

开启自动驾驶

自动驾驶车的定位技术以及供
应商体系以及应用场景

IN-DRIVING

GNSS系统方面的进展

□ GNSS

- 具有全球导航定位能力的卫星导航系统称为**全球卫星导航系统**，英文全称为**Global Navigation Satellite System**，简称为**GNSS**。

□ 现有GNSS

- **GPS**
- **GLONASS**
- **GALILEO**
- 中国北斗（**BeiDou**，原**COMPASS**或**CNSS**）

千寻公司是干什么的？

现在天上有四大导航系统，分别是：GPS、北斗、格洛纳斯、伽利略。这四种系统的功能是一样的，就是播发电磁波信号，地面端收到信号以后，通过解算得到所在位置坐标，

但需要注意的是我们地面端在使用的时候不是单用GPS、北斗、格洛纳斯或者伽利略其中一种，而是这几种系统组合在一起使用。

地面端“单点”定位精度最高1米左右，这个是导航系统原理限制，并不是咱们技术差比不上别人。

想要提高精度，解决办法就是架设一个固定的参考站，地面端通过接收参考站发过来的信号通过解算得到1厘米的精度，这个技术有个专业属于叫“cors”。

千寻就是在干这个事，到处建参考站，不管你跑到哪里，他都能给你发信号，得到1厘米精度坐标。

建CORS站是为了干什么？

构成一个定位增强系统

- 为何要增强
 - 精度 (aircrafts land in low visibility)
 - 改正信号覆盖面积
 - 完好性(integrity)
- 如何增强
 - 提高精度 (→米级→分米级)
 - 采用空基卫星播发差分改正数
 - 监测完好性
- 增强方式
 - SBAS: Space Based Augmentation Systems
 - GBAS: Ground Based Augmentation Systems

定位增强系统的一个详细了解

http://www.beidou.gov.cn/zy/kpyd/201710/t20171011_4576.html

表 1 当前卫星导航增强系统所采用的增强技术分类

	星基增强系统		地基增强系统	
精度增强技术	广域差分技术	广域精密定位技术	局域差分技术	局域精密定位技术
完好性增强技术	广域差分完好性监测技术	系统基本完好性监测技术		局域差分完好性监测技术
连续性和可用性增强技术	天基卫星增强技术		地基伪卫星增强技术	

目前，国外卫星导航增强系统主要分为星基增强系统（SBAS）和地基增强系统（GBAS）两大类。星基增强系统如美国的广域增强系统（WAAS）、俄罗斯的差分校正和监测系统（SDCM）等，地基增强系统如美国的局域增强系统（LAAS）等。这些系统综合使用了各种不同增强效果的导航增强技术，最终实现了其增强卫星导航服务性能的目的。从增强效果上看，这些增强系统所使用的卫星导航增强技术主要包括精度增强技

NDGPS系统（举一个例子，美国（千寻））

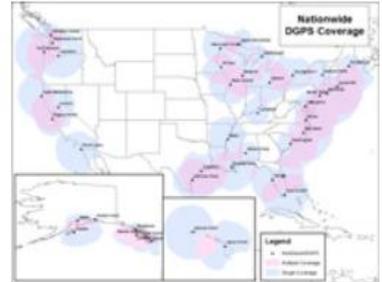
- 对**GPS**观测量的误差源加以区分，并对每一个误差源分别加以“模型化”，然后将计算出来的每一个误差源的误差修正值（差分改正值），**通过数据通讯链传输给用户，对用户GPS接收机的观测值误差加以改正，以达到削弱这些误差源影响，改善用户GPS定位精度的目的。**

全国范围差分GPS系统（NDGPS）

NDGPS是由联邦铁路管理局、美国海岸警卫队和联邦公路管理局经营和维护的地面增强系统，它为地面和水面的用户提供更精确和完全的GPS。NDGPS是按照国际标准建造，世界上五十多个国家已经采用了类似的标准。欲索取更多信息，请访问下列网页：

- [NDGPS General Information \(uscg.gov\)](http://uscg.gov)

[← 回到首页](#)



商用全球差分系统 (商用, 全球的, 星基的)

- **Starfire** Navigation System
- **OmniSTAR** systems by Fugro
- precise enough to be useful in survey applications where accuracies better than 10 centimeters or 4 inches are required.

