Aerospace Information Research Institute (AIR)
Chinese Academy of Sciences (CAS)

Summary of IPIN 2023 Competition Track6

Track6 Chairs: Xinchun Ji， Wenchao Zhang (AIR-CAS)

Why Track 6 ?

- **Key words:**
  - **Smartphone based vehicle navigation**

    has become a widely used navigation and positioning application.
  - **Indoor vehicle navigation are more challenging**

    such as tunnels and garages, as well as urban canyon areas, are the biggest challenge facing vehicle navigation.

Goals of track6

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- **Explore** the performance of smartphone-based vehicle indoor positioning application.
- **Communicate** on the methods of multi-information fusion of positioning.
- **Promote** the continuous advancement of smartphone-based vehicle positioning technology.

Rules of track6

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- **Test Data: Only from smartphone**
  - —GNSS, Accelerometer, Gyroscope， Magnetometer, AHRS
  - —Wheel speed from OBD-II (This year's difference)
- **Test scenarios: Mostly Indoor, complex vehicle motions**
- **Method： Only real-time positioning algorithm is admitted.**
- **Evaluation: Third quartile of 2D positioning error**
  - — Result over 40m invalid.

Challenging Points of Track6

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No prior information and low-grade smartphone sensors

- no prior mark information---the reference mark of Bluetooth, WIFI, etc.
- no road map
- low-grade smartphone MEMS sensors, low precision wheel speed information(~5%)

No prior information

low-grade smartphone sensors

Challenging Points of Track6

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Long-time Continuous No GNSS signal

More than 45min （This year's biggest different challenge）

For indoor scenarios, GNSS has been blocked

Challenging Points of Track6

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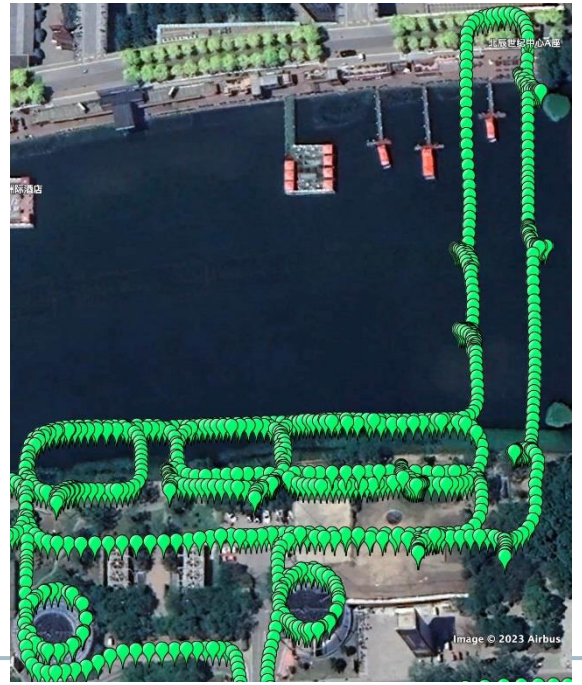
Complex vehicle motion

- no structured roads, a random and irregular test route
- frequent reversing , parking and rotation, passengers getting on and off



Irregular test route

Frequent reversing , parking and rotation

Data Collection

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- A Huawei mate20 Pro smartphone is installed at the front of the vehicle.
- The installation of smartphone is not completely firm.
- Two phases: Initial alignment phase and Final score evaluated phase

