AV Localization

EPISODE 0018


DRIVEN
What's in an AV Map?
EPISODE 0006


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How an AV Plans its Mission
EPISODE 0010

AV POSE

- **MAP: High-def map of ODD**
- **MISSION: Provide destination**
- **GO: Navigate to destination**

- ***Position***
- ***Orientation***
- ***Speed***
- ***Acceleration***
- ***Orientation rates***

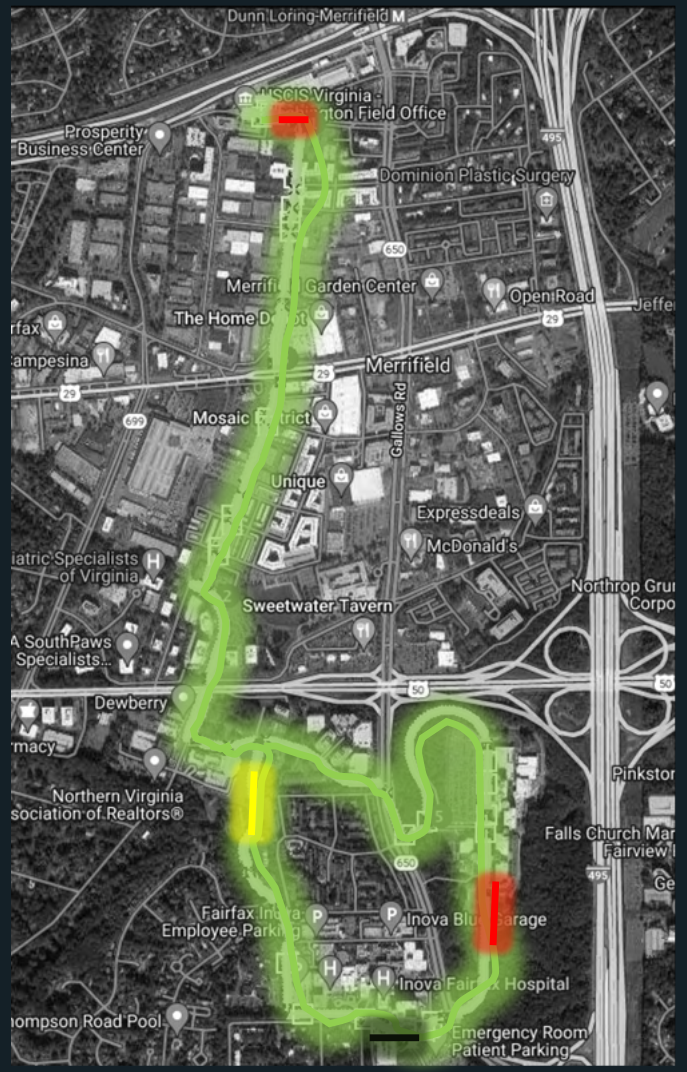
GPS-Based Guidance

- ODDs with surveyable GPS
- Characterization of routes

