Track 6: Smartphone on vehicle (Onsite)

Overview of the competition:

Track6 is a track that focuses on the performance evaluation of smartphone positioning algorithms in vehicle-mounted scenarios. In previous competitions, offline evaluation of positioning accuracy and offsite-online evaluation of positioning accuracy were adopted. This year, after communicating with the competition committee, in order to make the Track6 competition closer to real application scenarios, we plan to turn this year's track6 competition into a live real-time competition. Just like we use mobile phones in real life, we start walking from indoors (such as offices, etc.) with our smartphones, walk through corridors, stairs/elevators, etc., reach the underground garage, walk to the side of the vehicle, enter the car and fix the mobile phone in front of the car, drive out of the underground garage, pass through open road areas, urban canyon road areas, etc., and after arriving at the underground garage at the destination, take the mobile phone out of the car, and then walk through the underground garage area, stairs/elevators, corridors, and finally reach the destination. In this process, positioning information is all provided by smartphones.

Competition Goal:

The goal of this track is to evaluate the performance of different integrated navigation solutions based on the sensors of vehicle-mounted smartphone, such as GNSS, MEMS and magnetometer, etc. At the same time, the stage of pedestrian positioning by the smartphone before and after the pedestrian gets on the vehicle is also used as the test and evaluation content of this track. Therefore, the test route consists of three parts: pedestrian route (about 5 minutes), vehicle route (about 20 minutes), pedestrian route (about 5 minutes), with a total duration of about 30 minutes. Among them, the vehicle route is a closed-loop route, and the scenarios include open route scenarios, urban canyon scenarios, underground garage scenarios, etc. And, the open route scenario with unobstructed satellite view is not considered for computing the evaluation score. The pedestrian routes are all in the same office building, and the scenarios include vehicles getting on and off, underground garages, stairs/elevators, corridors, etc.

The big difference from last year:

- The biggest difference between this year's track6 and the previous is that it has been changed to a live competition. At the same time, the test route includes both pedestrian routes and vehicle routes, so the integrated navigation solutions developed by the competitors needs to be able to cope with both pedestrian scenarios and vehicle scenarios.

Main features of the competition:

- In order to ensure the fairness of the competition, we have also designed the format of the live competition.

When the competition starts, the volunteer will carry an Honor Magic6 Pro smartphone and follow the established route through the pedestrian route (about 5 minutes), the vehicle route (about 20 minutes) and the pedestrian route (about 5 minutes) in turn. The smartphone has been pre-installed with a specially designed mobile data collection APP software. The software will send all the data collected by the mobile phone sensors in real time to the server through the 4G network in real time. Before the competition, the competitors can use their own computers to debug whether they can access the server interface (an interface based on a web API has been developed: EvaalAPI (https://evaal.aaloa.org/evaalapi/). This API will be used by competitors for reading the sensor values and sending position estimates) normally. During the competition, they can access the API in real time to obtain the real-time data of the competition, then use their own algorithms for real-time processing and sending position estimates computed from received data before getting new data. Once the volunteer has completed all the routes, the competitors also complete the real-time processing of all the competition data.

- The competition teams can calibrate their algorithmic models with previous years' testing trials (both track3 and track6) containing readings from sensors of the pedestrian-hold smartphone and vehicle-mounted smartphone and some ground-truth positions. During the on-site competition, players gather in a fixed competition office to evaluate the accuracy of the integrated navigation algorithm in real time, without any additional calibration sources allowed.
- After completing the registration (https://ipin-conference.org/2024/registration/) for the competition, you can apply for the indoor map of the pedestrian route from Track 6 chairs in time. Before the competition day, the organizing committee will allow the competitors to conduct on-site survey and debug the server interface EvaalAPI. Regarding the debugging of the EvaalAPI interface, there are currently two time periods. One is in August when we will publish a piece of test data on the server to debug whether the EvaalAPI interface can be accessed normally. The other is the day before the live competition of track6, when the competitors will be asked to debug whether they can access the EvaalAPI interface normally. For specific time arrangements, please refer to the "Important dates" section. On the day of the competition, the on-site competition will be held twice, and the best result of the two competition test results will be used as the final score of each competition team.
- The coordinates of the starting 2 points for the reference path walked by the volunteer will be provided to the competition teams on the competition day, about half an hour before the competition starts. During the competition, the volunteer collects data by holding the smartphone naturally during the pedestrian route, and is not required to hold the smartphone in any specific or fixed position or orientation. During the vehicle route,

the phone is fixedly installed at the front of the vehicle to record the motion measurements of the vehicle.