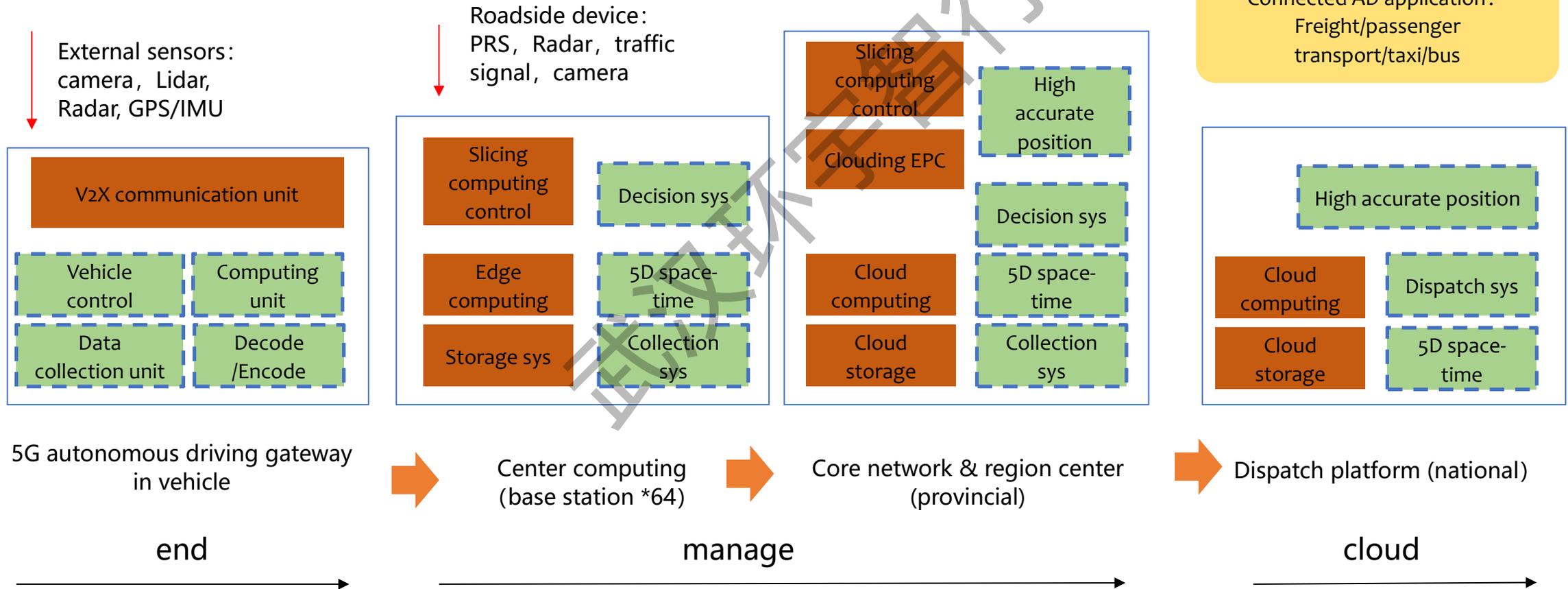
武汉环宇知行

Localization service on 5G by China Mobile

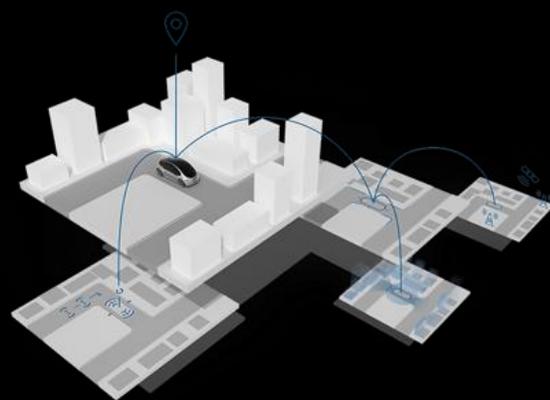
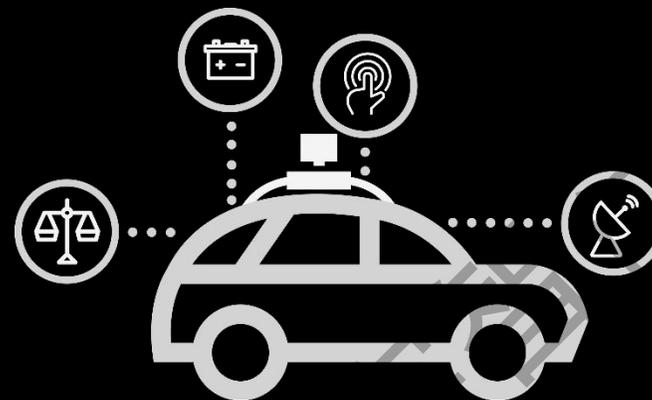
serve over hundred million users