- Dual antennas
- Static & dynamic heading

- Encoders & position derived speed

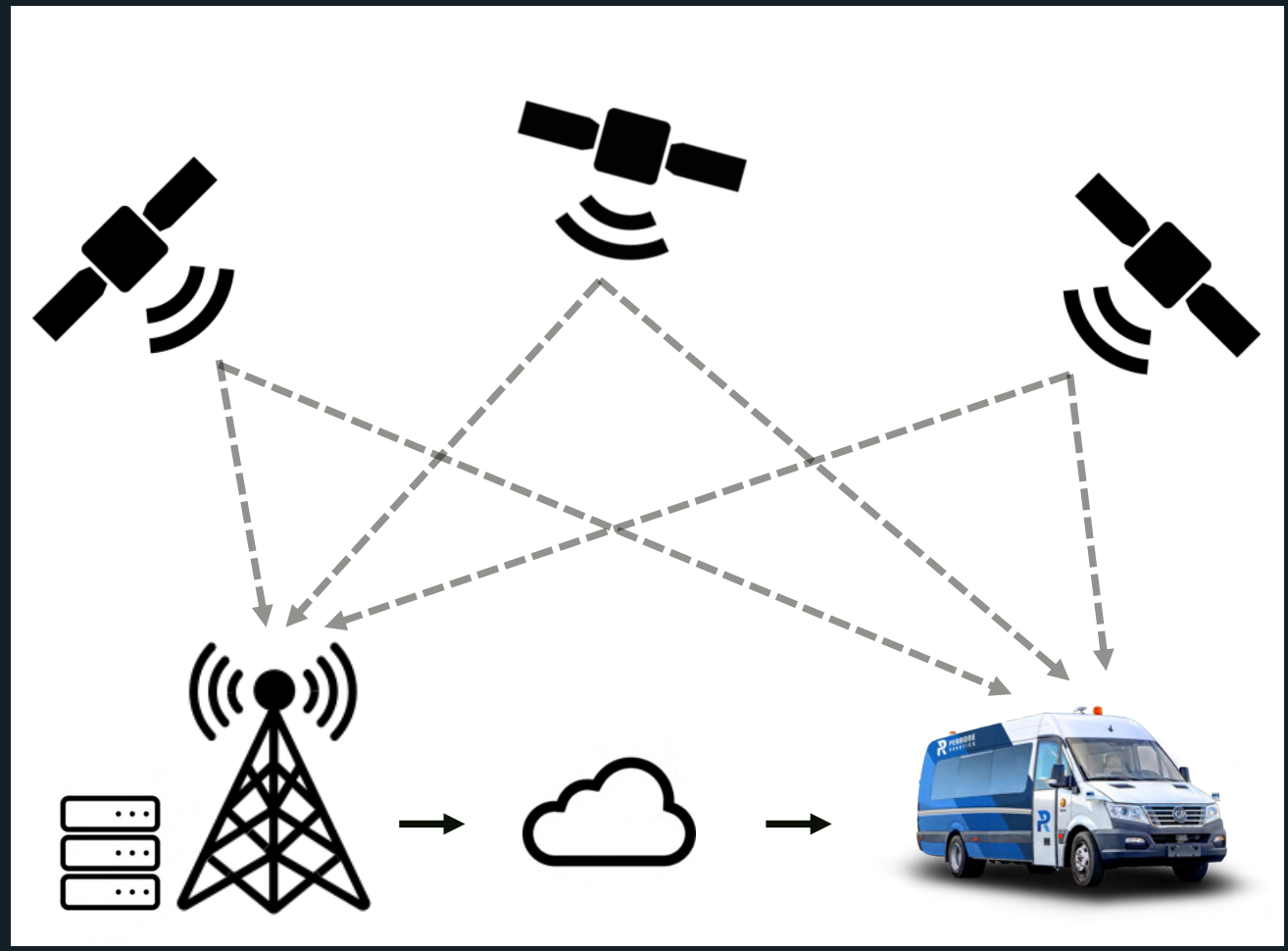
- Flexible constellation selection
- Built-in & augmented filtering



RTK Corrections

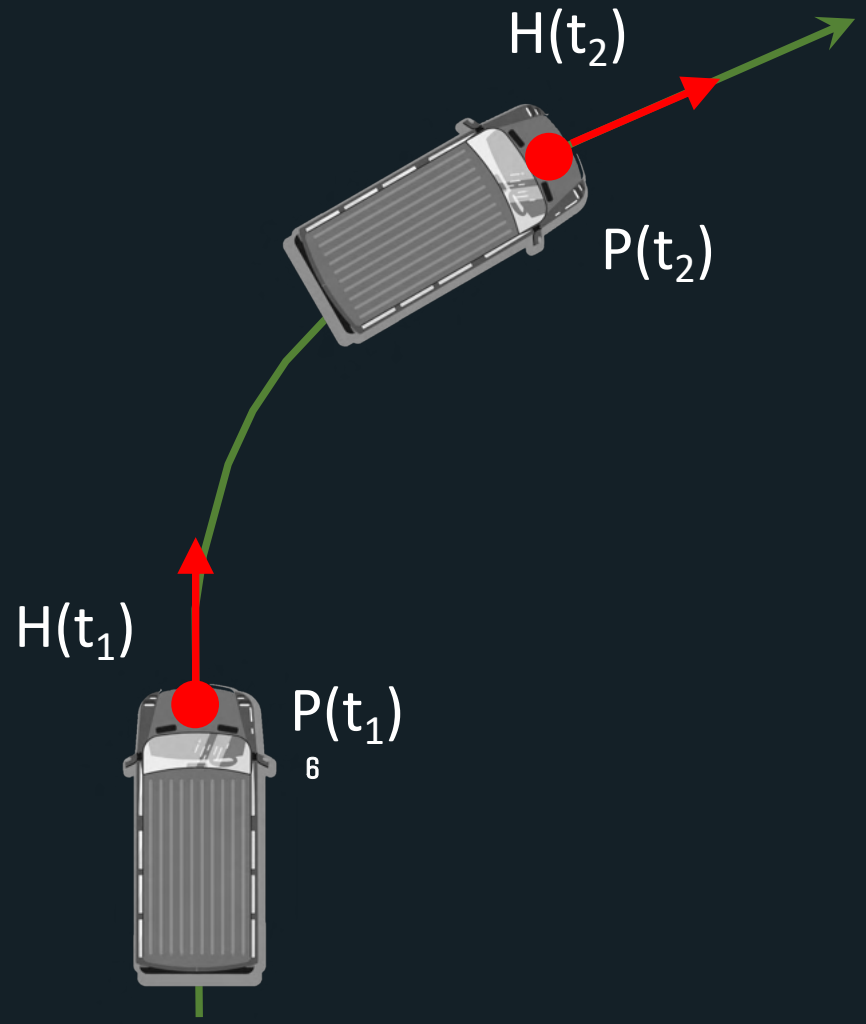
RTK: Real Time Kinematics

- **Correction service for position accuracy**
- **Cellular-based corrections**
  - Redundant cell service
  - Signal enhancement
- **Satellite-based corrections**
- **Fixed base stations**



