

A localization stack for L4 autonomous driving

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A Decade of Autonomous Driving

Continental's Systems of Interest



A Decade of Autonomous Driving

Real World Impressions

**A Seamless Journey of
Driverless Mobility
powered by the
Common Core**

Commuting to the City...



Automated Valet
Parking...



Last Mile using
Shuttle

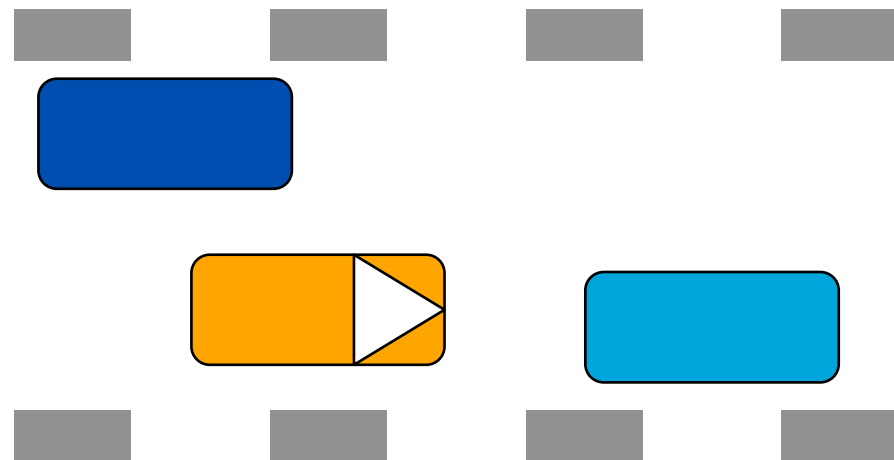


Driverless Truck



Localization Stack for L4 AD

Why do we need a localization stack?



 Ego Vehicle

 Sensed Object

 Static Object from HD Map

 Previously Sensed Object

HD-Map [G]

Position [L]

Sensorics [B]

AD Functions

for AD we need everything in a common coordinate frame!

