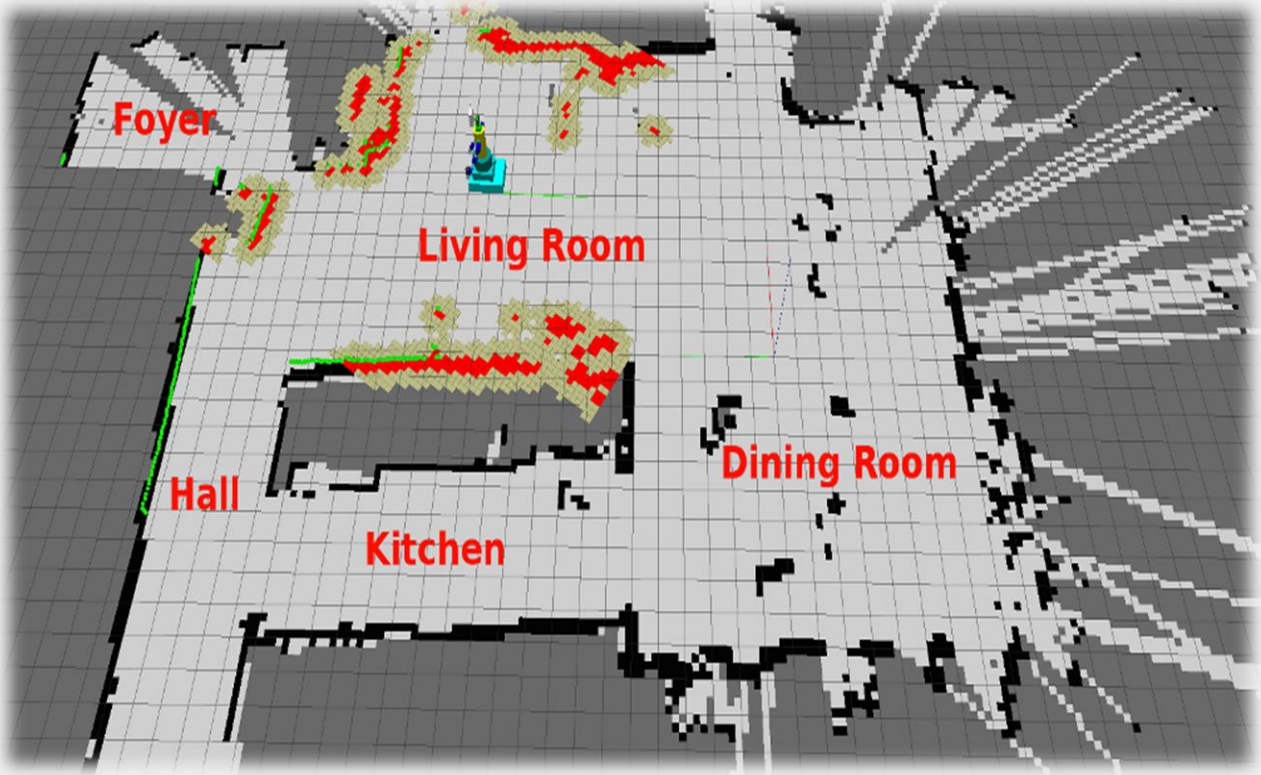
- Location
- Current Position
- Decision Making



State Estimation

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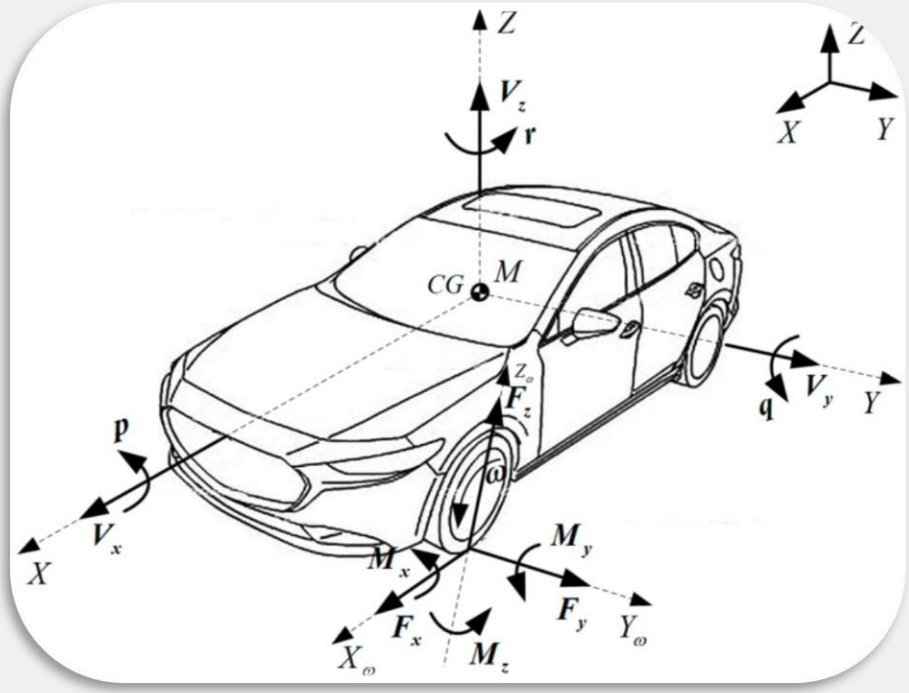
Best Value From Noisy Measurements