- Regarding the ground truth of the pedestrian route, the true-value points measured in advance will be marked on the ground on the day of the competition. The ground truth of the vehicle route is obtained through a DGNSS/FOG-INS reference system with an expected accuracy of 20 cm at 1 Hz.

Desired localization approaches:

Any kind of positioning algorithm is admitted.

Description of smartphone real-time data：

- Regarding the format of the data collected by the smartphone in real time during the competition, you can refer to the data of last year's Track6 competition, the format is exactly the same. The following describes the format of the data collected by the mobile phone. Each line of the real-time data collected by the smartphone begins with an initial header (4 capital letters followed by a semicolon, e.g., ‘ACC’,’MAGN’,’GNSS’ etc.) that determines the kind of sensor read, and several fields separated by semicolon with different readings. This is an extract of a real log file shown as example:

```
ACCE;77.402;77.377;-0.06520;9.46413;2.50431;3
GYRO;77.402;77.378;0.00007;0.00445;-0.00023;3
AHRS;77.403;77.375;-74.7500;-0.1400;323.2900;0.5759;0.1921;0.2495;1
ACCE;77.403;77.381;-0.11155;9.48608;2.45579;3
GYRO;77.403;77.382;-0.00075;-0.00250;-0.00017;3
MAGN;77.410;77.389;26.06250;-8.43750;-37.56250;1
ACCE;77.410;77.385;-0.10799;9.50813;2.55533;3
GYRO;77.410;77.386;0.00066;-0.00585;0.00026;3
LIGH;77.411;77.389;1079.6;3
PRES;77.411;77.389;1000.1187;3
GNSS;77.414;40.006691;116.390211;52.700;70.600;0.0;3.8;269035.000;25;21
AHRS;77.414;77.385;-74.7500;-0.1400;323.2800;0.5759;0.1922;0.2495;1
ACCE;77.414;77.389;-0.08233;9.51401;2.73340;3
GYRO;77.414;77.390;0.00120;0.00155;0.00068;3
ACCE;77.415;77.393;-0.10364;9.44867;2.59878;3
GYRO;77.415;77.394;0.00058;0.00426;0.00019;3
MAGN;77.417;77.399;26.00000;-8.31250;-37.56250;1
ACCE;77.419;77.397;-0.09462;9.39126;2.47738;3
GYRO;77.419;77.398;-0.00061;0.00089;0.00037;3
AHRS;77.422;77.395;-74.7500;-0.1400;323.2900;0.5759;0.1921;0.2495;1
WIFI: 77.423; 48:4a:e9:af:63:75;-70;wiGuest
WIFI: 77.423; 48:4a:e9:af:63:72;-69;netair
BLE: 77.423; 48:02:86:7D:7D:CE;-90
BLE: 77.423; 8C:85:90:CB:20:BB;-84
ACCE;77.423;77.401;-0.04969;9.39861;2.48839;3
GYRO;77.423;77.402;-0.00063;-0.00524;0.00042;3
MAGN;77.427;77.409;25.81250;-8.12500;-37.43750;1
ACCE:77.427:77.405:0.05193:9.36032:2.63375:3
```

- The detailed list of fields in each sensor’s row, and one specific example, is shown next:

MAGN: the local magnetic field, as measured by the 3-axis magnetometer in the phone	
Format	MAGN;AppTimestamp(s);SensorTimestamp(s);Mag_X(uT);Mag_Y(uT);Mag_Z(uT);Accuracy(integer)
Example	MAGN;0.035;8902.708;-20.70000;-34.02000;-19.20000;3
ACCE: the phone's acceleration, as measured by the 3-axis accelerometers in the phone	
Format	ACCE;AppTimestamp(s);SensorTS(s);Acc_X(m/s^2);Acc_Y(m/s^2);Acc_Z(m/s^2);Accuracy(integer)
Example	ACCE;0.034;8902.708;-1.80044;6.41646;7.17303;3
GYRO: measures the phone's rotation, using the 3-axis orthogonal gyroscopes in the phone	
Format	GYRO;AppTimestamp(s);SensorTimestamp(s);Gyr_X(rad/s);Gyr_Y(rad/s);Gyr_Z(rad/s); Accuracy(integer)
Example	GYRO;0.032;8902.705;-0.22846;-0.21930;-0.05498;3
PRES: the atmospheric pressure	
Format	PRES;AppTimestamp(s);SensorTimestamp(s);Pres(mbar);Accuracy(integer)
Example	PRES;0.038;8902.726;956.4289;0
LIGH: for light intensity in Luxes	
Format	LIGH;AppTimestamp(s);SensorTimestamp(s);Light(lux);Accuracy(integer)
Example	LIGH;0.032;8902.693;292.0;0
GNSS: the Latitude, Longitude and Height estimated from GPS/BD	
Format	GNSS;AppTimestamp(s);Latit(º);Long(º);Altitude(m);Bearing(º);Speed(m/s); Acuracy(m); GPS TOW(s);SatInView;SatInUse;
Example	GNSS;0.611; 40.069708; 116.275895; 36.135;0.000;4.0;0.0; 8272.999; 17;15
AHRS: the mobile phone 3D orientation in terms of pitch, roll and yaw	
Format	AHRS;AppTS(s);SensorTS(s);PitchX(º);RollY(º);YawZ(º);RotVecX();RotVecY();RotVecZ();Accuracy(int)
Example	AHRS;0.033;8902.705;41.6550;11.7495;-124.0558;0.25038;-0.26750;-0.80406;-2
WIFI: local WIFI info measured by the phone	
Format	WIFI: AppTimestamp(s);BSSID;Level;SSID
Example	WIFI: 29.664;48:4a:e9:af:77:f5;-79;TUF_5400_5G
Bluetooth: local Bluetooth info measured by the phone	
Format	BLE: AppTimestamp(s);Address;RSSI
Example	BLE:3.998;48:02:86:7D:7D:CE;-92

POSI: ground-truth position (only in calibration files)	
Format	POSI; GPS TOW(s);Latitude(degrees);Longitude(degrees);Altitude(m)
Example	POSI; 8272.999; 40.081377, 116.261005, 35.900

- The sampling rate of each type of sensor can be different since it is dependent on the embedded sensor chips used by a particular phone. Typical sampling frequency value for the inertial data is about 250Hz, but we forced the sensor to the maximum rate.

Description of the Output File：

The competition teams must submit position estimates with a frequency of 1 Hz. The position should be formatted as a comma-separated string with 4 fields:

- 4 columns:

Column 1: Timestamp in GPS second of week. The timestamp can be obtained from the real-time data stream of the smartphone

Column 2: WGS84 latitude in decimal degrees with at least 6 decimal digit resolution

Column 3: WGS84 longitude in decimal degrees with at least 6 decimal digit resolution

Column 4: Altitude in decimal meters with at least 1 decimal digit resolution

- Example:

```
22576,40.422833,117.718888,36.2
22577,40.422309,117.718466,36.2
22578,40.422226,117.718312,36.2
22579,40.422213,117.71827,36.2
22580,40.422156,117.718237,36.2
22581,40.422099,117.718204,36.2
22582,40.421969,117.718131,36.2
22583,40.421874,117.71808,36.2
22584,40.421801,117.718039,36.2
22585,40.421801,117.717979,36.2
22586,40.421783,117.71803,36.2
22587,40.421845,117.7179947,36.2
22588,40.421893,117.7179473,36.2
22589,40.42196,117.7178875,36.2
22590,40.422036,117.7178151,36.2
```

Evaluation criterion：

- Following the Evaal evaluation criterion, the third quaritle of 3D positioning error of output points will be evaluated. The error will be measured based on x, y coordinates (longitude and latitude). To this, a penalty P = 15 m will be added for each floor error (z). For example, if the x, y error is 4 m and the estimated floor z is 2 while it should be 0, the computed error for that estimate will be 4 + 2P = 34 m.

- Except for the open route scenario with unobstructed satellite view is not considered for computing the evaluation score, all other route scenarios are considered as evaluation accuracy scenarios.

Important dates:

- The day for online debugging EvaalAPI interface is: **August 2024**
- The day for site survey and debugging EvaalAPI interface is: **October 9th 2024**
- The day for competition is: **October 10th 2024**
- Proclamation of winners: **October 17th 2024**

Contact points and information:

For any further question about this competition track, please contact to:

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