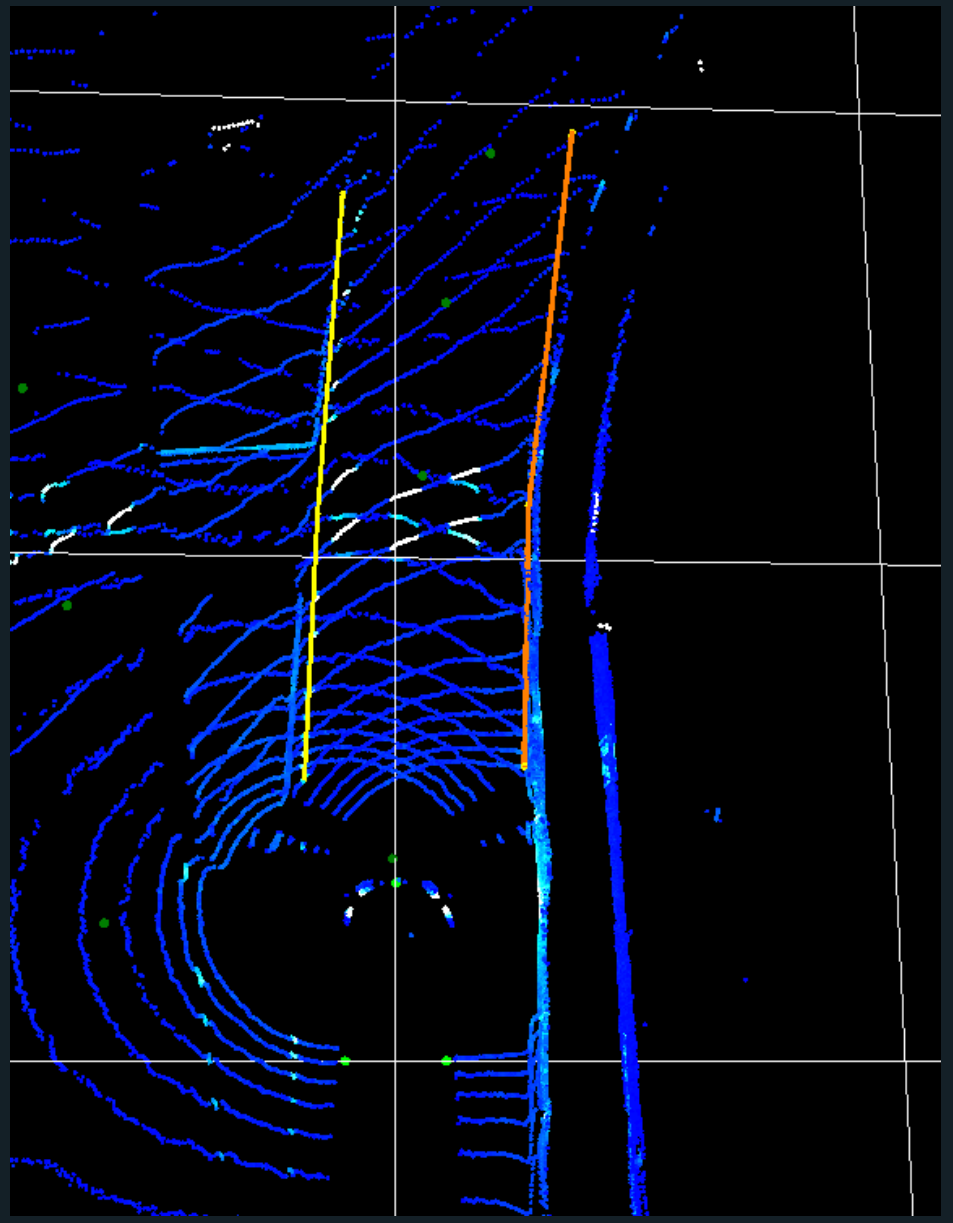
Dead Reckoning

- **Projection of positions & heading in degraded conditions**
- **Short distance “patch”**