Techniques/softwares can be used are,

- **PolaRX@ 3-antenna GPS**
- **ESC-Sensorik**
- **Correvit**
- **IMU**



State Estimation

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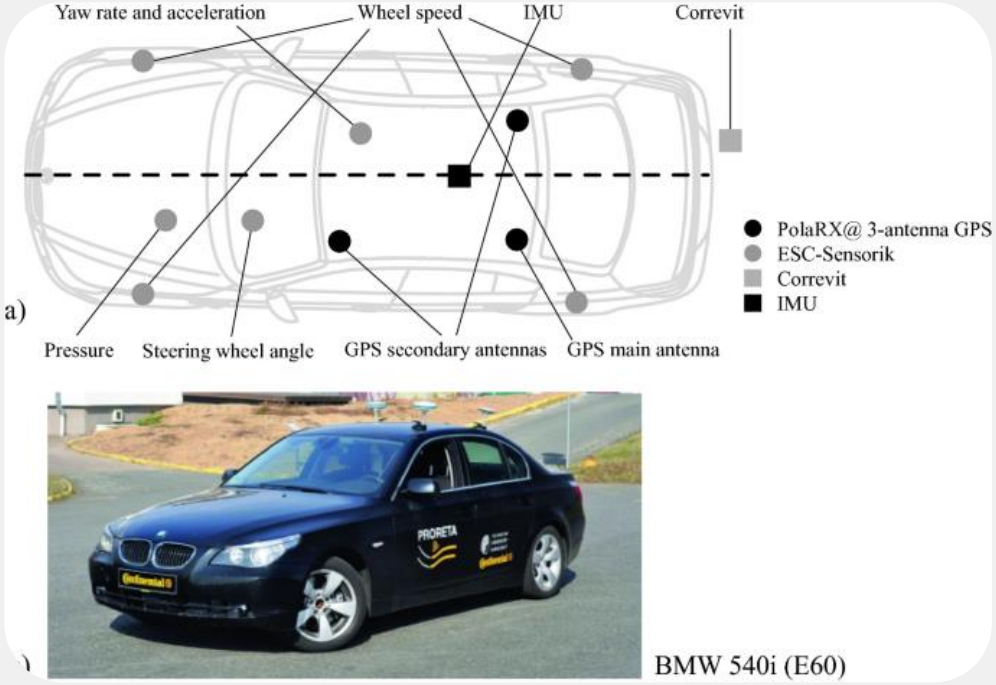
Measurements can be,

- Yaw Rate
- Acceleration
- Wheel Speed
- IMU
- Correvit
- Pressure
- Steering Wheel Angle
- GPS Secondary Antennas
- GPA Main Antennas