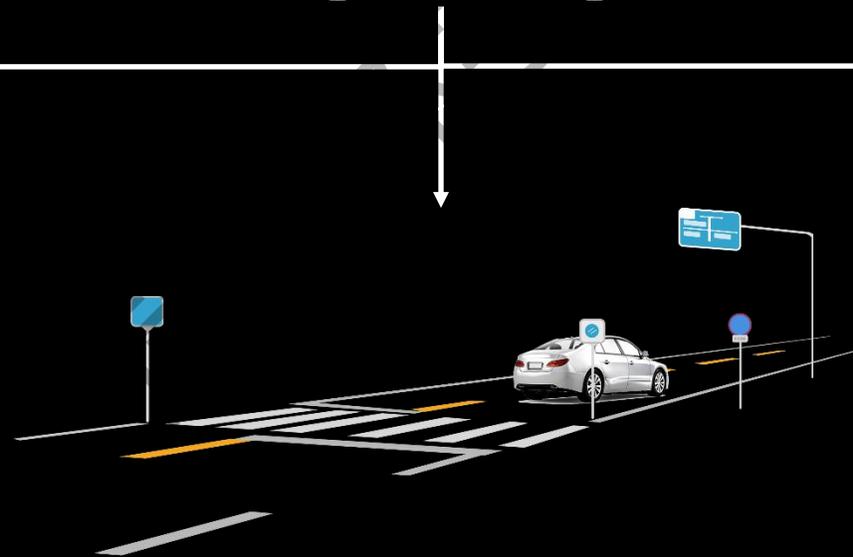
 Indriving
 China Mobile



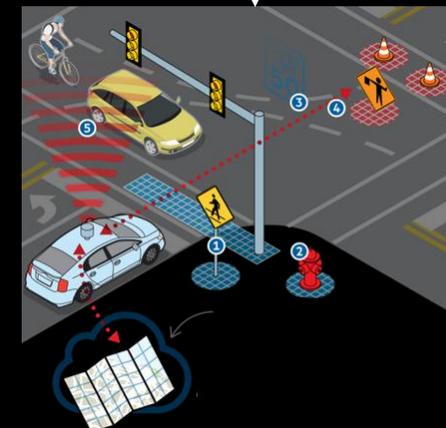
Localization Services for vehicle in **Different Scenarios**