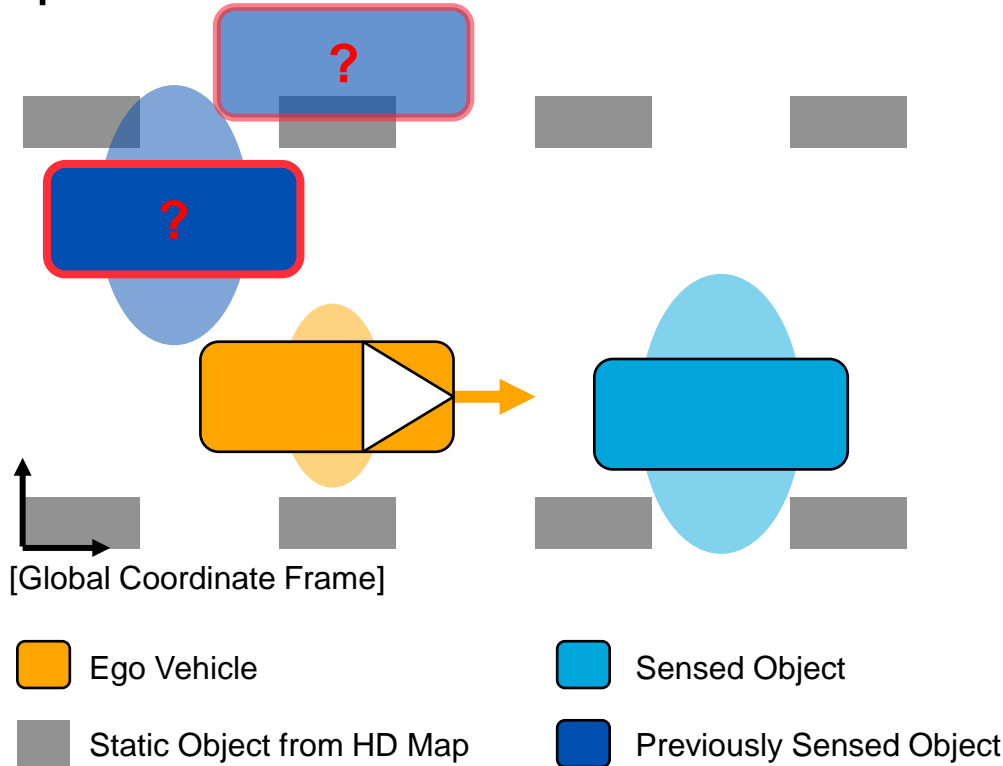
[G] Global Coordinates

[L] Local Coordinates

[B] Vehicle Body Coordinates

Localization Stack for L4 AD

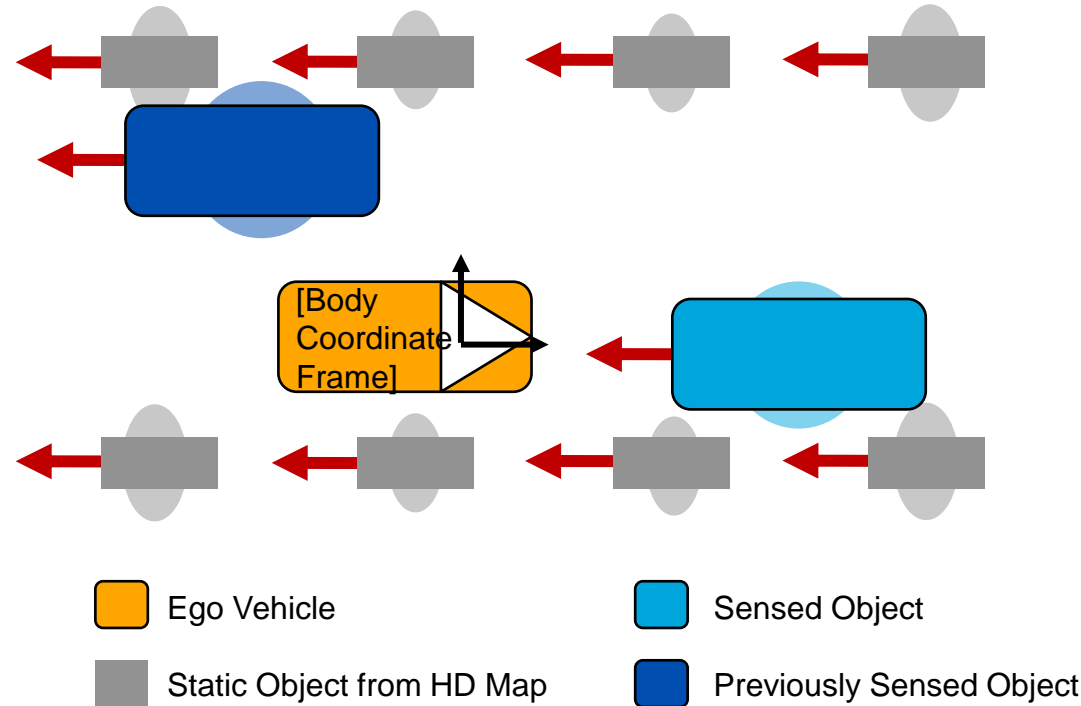
Option 1: Global Coordinate Frame



- **very uncertain environment model in [G]:** detection uncertainty + position uncertainty
- **possibly inconsistent**, e.g. jumps lead to previous detections in the wrong place
- **Robustness / safety:** absolute localization depends on external information (e.g. GNSS, landmarks+map)

Localization Stack for L4 AD

Option 2: Body Coordinate Frame



+ vehicle position known exactly
(=coordinate origin)