Localization

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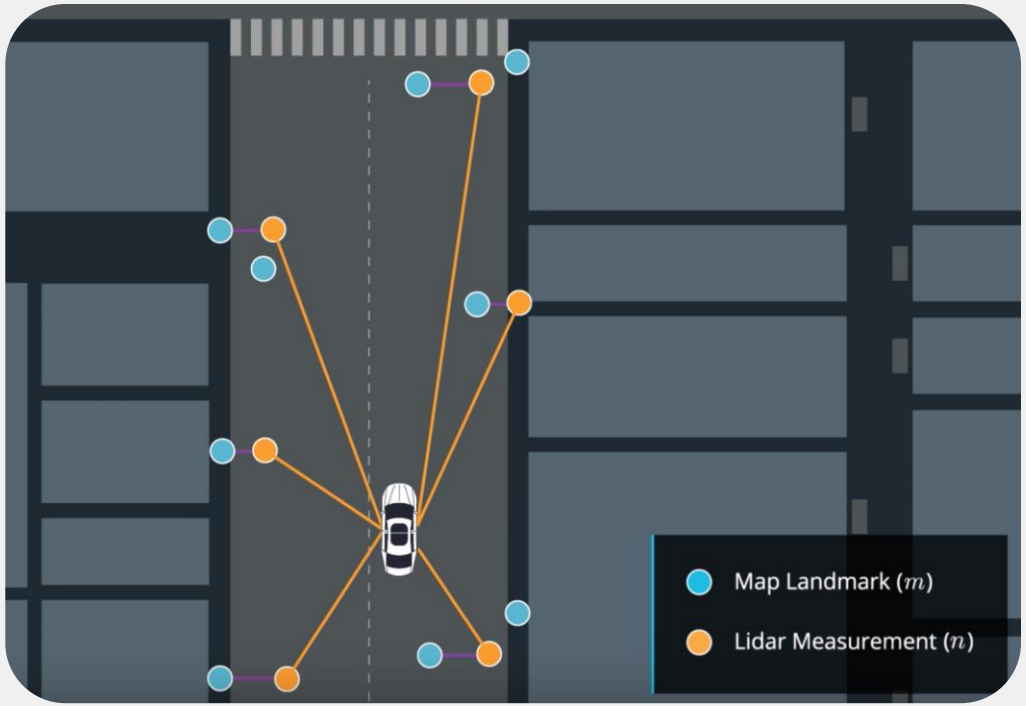
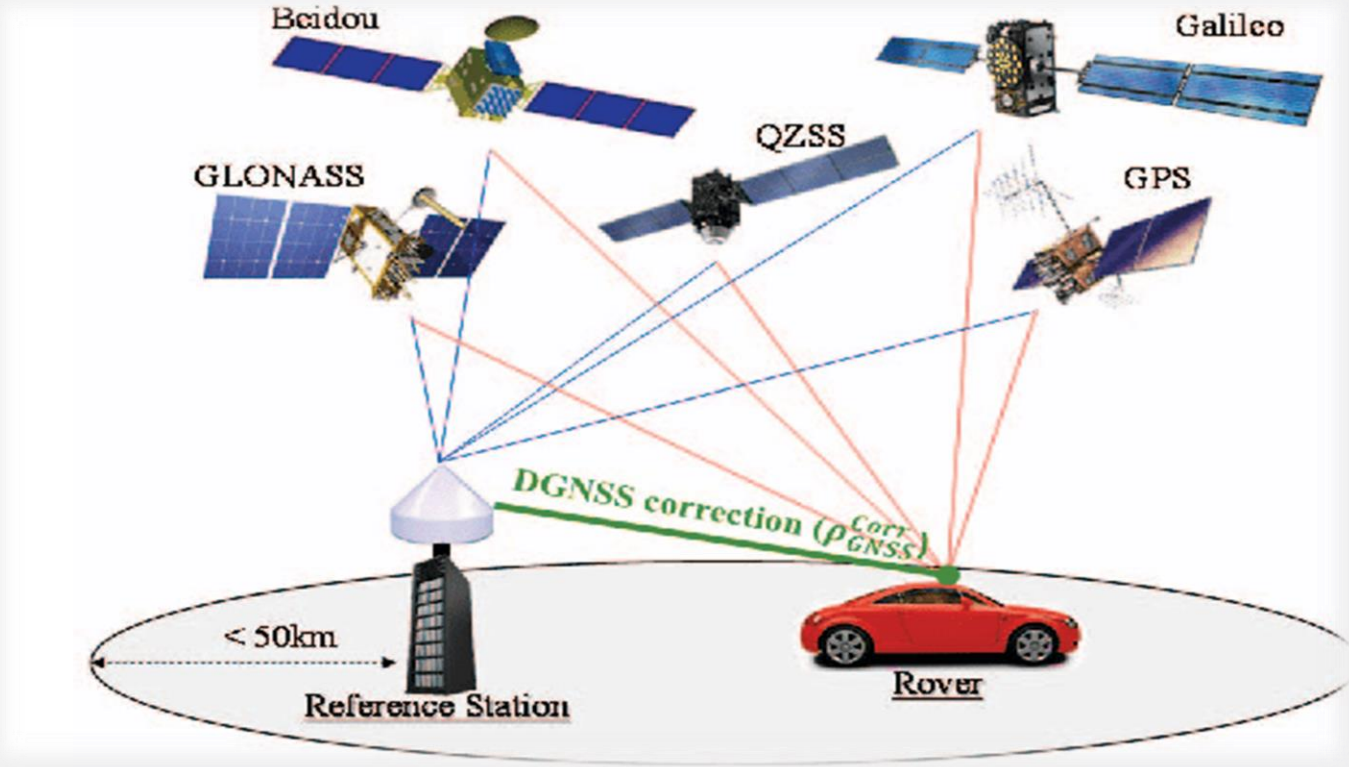
- **Finding the Location (Position or Orientation) on Map**
- **Uses Decision Making**



Localization by GNSS



GNSS – (Global Navigation Satellite System)

Localization by Odometry

Odometry estimates a vehicle's real position & orientation relative to beginning location.