Underground Parking

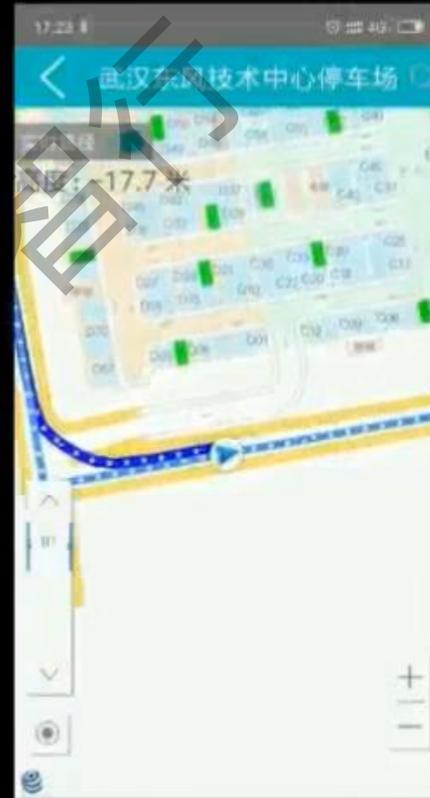


Highway



Urban Environment

Underground parking lot



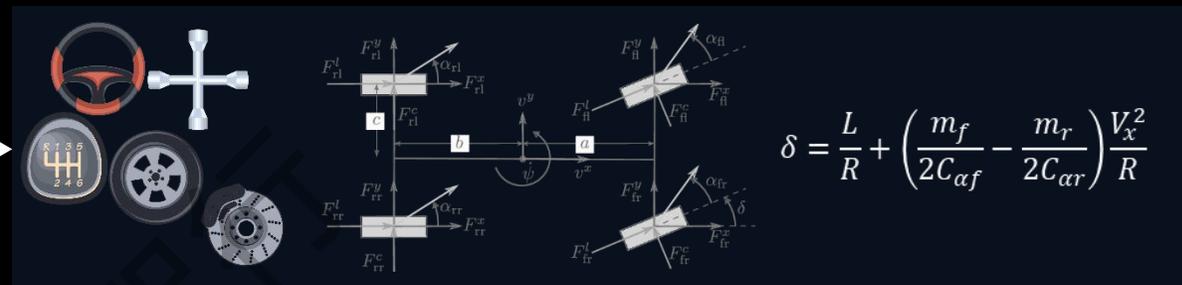
Locate Car in Underground parking

multi-sensor Fusion -- location error within 2 meter

Car-based

Kinetic model

Low-speed odometer

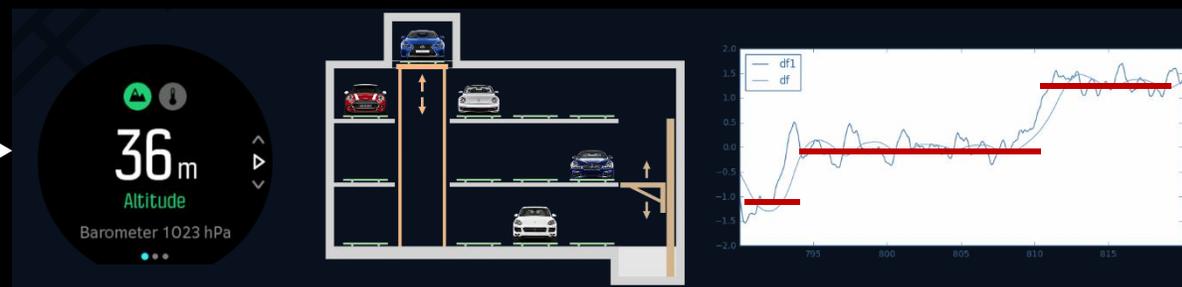


$$\delta = \frac{L}{R} + \left(\frac{m_f}{2C_{\alpha f}} - \frac{m_r}{2C_{\alpha r}} \right) \frac{V_x^2}{R}$$