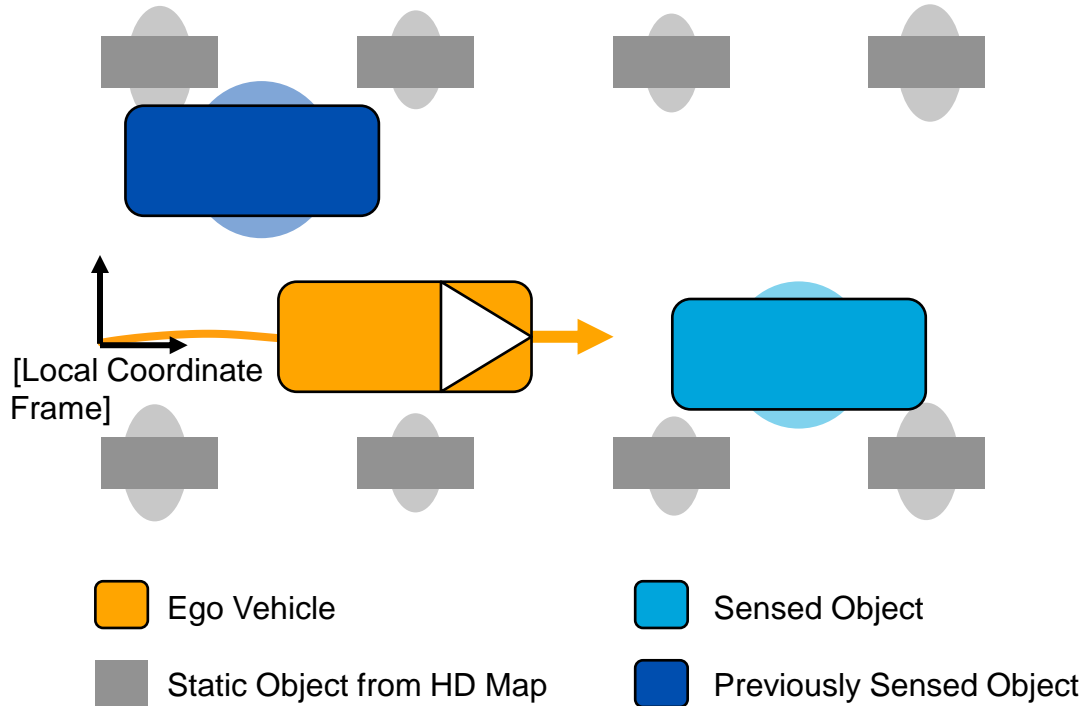
+ direct representation of detections

- no direct access to HD map:
Global Position needed to transform map

- inefficient, inaccurate and complex:
whole environment model “shifts”

Localization Stack for L4 AD

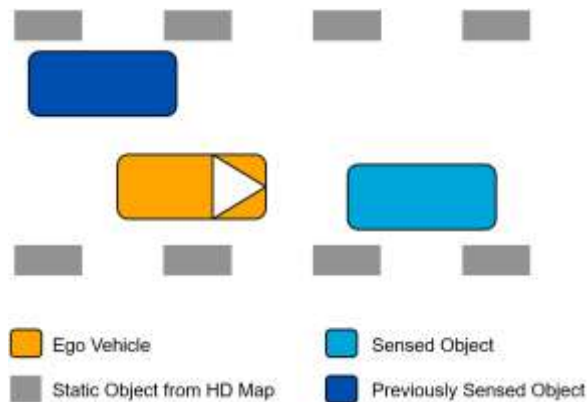
Option 3: Local Coordinate Frame



- + move the vehicle, not the environment
- + consistent environment model
accurate spatial relations on short-term
- + higher availability: no dependence on external information
- no direct access to HD map:
Global Position needed to transform map

Localization Stack for L4 AD

How do we put the best pieces together?