Localization by LIDAR

LIDAR sensors acquire distance data from surroundings for laser navigation.

Localization by Cameras

Camera is very useful for visual navigation and obstacle detection, mostly at 360.

Localization by INS

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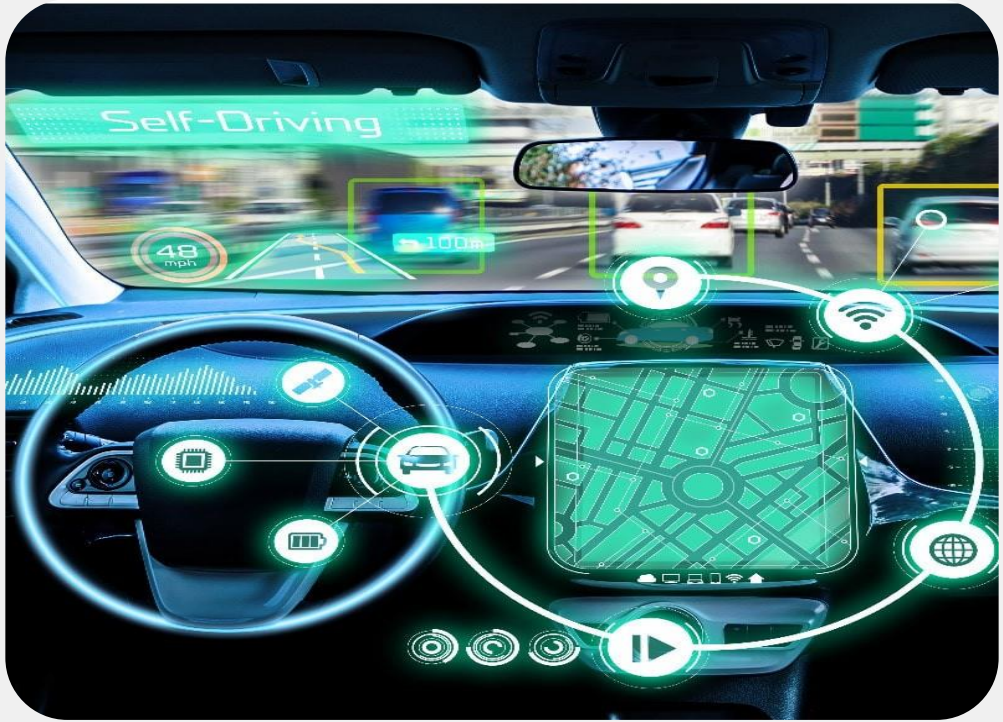
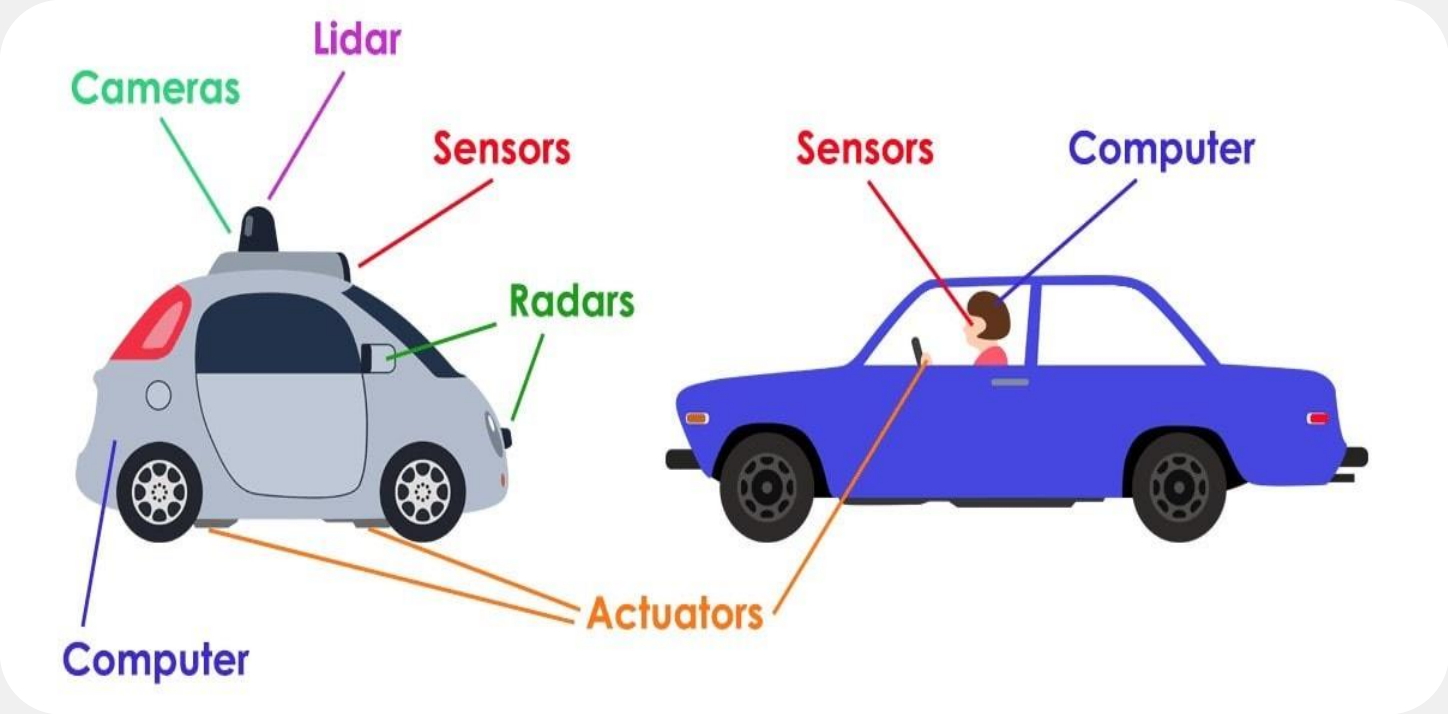