FUSION

MEMS Barometer

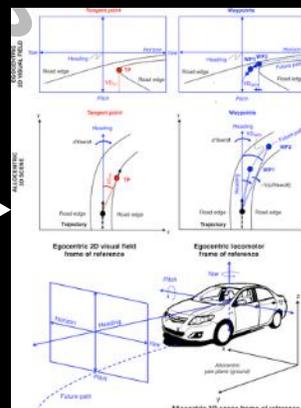
Height estimation



Curvature phase with scale and geometric information

Can-bus

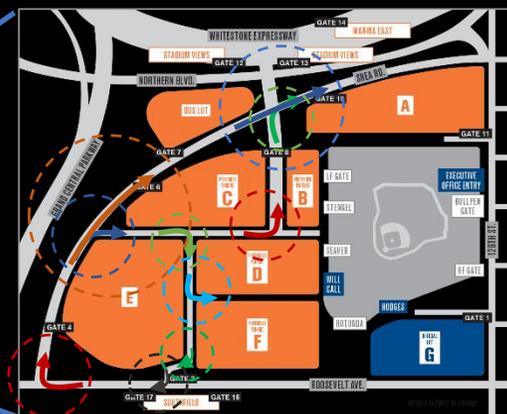
IMU-Wheel



Extraction

Sematic map

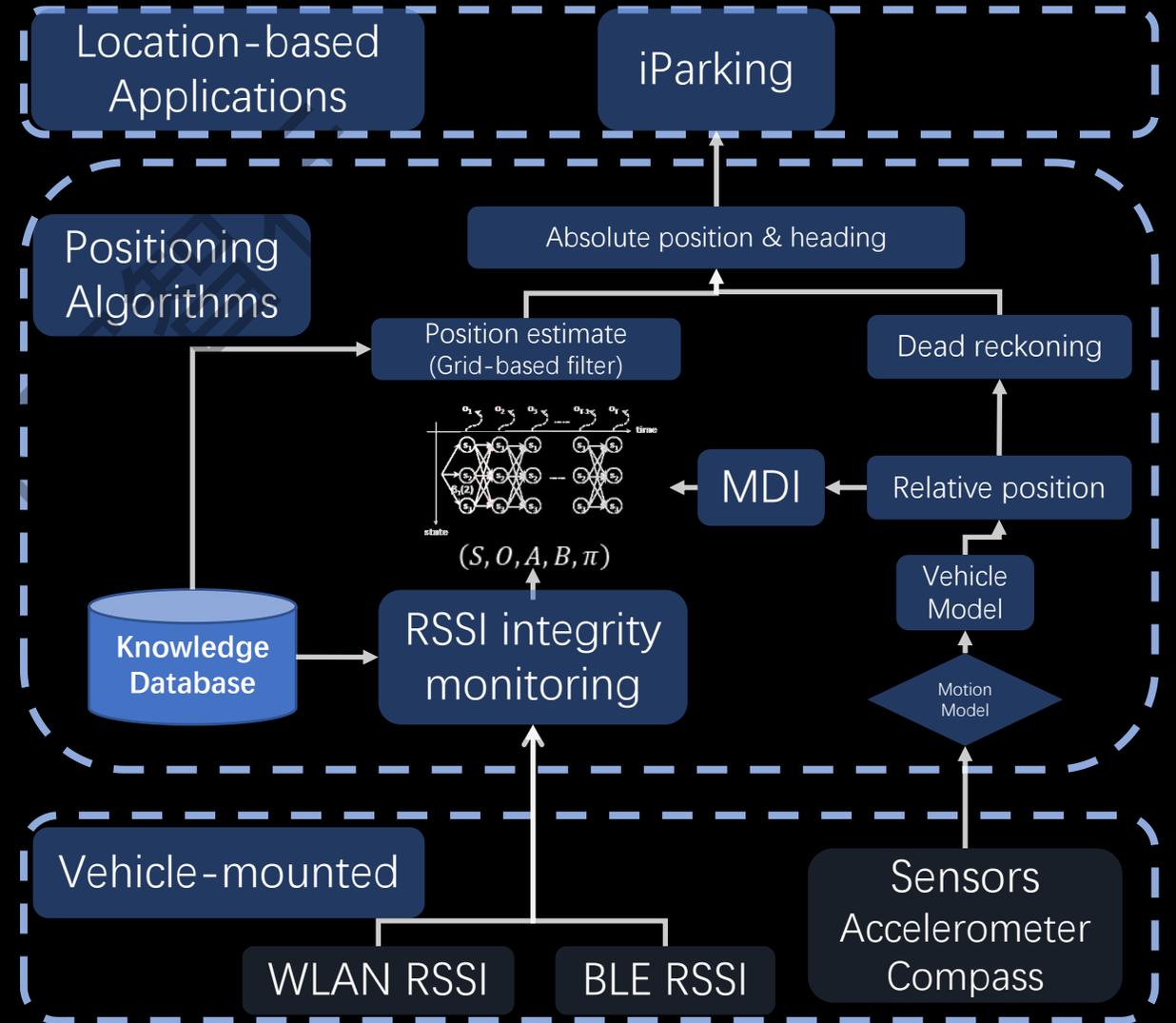
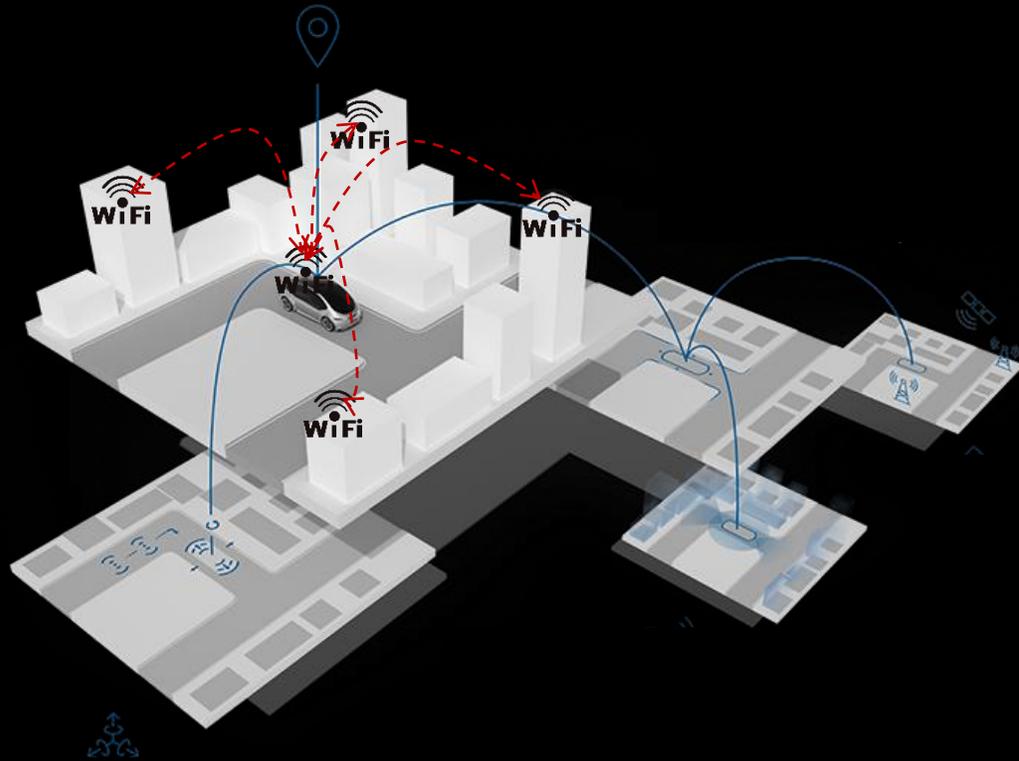
Generation