sensor calibration

dynamic alignment

Final evaluation ~ 40minuates

start

static alignment

GNSS signal attenuation and interruption

Data Collection

Data Real-time Collection Process Video

Data Collection

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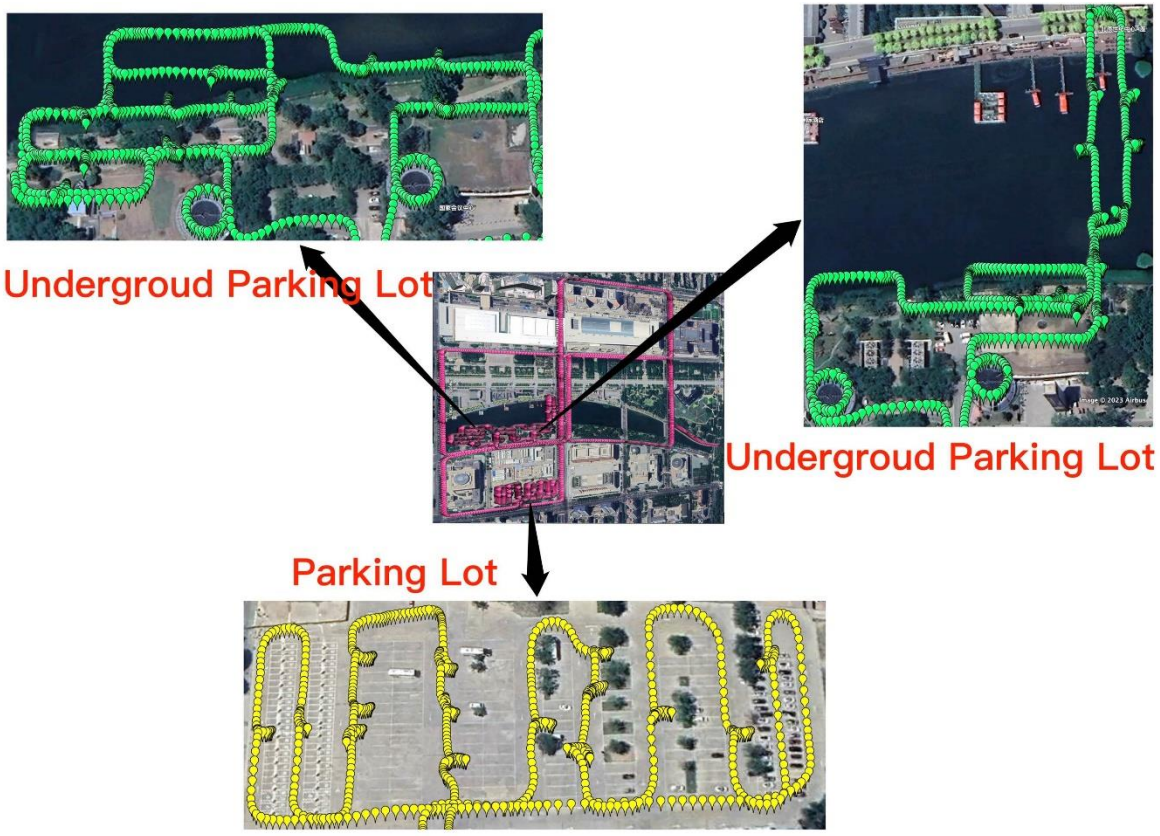
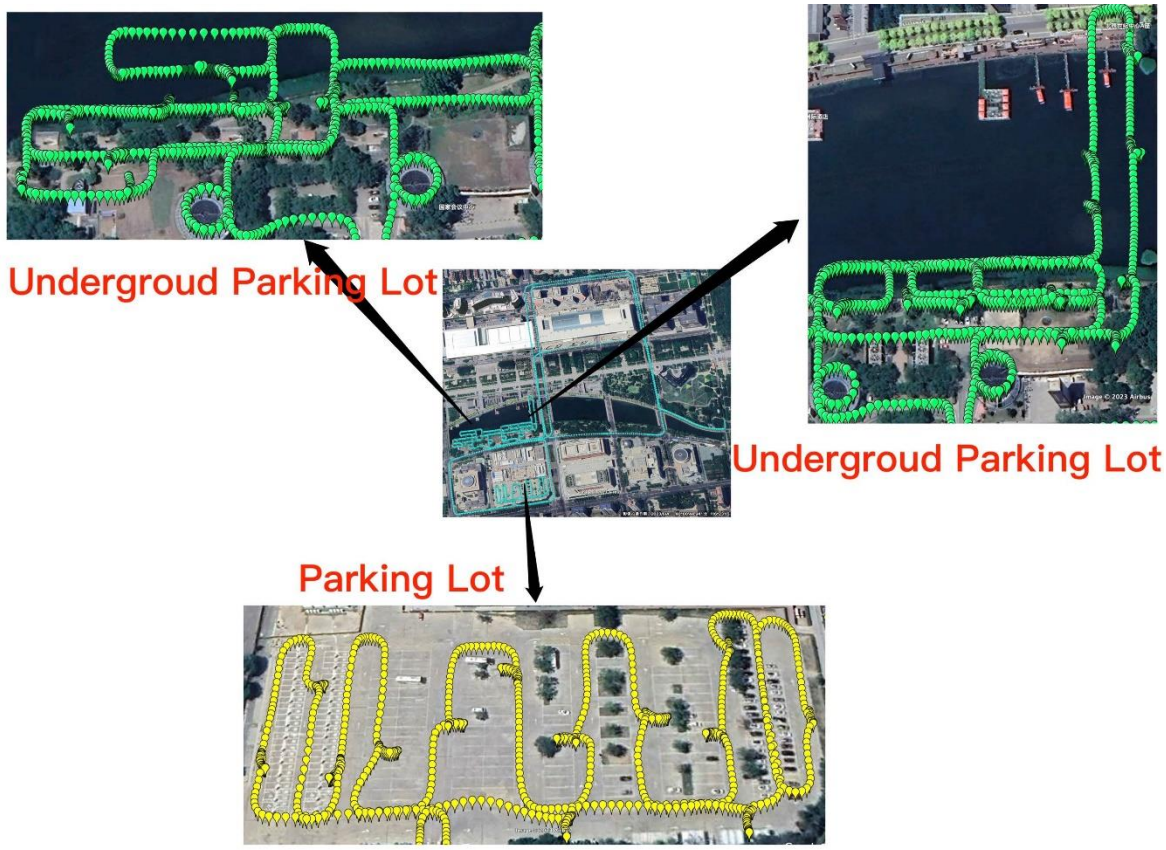