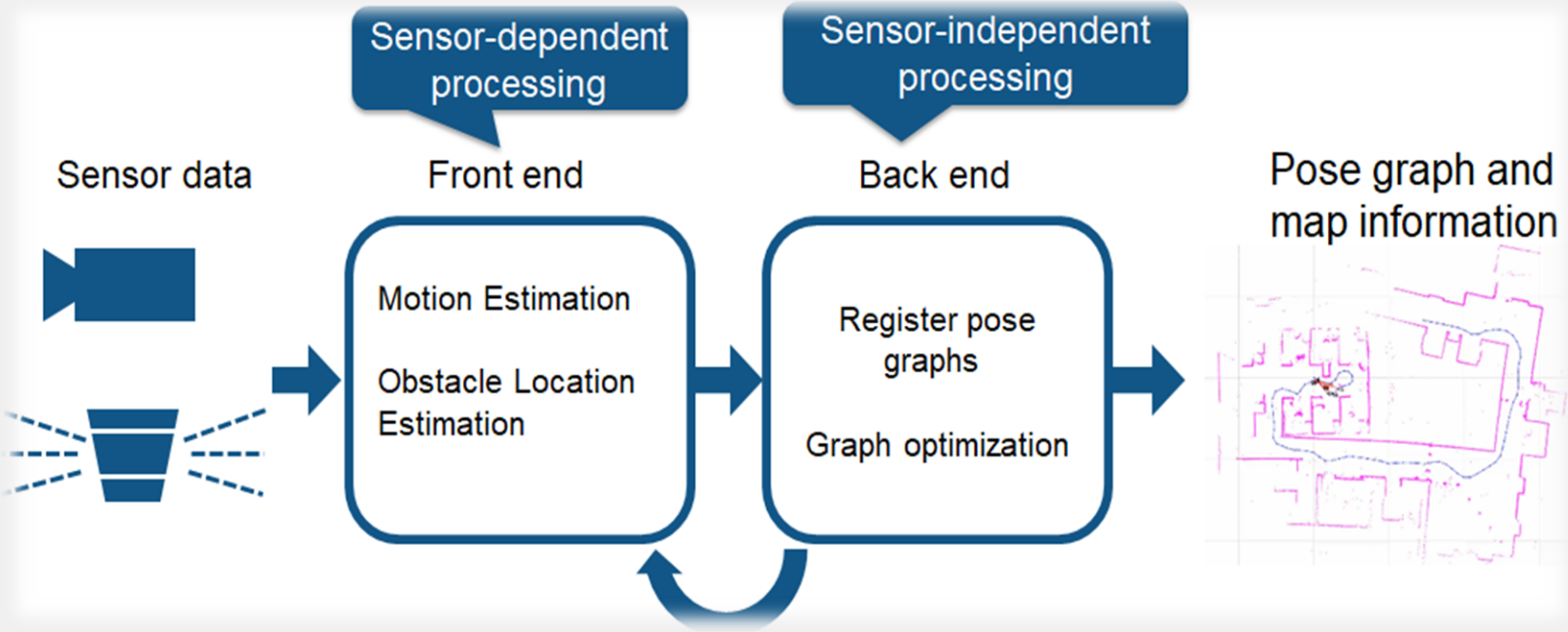
INS – Intertial Navigation System

MSF Based Localization



MSF – Multi-Sensor Fusion

Work Flow Diagram



Processing Flow Diagram