Locate Car in Underground parking

WiFi and BLE based -- location error within 1 meter

infrastructure
based



Localization by highway semantic map

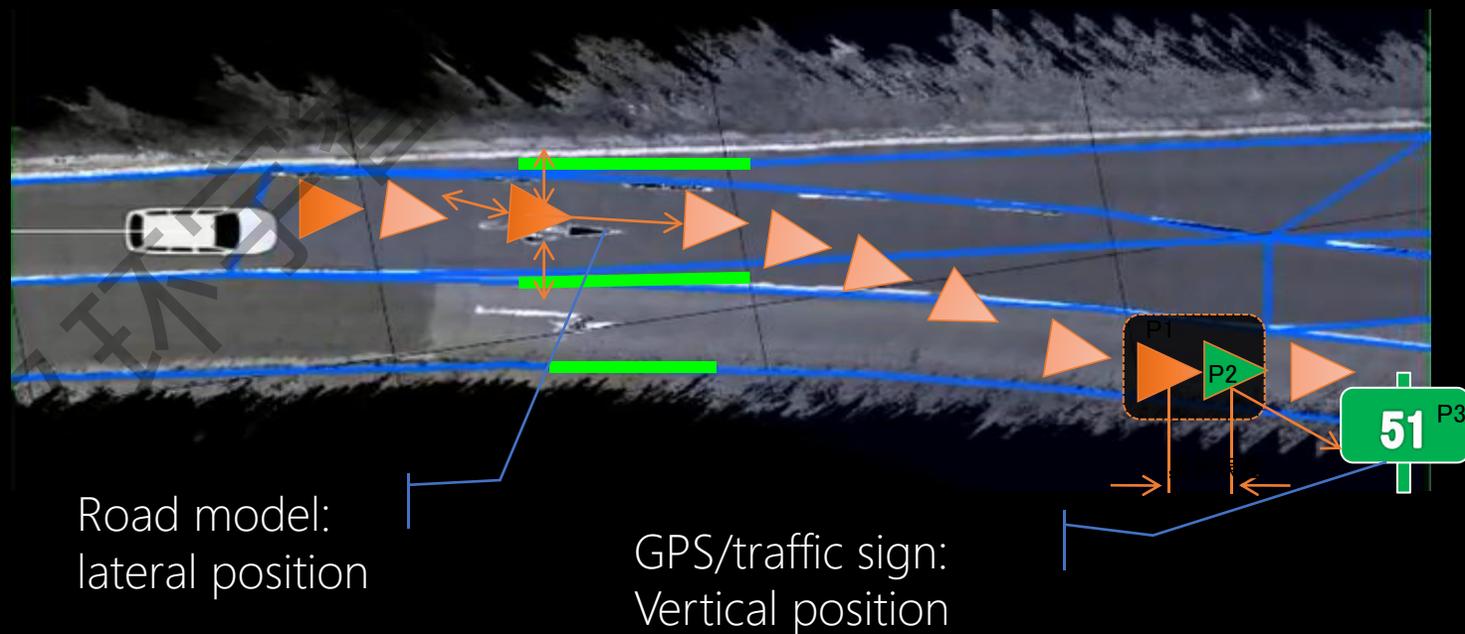
The screenshot displays a driving simulation interface with the following components:

- Top Left:** A vertical list of red text data: Camera: Deviation: 0, Angle: 6, LeftLane: 0, RightLane: 0, LDW: 0; Camera: Freq: 48, LD: -1479, RD: 4062, ChangeLane: 0; Camera: LeftLineT: 1, RightLineT: 3, LeftLineW: 0, RightLineW: 0; Camera: SignalType: 2, X: 29.1, Y: 6.7, Z: 0.0, Correction: 0; Navi: SignalType: 2, SignalAngle: 250, CarToSignal Dis: 11; Navi: LaneWidth: 3741, SaltusStep: 0, ChangeLane: 0, Steering: 1, Valid: 1; Navi: MapFreq: 3, LocatorFreq: 0, GPS: Freq: 40, CANSpeed Freq: 9; Car: Correction: 0, Factor: 0.975, CAN Meter: 0.0, GPS Meter: 0.0; Car: Speed: 80, GSpeed: 77, Angle: 250, Roll: 249, RAngle: 250, ToGPS Dis: 21; CAN 1: Read Status: 0, CAN 2: Read S...
- Top Right:** A first-person view of a road with lane markings and a guardrail.
- Center:** A 3D top-down view of a red car on a road with lane markings.
- Bottom Left:** A 2D map view showing the car's position on a road network.
- Bottom Center:** A control panel with buttons for "出发地" (Start Location), "GPS", and "Camera".
- Bottom Right:** A detailed control and status panel with the following sections:
 - NAVIGATION:** NAVI OPEN/CLOSE, CAMERA OPEN/CLOSE, LOG SWITCH OPEN/CLOSE.
 - Lane:** Event: Unknown, Traffic Event: Unknown, Traffic Sign: Unknown. Lane width: L [1479] R [4062], Distance: > [29.1] [6.7].
 - Camera:** Device Number: 1, Gray Value: 28, Exposure Time: 28, Brightness: 46.
 - Log:** 12:57:29->onLaveOpenBtnTouched open successfully...