HD-Map [G]

„Absolute Localization“

Position [L]

„Relative Localization“

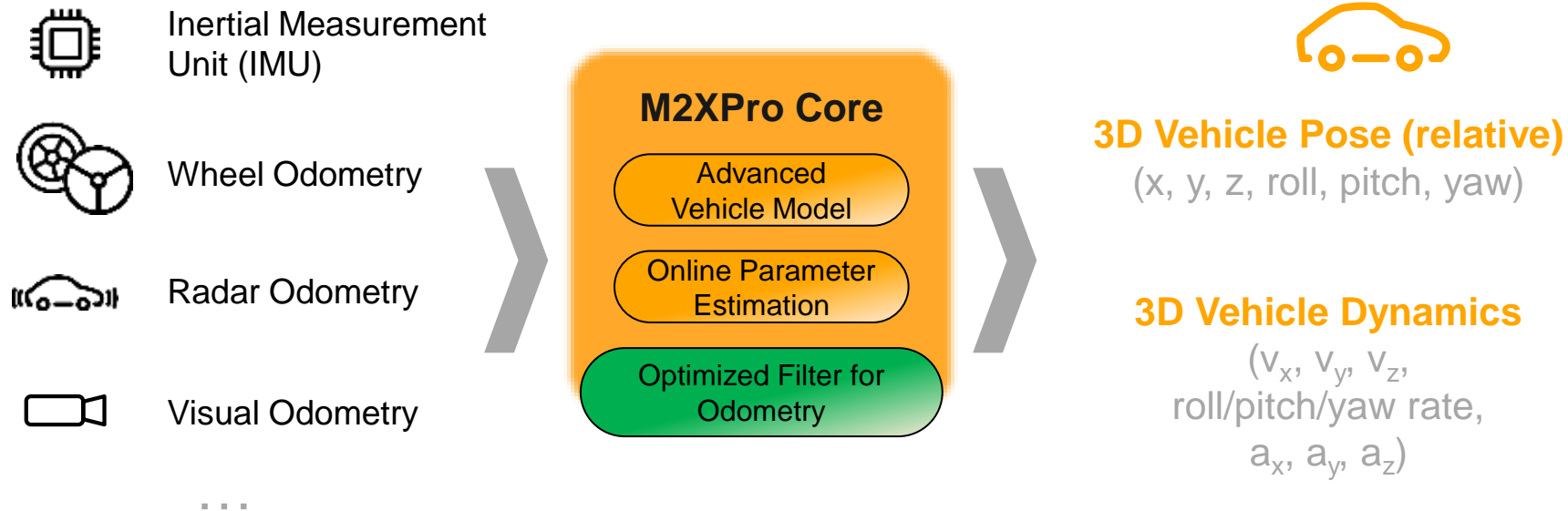
Sensorics [B]