Example – 01

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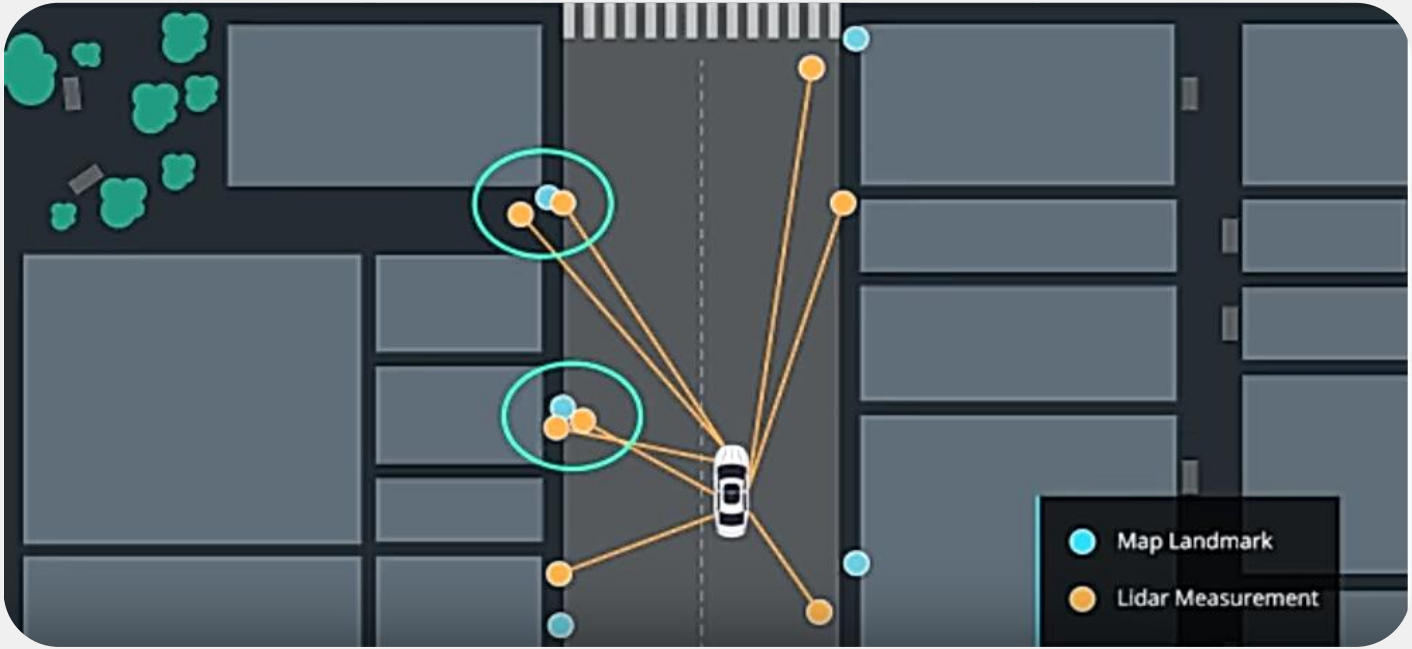
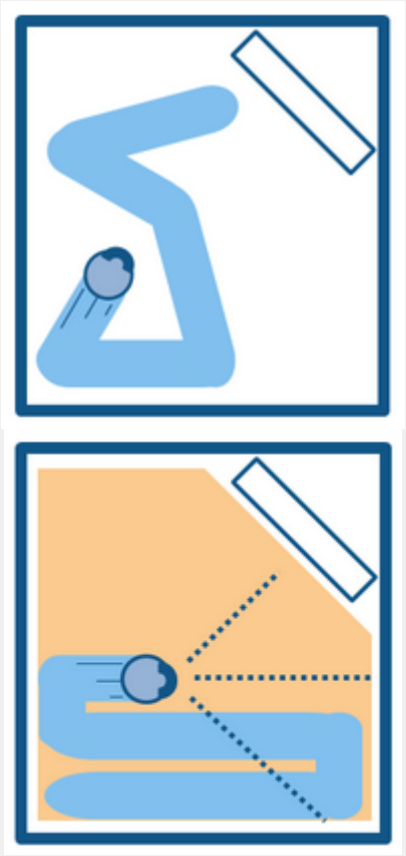