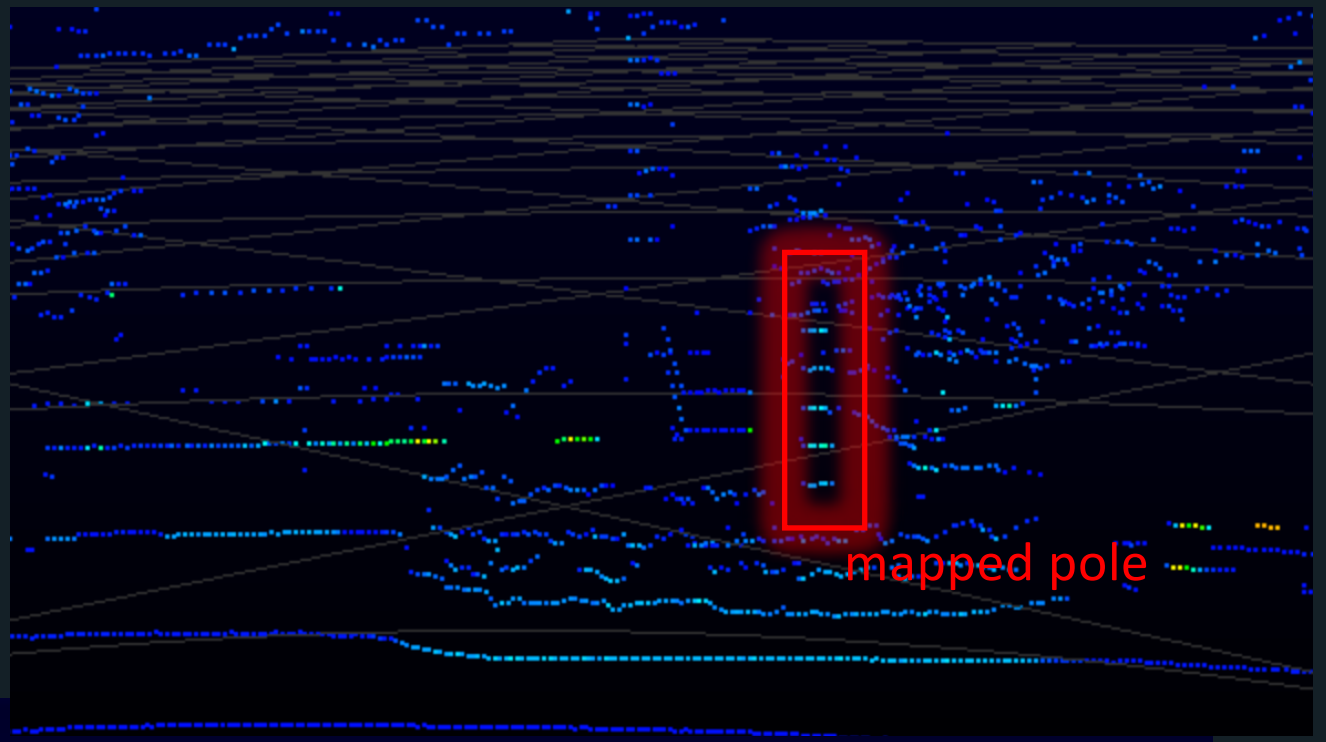
Lane Keeping

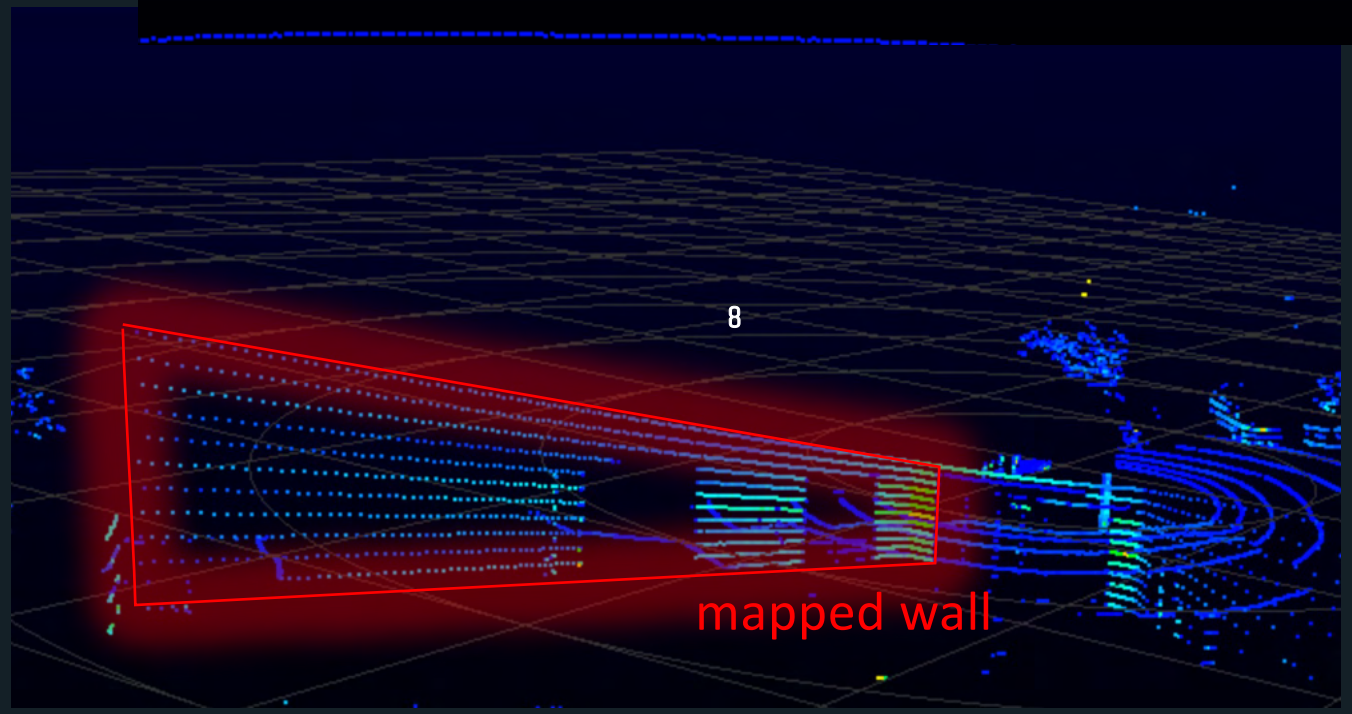
- **Lane lines & curbs**
- **Paved/gravel/grass/dirt**
- **Lateral position alignment**
- **Longitudinal position estimation**