Semantic map for localization on highway



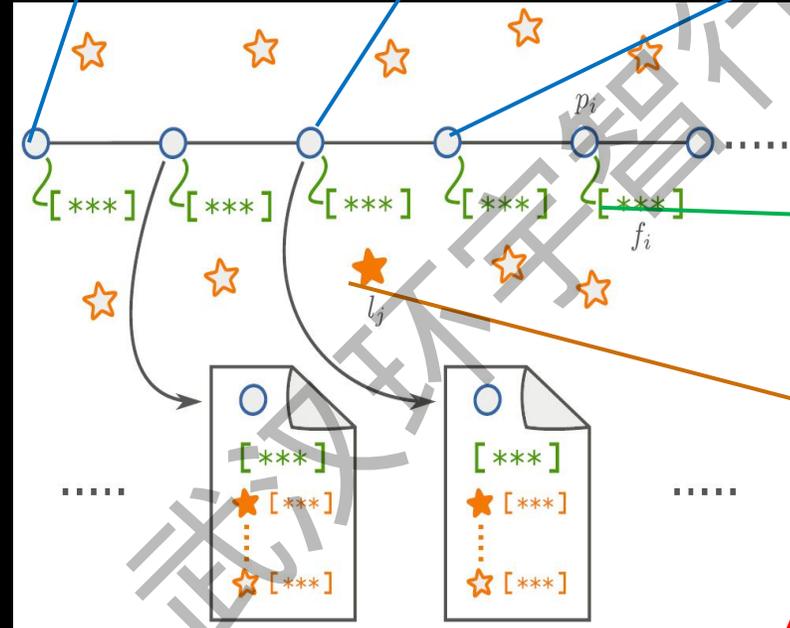
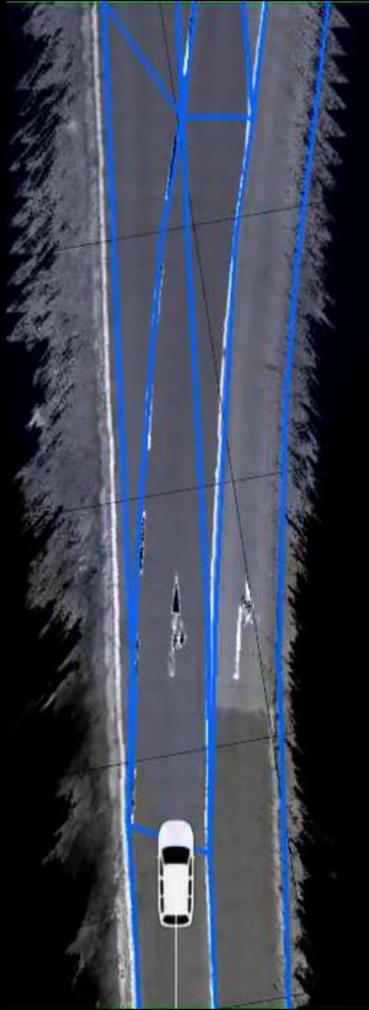
Semantic information for a map