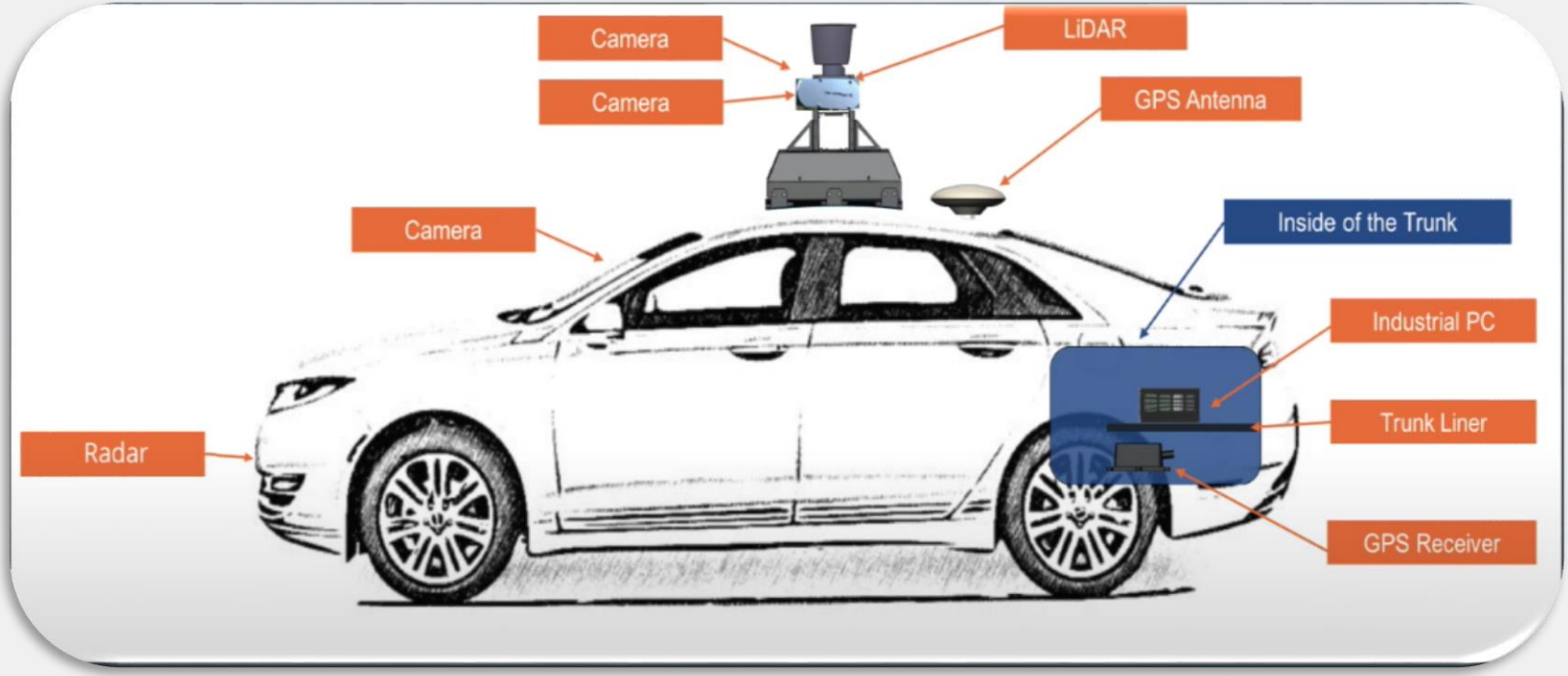
State Estimation and Localization Using SLAM

Example – 02



Automatic Vacuum Cleaner (Robot)

Methods of Implementation



Implemented using Multi-Sensor Fusion (FSM) based technique.