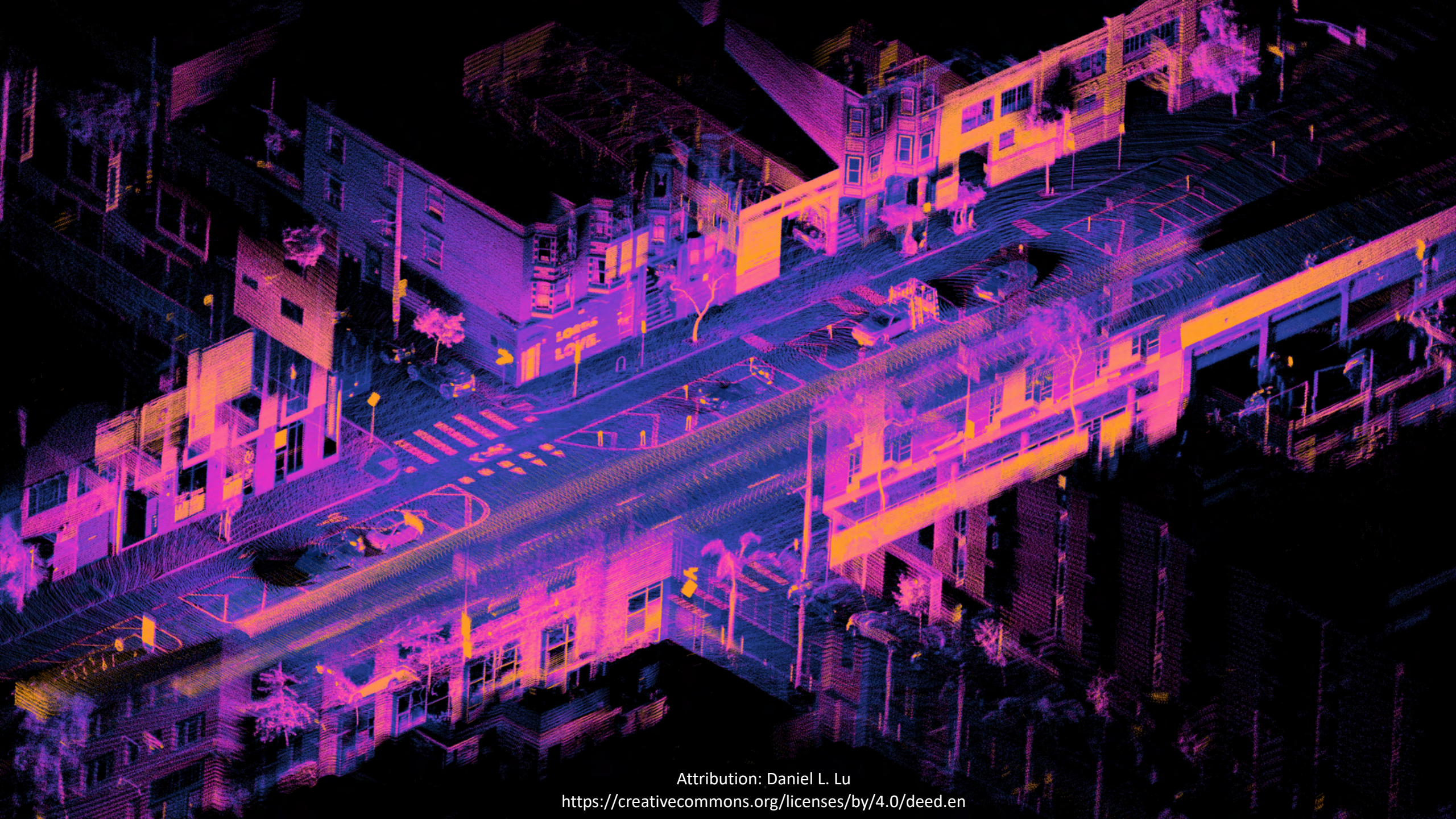


SLAM

- **Map world features**
- **Detect features while driving**
- **Triangulate location**