AD Functions

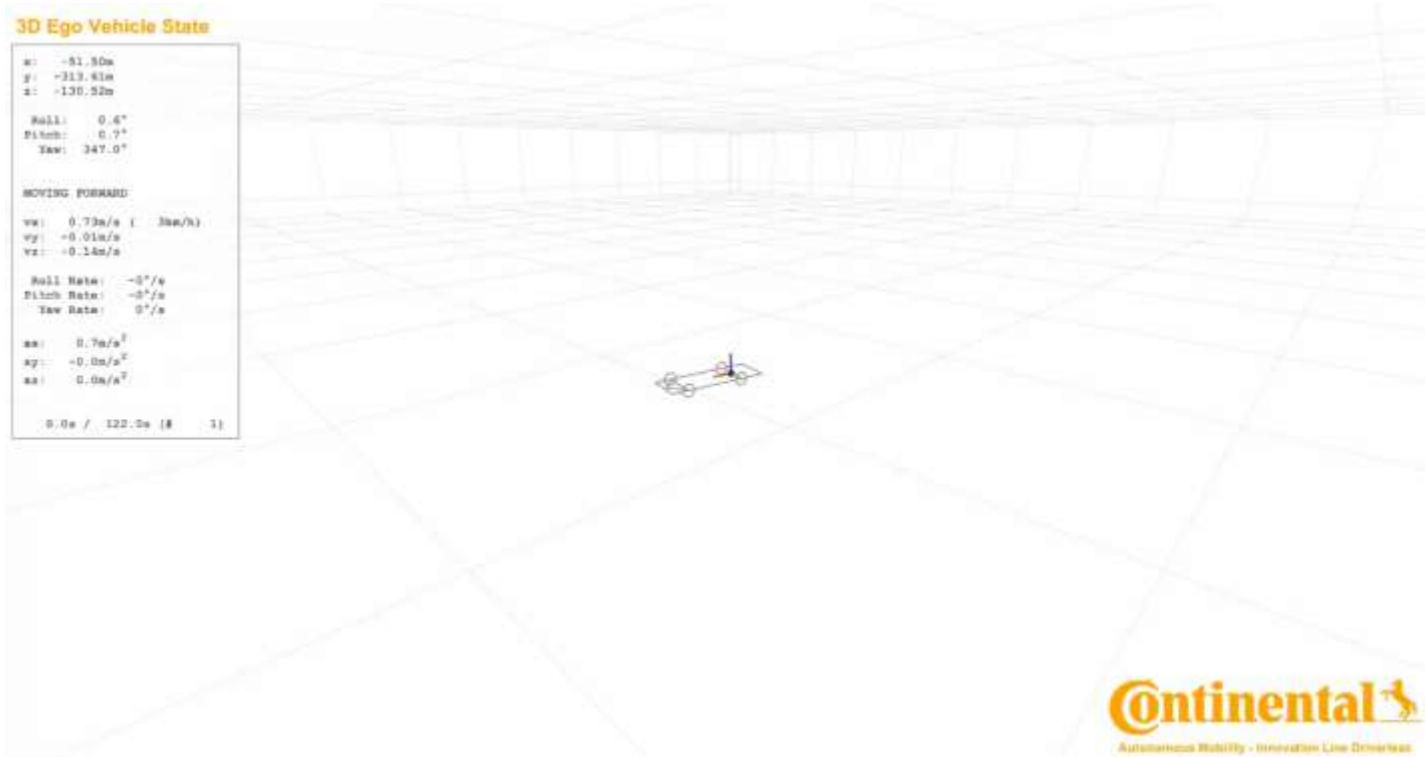
Relative Localization

3D Odometry Fusion Overview



Relative Localization

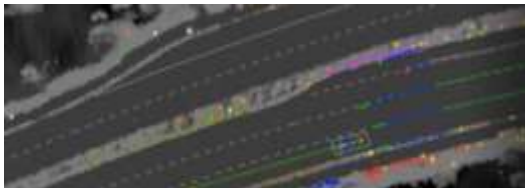
Real World Example: Garage Test Drive



Absolute Localization

Why do we need an absolute localization?

- › **Safe and secure position to drive based on HD maps**



- › **Using consistent maps with absolute offsets**



- › **Robust when an input fails**

GNSS outage in urban areas



Indoor Operation (Tunnels, Parkhouse, ...)



Limited visual perceptability



Unreliable Odometry (slip)