SUMMARY

AUGMENTED STARTUPS
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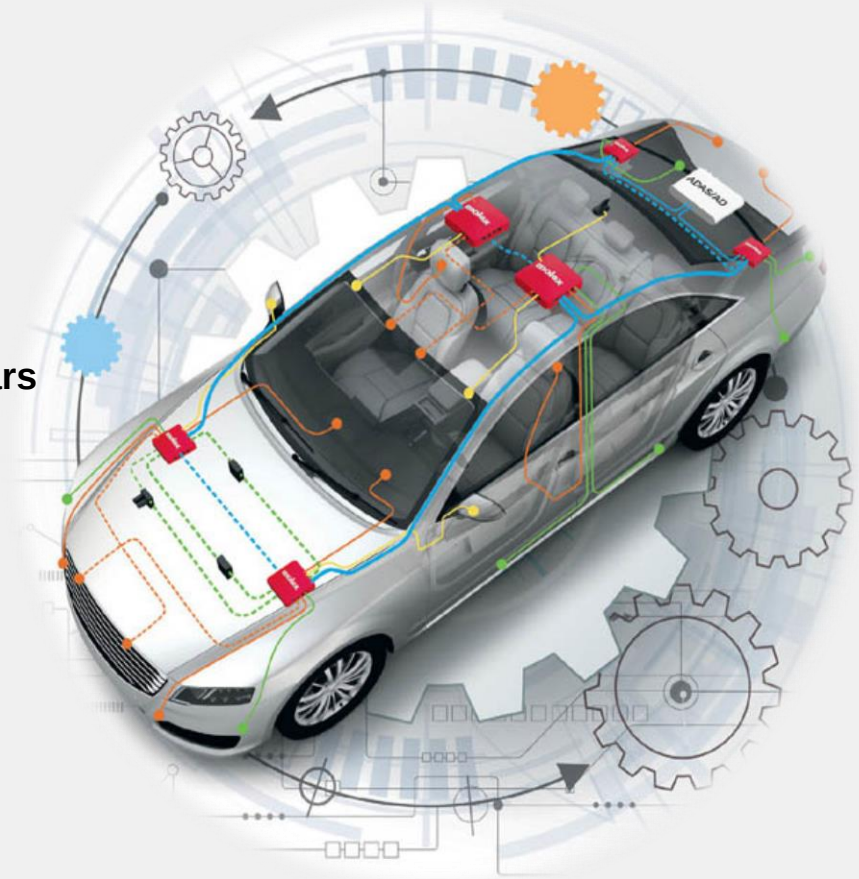
- SLAM
  - Basic Intro
  - Why Simultaneously?
  - Why Localization?
- State Estimation
  - Role of State Estimation in Self Driving Cars
- Localization
  - Types of Localization
- Overall Work Flow
- Implementation of Technique
- Example – 01 & Example – 02



References

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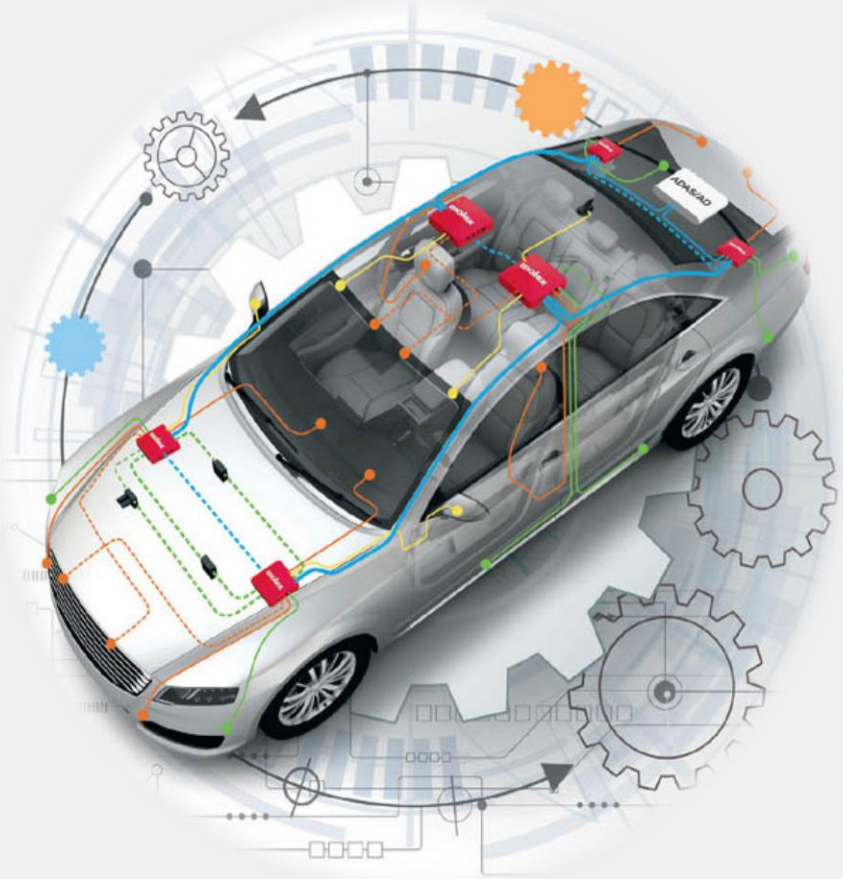

Thanks