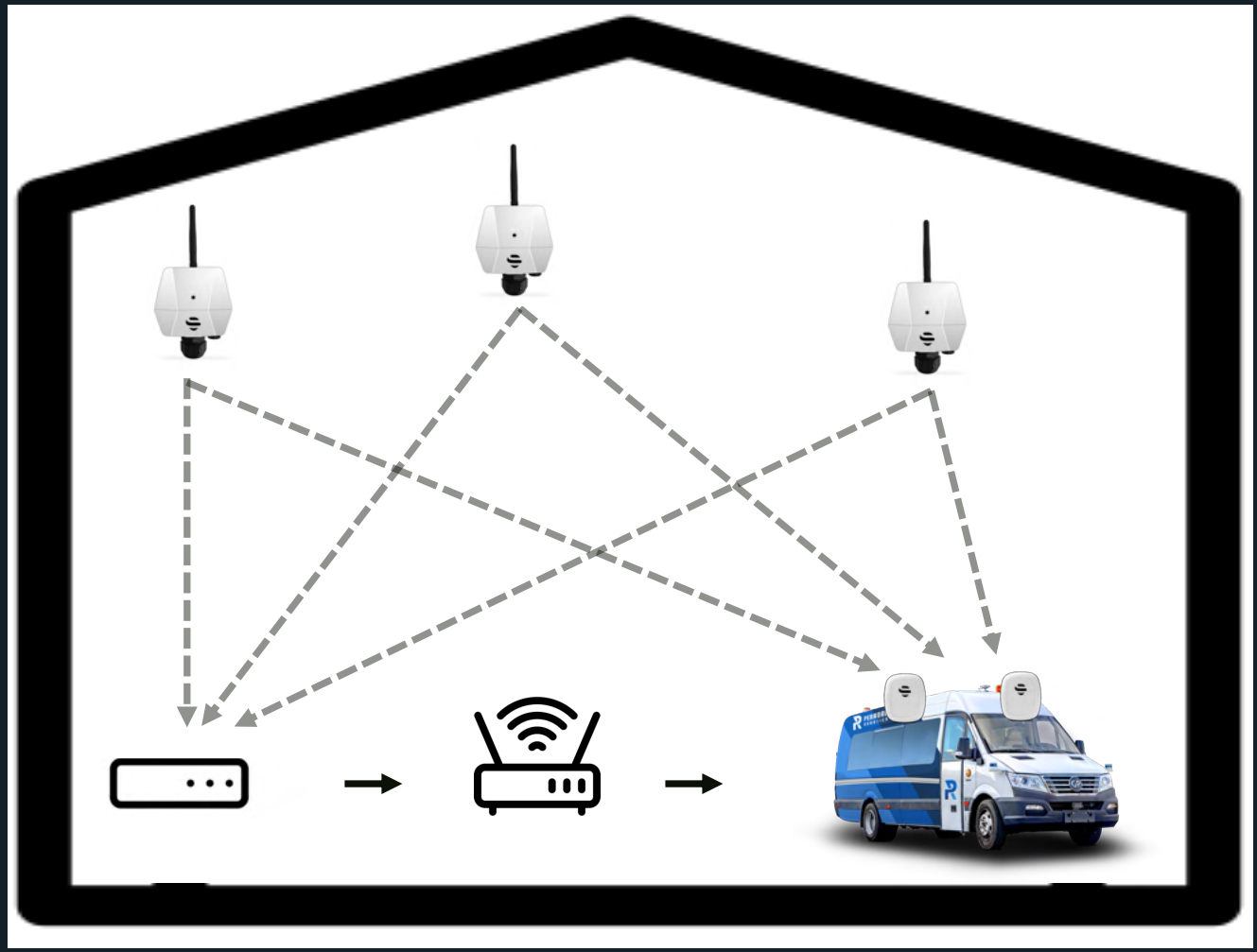






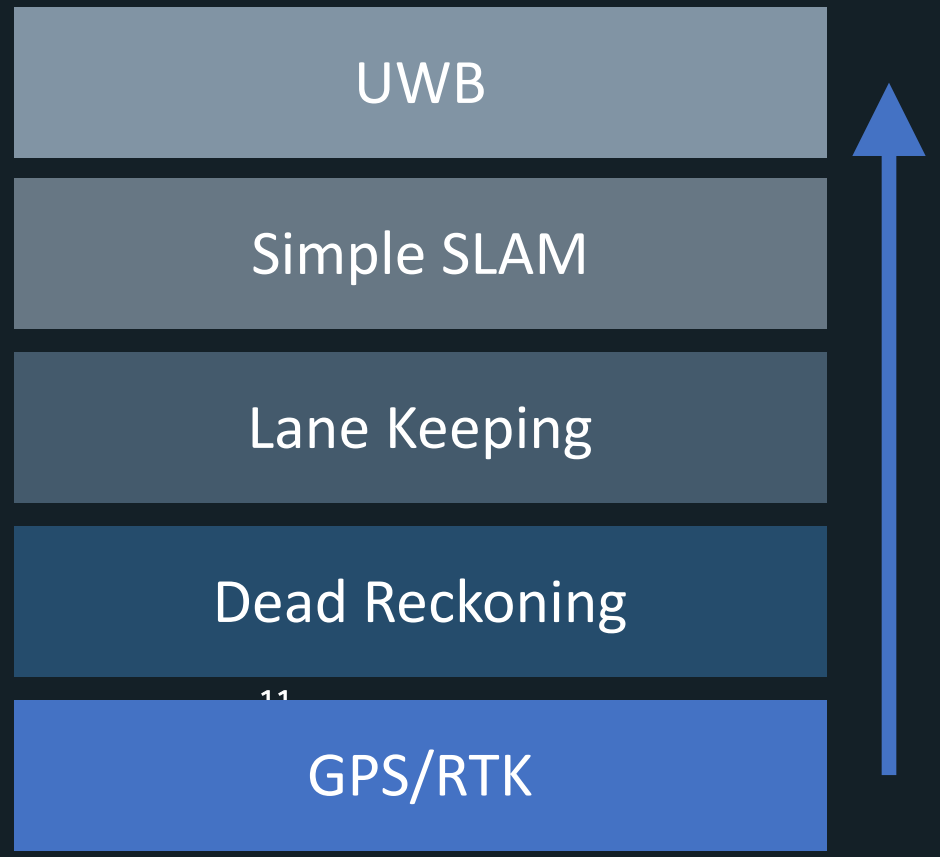
UWB

- Indoor environments
- Mount anchors in infrastructure
- Place tags on AV
- Obtain tag positions on vehicle
- Derive position & heading



Layered & Redundant Design

- **GPS/RTK as foundation**
- **Dead Reckon for patches**
- **Lane Keeping for longer patches**
- **SLAM for simple features**
- **UWB for indoor environments**