Test Route 1



Test Route 2

Evaluation areas: underground parking lots and floor parking lot with blocked GNSS signal areas

Competitors of Track 6

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- Team SmartLoc

  Nanyang Technological University, Singapore

- Team BJTU-DiDi

  Beijing Jiaotong University, Beijing

- Team AINS

  Beijing Automation Control Equipment Institute, Beijing

Results

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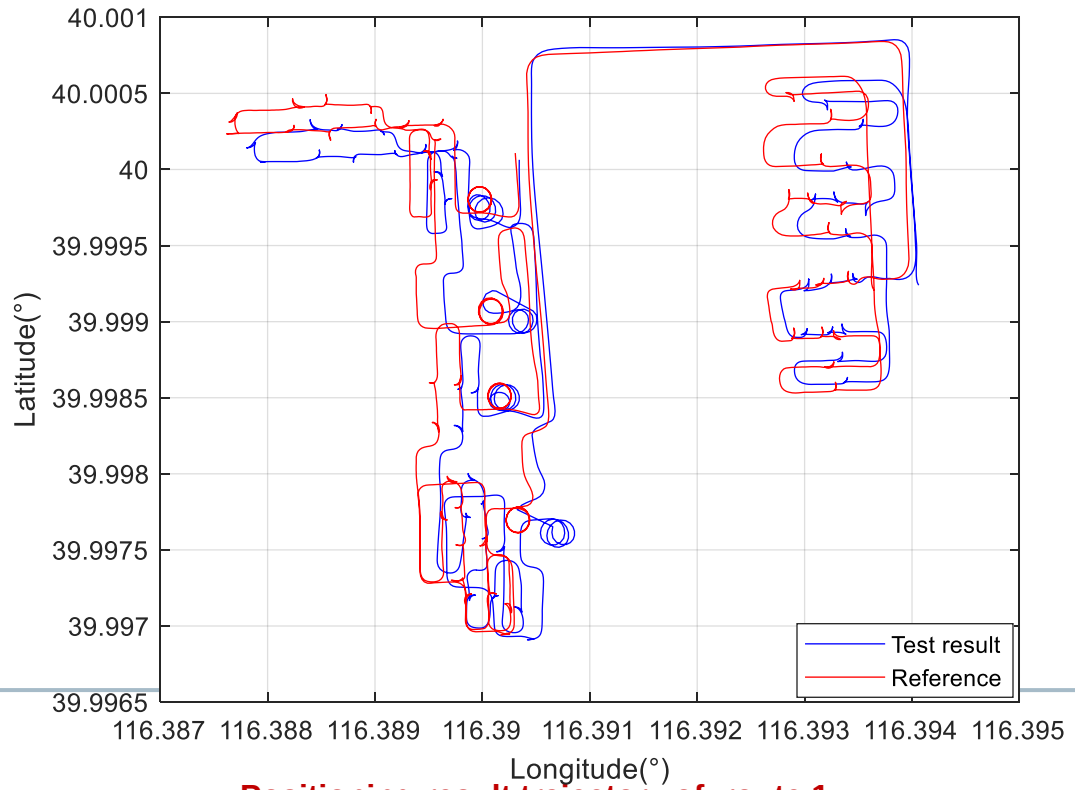
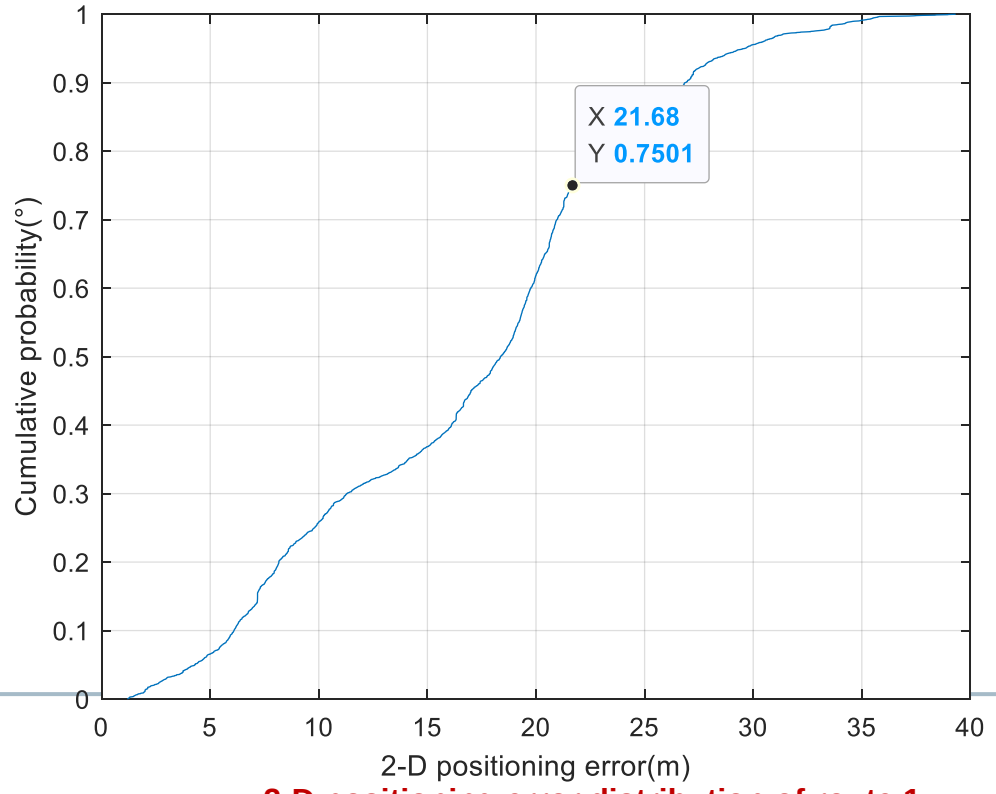
Maximum error limit: 40m

