July 09th, 2018

IPIN 2018
NINTH INTERNATIONAL CONFERENCE ON INDOOR POSITIONING AND INDOOR NAVIGATION
SEPTEMBER 24-27, 2018, NANTES, FRANCE

IFSTTAR TEAM GEOLOC ATLANTIS LE CENTRE

Call For Competition

September 22nd, 2018 - Shopping mall *Atlantis le Centre*, Nantes, France

Overview of the competition

IPIN is pleased to announce the Indoor Localization Competition, which will be held in the course of the IPIN 2018 Conference at the city of Nantes (France). The competition aims at bringing together academic and industrial research communities in order to evaluate different approaches and to address real issues on indoor/urban positioning and navigation in a real opened environment.

This year competition takes place at the largest shopping mall in Western France: *Atlantis le Centre*. The shopping mall contains several wide corridors, open areas, large parking areas, more than 150 shops, more than 30 restaurants, an IKEA furniture store and a supermarket (see the floor plan below). This competition is a unique opportunity to solve remaining issues in your GEO-IOT, Location Based Services or other geolocation applications in a dynamic real environment.

You may take a virtual tour of Atlantis available here

Four competition tracks

IPIN 2018 Indoor Localization Competition consists of four independent challenging tracks, including two on-site and two off-site contests, where the accuracy of the competing systems will be evaluated using the "black-box testing" approach on each track. All proposed systems for competition must be self-contained working solutions and the competitors cannot deploy their own infrastructure for positioning purposes in the on-site tracks. The proposed competition tracks in 2018 are:

- Track 1 "Camera based Positioning (on-site)"
- Track 2 "Non Camera based Positioning (on-site)"
- Track 3 "Smartphone based Positioning (off-site)"
- Track 4 "Foot-Mounted IMU based Positioning (off-site)"

Dedicated sessions at the 2018 IPIN conference (September 24th-27th, 2018) will be scheduled to introduce the details of all competing systems and the final results. If you have any question related to the competition tracks, please contact ipin2018@ifsttar.fr for further information.

General information

First chapters of this document cover the common parts of IPIN2018 competition tracks including the organizational aspects, and the evaluation criterion. The 4 last chapters provide additional details related to each tracks (Track1-2-3-4 special features). We encourage competitors to read the whole document.

Important dates

Registration deadline	15 July 2018, AoE*
Notification of admission	Shortly after requested by e-mail
Result submission (Track 3 and Track4)	September 14th, AoE
System setup (Track1 and Track2)	21 September 2018
Competition (Track1 and Track2)	22 September 2018
IPIN conference	24-27 September 2018

*: AoE (Anywhere on Earth) timezone is 12 hours behind UTC (GMT).

This year, for paper submission, it is reminded that the 'Regular' or 'Work In Progress' process has to be followed. No dedicated competition paper submission will be held.
"Technical description" (described below) provided by the competitors will be made accessible on IPIN2018 website.

Registration for the competition

A "competitor" can be any individual or group of individuals working as a single team, associated to a single or a number of organizations, who wants to participate in one or several tracks.

Competitors apply for admission to the competition tracks by providing a short (2 to 4 pages) "technical description" of their localization system, including a cover letter and a brief description of their approach. The technical description must be sent by e-mail to the chairs of the intended track. Track chairs will accept or refuse the application in a short time, based on technical feasibility and logistic constraints.

After acceptance of the competitor's technical description, in order to register your team for the competition, at least one member of your team must be registered for the conference. The online registration is already open. During the registration process, the team leader must state its intention to participate in the competition and indicate:

- the desired competition track,
- the approximate number of team members,
- whether the team will submit a paper associated to the competition. (For more information about the papers contest, please read the Call for Papers.)

Pay attention:

1. In a team, an individual registration is required from every member who wish to participate in the competition AND in the conference.
2. If the other team members will ONLY participate in the competition, the indication made by the leader during his registration is sufficient.
3. Individual tracks may accept further submissions after the 15 July deadline: please contact the competition/chairs of the track you are interested in if you plan to submit after the deadline.

IPIN 2018 competition's context

Since the competition is taking place in a shopping mall, only infrastructure-free localization technologies can compete. Indeed, it is not possible to install any specific equipment in this private environment. The competition tracks cover about 9000 m² of the shopping mall, including staircases, escalators and other facilities common in shopping centers.