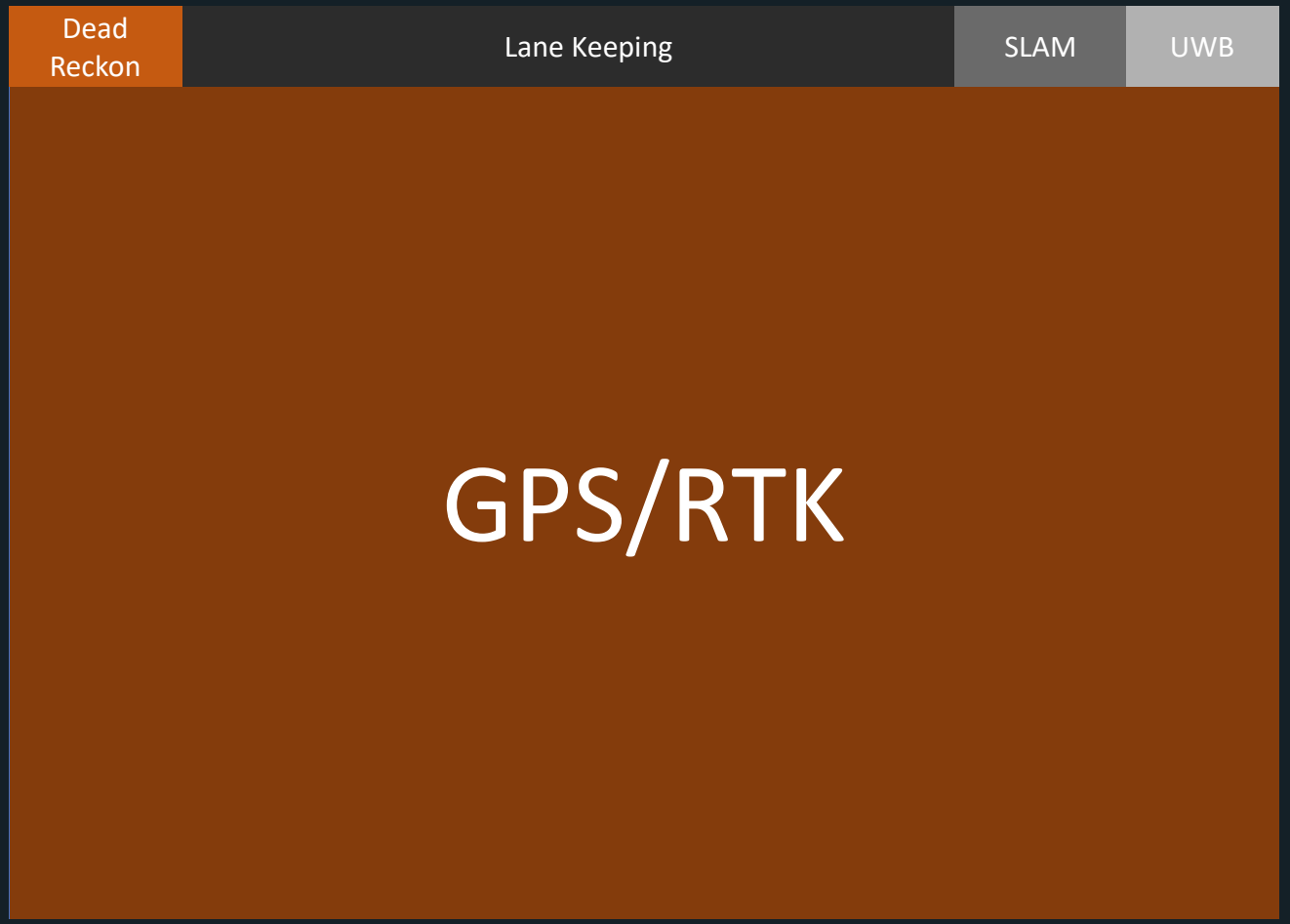


Graceful Degradation

- **Configurable max speeds based on modes & confidence**
- **Switch modes based on confidence during operation**
- **Build confidence and speed cues into maps**
- **Come to halt if no further recourse - teleop**

Coverage

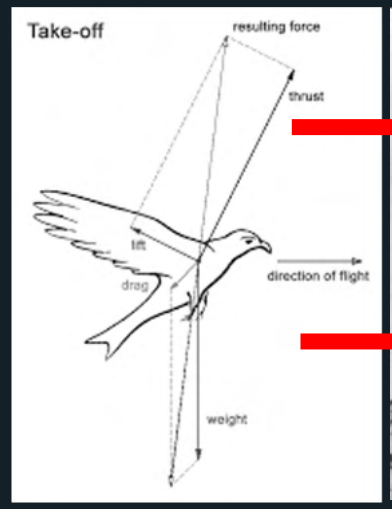
- **GPS/RTK can provide 95%-100% coverage for targeted L4 ODDs**
- **Dead Reckon & Lane Keeping to patch through outages**
- **Simple SLAM for simple environments**
- **UWB for complex indoor environments**



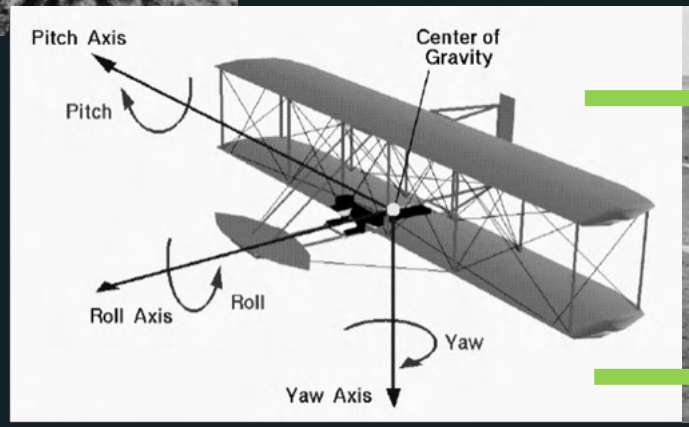
Pitfalls of SLAM & Machine Learning