Absolute Localization

Landmark based Localization - Lanes and Radar Features Example

Landmark-based Localization Technologies



Radar based localization



Traffic Sign Localization



Lane Marker Localization

Front- and surround view cameras

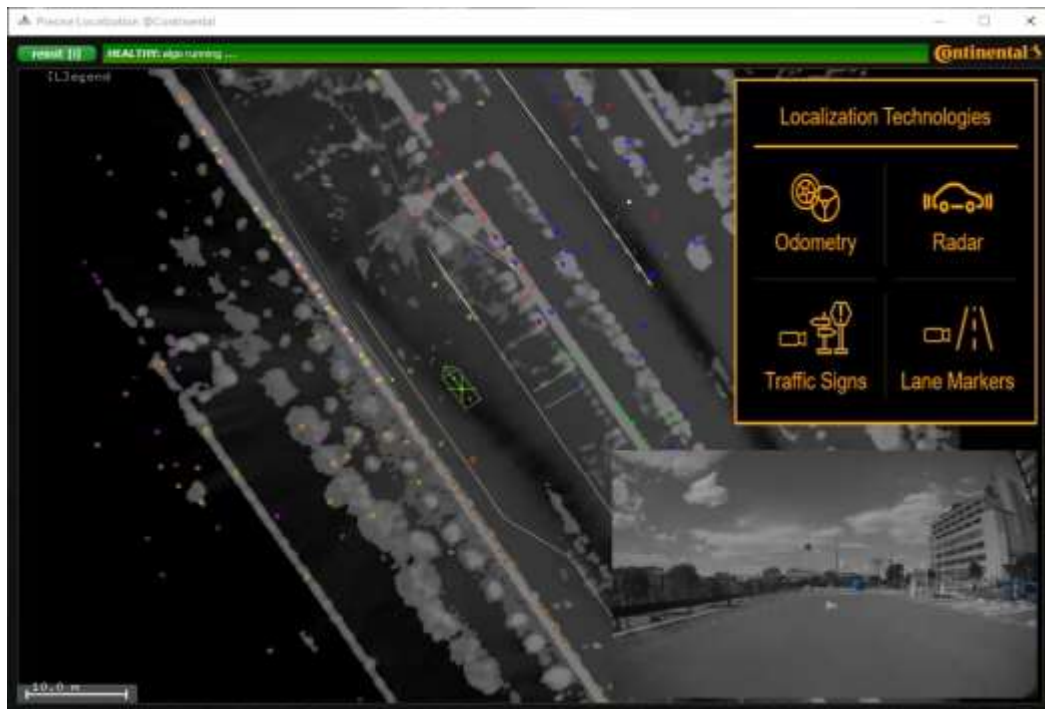


Odometry

including accurate motion models

Supported Conti-Sensorics and Hardware

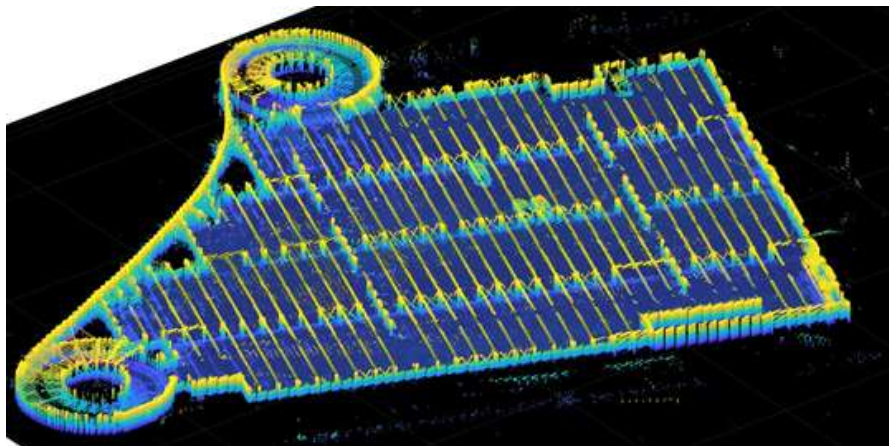
- › ARS430, SRR520 Radar (ARS540 planned)
- › SVC210/220 Surround view cameras
- › Odometry Fusion (modified M2XPro)



Absolute Localization

Can a feature-based localization layer be generic?

› Lidar pointcloud of our garage



› Testrun on derived radar localization layer



Application of the localization stack

Roadmodel: How our vehicle see map data

› Lanes, Topology and Attributes ahead



› In an Ego centric view



Thanks for your attention!

Q & A