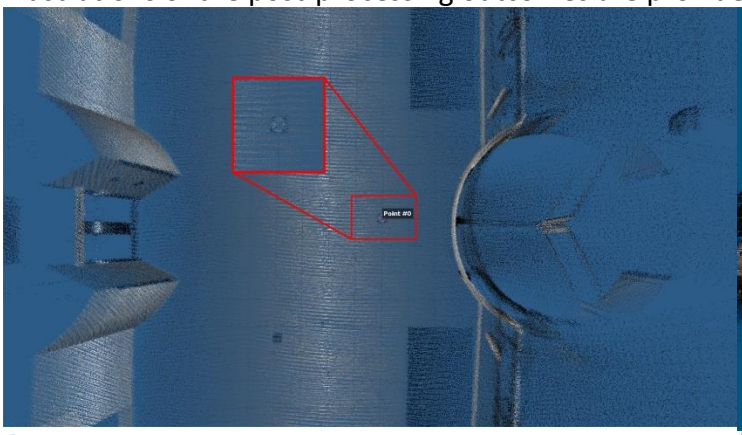
Some recommendations described in the norm ISO/IEC 18305:2016 have been considered for defining the 2018 competition framework (tracks length, evaluation criteria …).

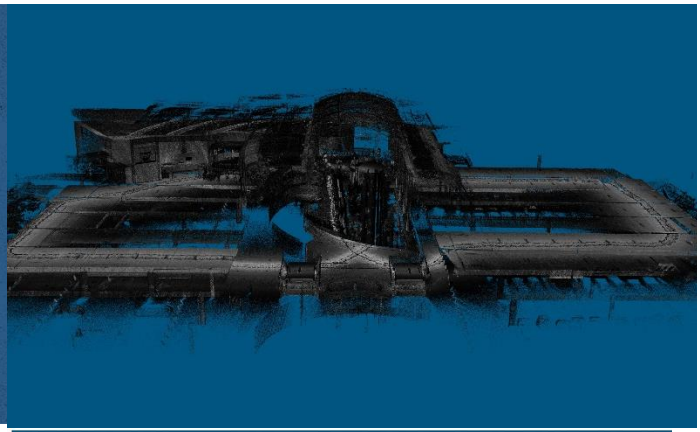
Individual competition time windows will be communicated to each team before the competition. Each team will carry or wear its own system. As no post-processing is allowed, each team will be required to give the file containing the estimated position coordinates in a format corresponding to the one described in the "Output File " section.

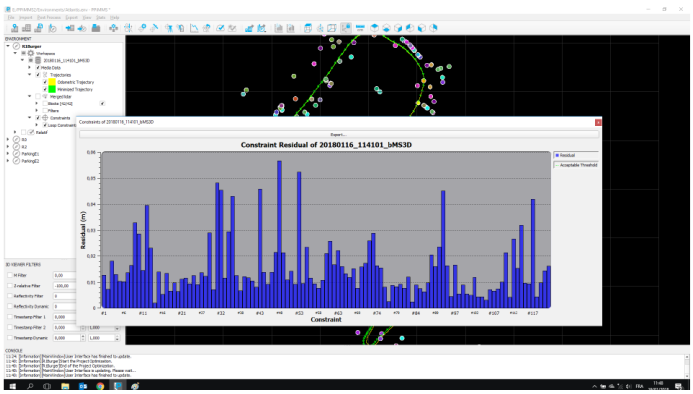
Mapping of the ground truth reference foot tracks

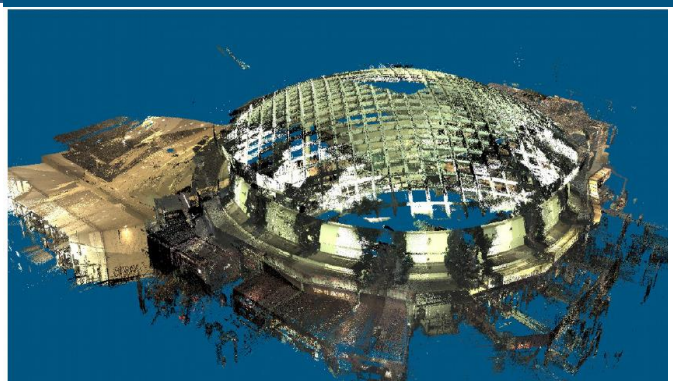
The bMS3D mobile mapping system was selected to map the ground truth of all foot tracks used for the off-site and on-site competition. It scanned and measured the coordinates of nearly 200 key points (marked with a 14 cm target on the ground). They constitute the ground truth. Several indoor and outdoor control points were surveyed to geo-reference the maps and control the accuracy of the coordinates estimated in a world reference geographical frame. The mobile mapping part was conducted by the company VIAMETRIS, who scanned the entire shopping mall on 4 different levels, including open floors and underground parking.