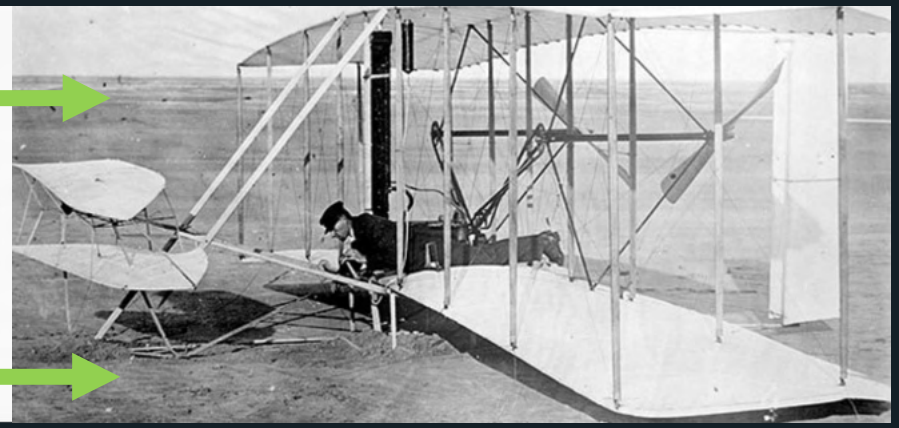
- **SLAM evolved from indoor nav in labs & offices**
- **Poorly suited for complex and changing environments**
- **SLAM & Machine Learning (ML) as probabilistic vs deterministic augmentation**

Probabilistic Bio-Inspired
vs.
Deterministic Controls-First



"Bio-Inspired"





"Controls First"

Lead with Determinism

- **L4 ODDs can be characterized for GPS/RTK**
- **95%-100% coverage across many ODDs**
- **Lead with determinism**
- **Gracefully degrade with other modes**
- **Redundancy of algorithms**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