Step 2

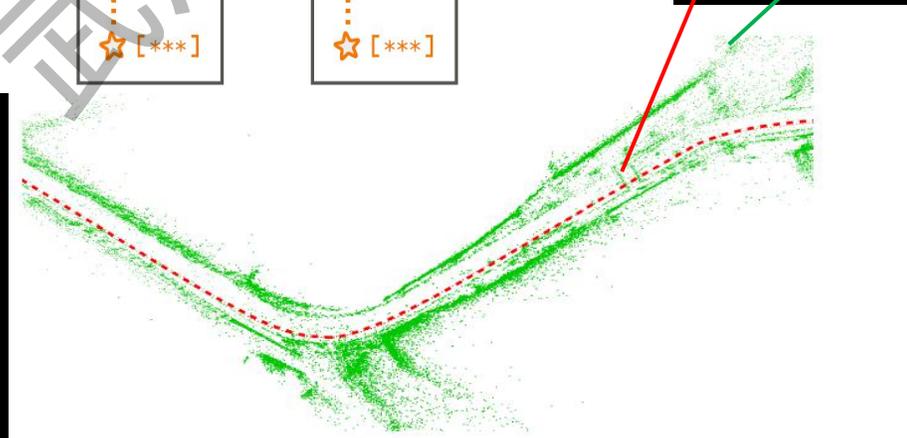
Mapping

Combine feature map and semantic map

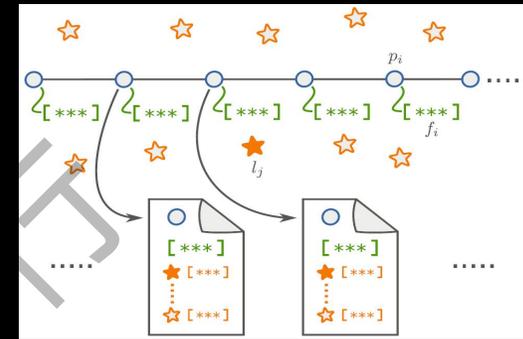


Pose of Camera/Lidar

Feature describe
Image: orb、line
lidar: edge、line



Coarse Localization: loading nearby map



Feature Extraction

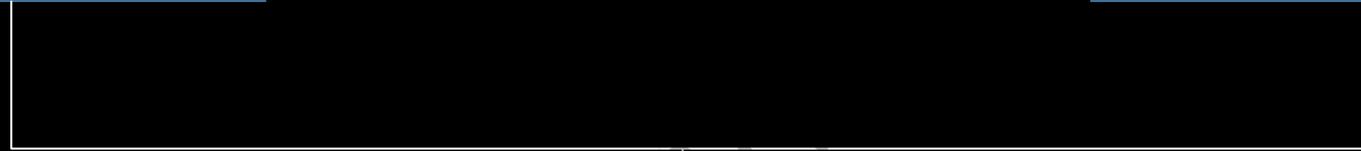
Off-line Visual Map

On-line Match

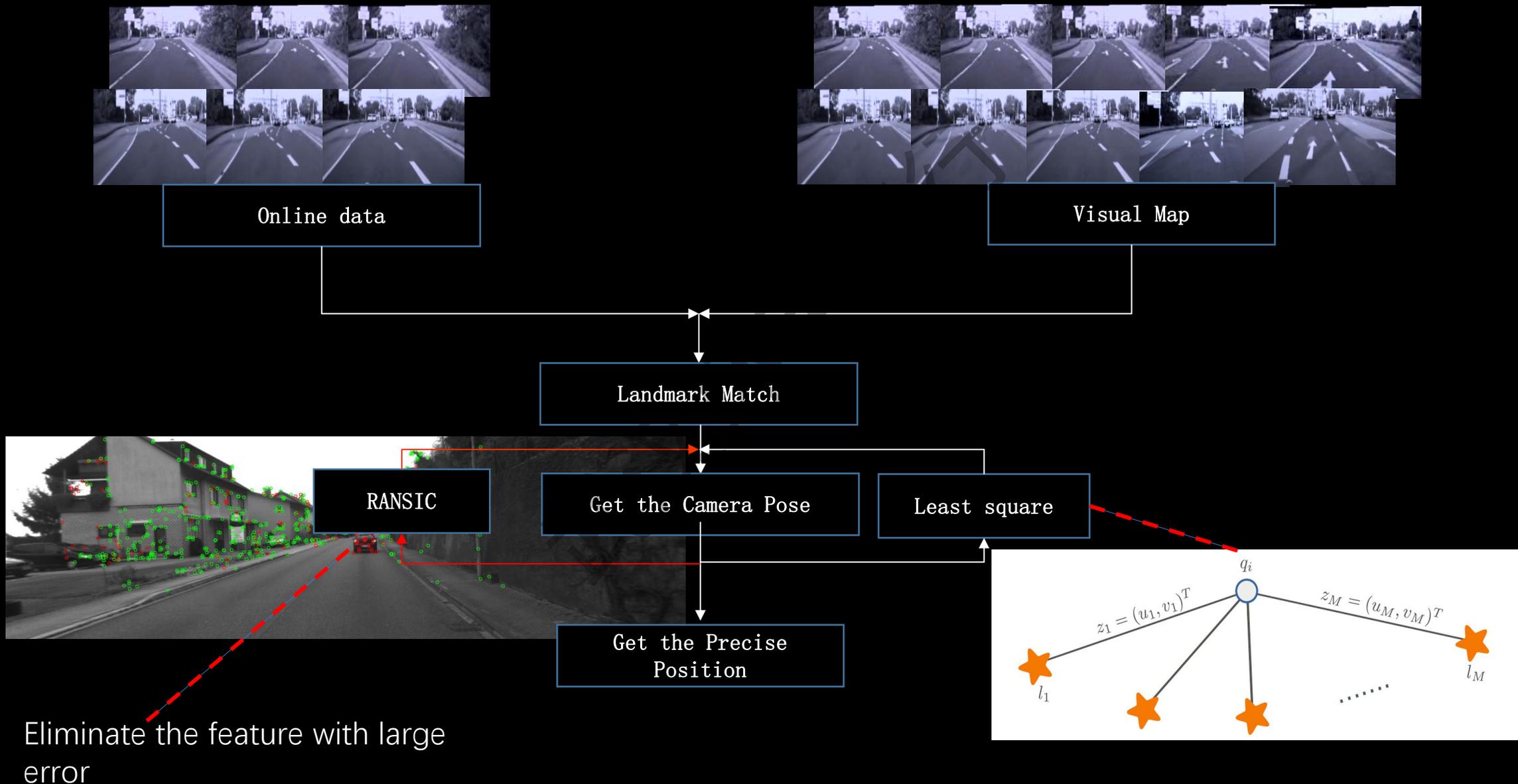
We get the Coarse Position



Load near by Map



precise Localization: get centimeter position



localization test for autonomous driving
on TITAN III with 70km/h speed by feature
map