Team SmartLoc

- Positioning trajectory that almost the same with the reference
- 2-D positioning error : **21.68m**, 75% @route 1 (route 2: 47.41m)



Positioning result trajectory of route 1



2-D positioning error distribution of route 1

Results

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10th IPIN Competition

WINNER

Track 6: On-Vehicle smartphone

SmartLoc

Nanyang Technological University, Singapore

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Presentation

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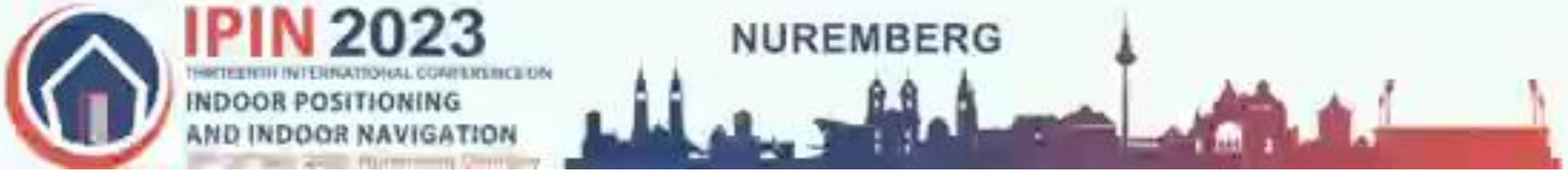
Track 6: On-Vehicle smartphone

Presentation of Winner

IPIN 2023 track6 : Smartphone on vehicle

- Team SmartLoc
  - Team Member: Wang Han
  - Nanyang Technological University, Singapore



Outlook

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Next year's challenge

- **On Site—Real-time testing in real scenarios!**

Hope more teams can participate track6!