Thanks to the 6DOF LIDAR SLAM and cameras of the bMS3D, key points of all tracks have been identified. Their absolute positions have been computed in post-processing mode using a mobile mapping software. Illustrations of the post-processing outcomes are provided here.









More info about the mobile mapping technology can be found at: http://www.viametris.com/products/bms3d/

Description of the Output File

The same format is expected for all tracks. For each trial, you must submit a CSV file whose format is now described.

- 5 columns :
  - Column 1: Timestamp in ms
  - Column 2: WGS84 longitude in decimal degrees with at least 9 decimal digit resolution
  - Column 3: WGS84 latitude in decimal degrees with at least 9 decimal digit resolution
  - Column 4: Floor Number in integer (0 : Ground Floor, -1, 1, 2)
  - Column 5: index in integer (key point number from 1 to N. 0 represents no landmark. Each specific integer represents the specific key point)
- Comma (“,”) used as data delimiter
- No header
- Track3 requirement: frequency 2 Hz synchronized with the beginning of the evaluation trajectory.

Example :

```
1505633871558,141.346908569,43.070758819,-1,0
1505633872089,141.346893310,43.070755004,-1,0
1505633872627,141.346893310,43.070755002,-1,0
1505633873156,141.346893308,43.070755003,-1,0
1505633873692,141.346893310,43.070755004,-1,1
1505633874227,141.346908569,43.070758819,0,0
1505633874774,141.346908570,43.070758817,0,0
1505633875316,141.346908579,43.070758819,0,0
1505633875840,141.346908569,43.070758815,1,2
1505633876372,141.346908565,43.070758819,1,0
1505633876905,141.347000132,43.070770263,1,0
1505633877448,141.347000142,43.070770261,2,0
1505633877994,141.347000152,43.070770262,2,3
1505633878532,141.347000162,43.070770263,2,0
```

Estimated position for key point 1

Estimated position for key point 2

Estimated position for key point 3

Evaluation will only take into account the estimated position at each indexed key point position, so that each track is considered as a series of key point positions (from 1 to N).

Evaluation criterion

The final metric will be based on the accuracy for the correct floor detection and the horizontal positioning error. In particular, the score for comparing the different location systems will be based on the following equations:

$$\textbf{Accuracy Score} = \text{3rdQuartile}\{\text{SampleError}(R_i, E_i)\}, \forall \text{ groundtruth reference in all final test sets}$$

$$\text{SampleError}(R_i, E_i) = \text{Distance}(R_i, E_i) + (\text{penalty} \times \text{floorfail})$$

where:

- “3rdQuartile” is the third quartile error, in meters, of a cumulative error distribution function, i.e., the error value that includes 75% of estimations (sample errors) with a lower error.
- R_i is the actual position (ground truth).

- E_i is the predicted position by the method proposed by the contest participant.
- floorfail is the absolute difference between actual floor and the predicted one.
- penalty is used to penalize errors in estimating the floor. penalty is set to 15 m.
- $\mathrm{Distance}(R_i, E_i)$ calculates the Euclidean distance between coordinates (longitude and latitude) of R_i and E_i.

The team with the lower "Accuracy Score" wins.

Awards

The best team in each track will be awarded the following prizes by the shopping mall center Atlantis:

- Track1 : 1000€ for 1st place
- Track2 : 1000€ for 1st place
- Track3 : 1000€ for 1st place
- Track4 : 1000€ for 1st place

Results will be announced the last day of the IPIN2018 conference, i.e., the 27th in the morning at the award ceremony. The top 3 teams of each track will have to give a presentation to the audience about the system they used and algorithm developed.
The global planned schedule for this last plenary session is the following one:

- Best Papers session
  - Best student paper : presentations the top 2 papers without knowing their rank
  - Best paper : presentations the top 2 papers without knowing their rank
- Competition session
  - Track1 : presentations the top 3 teams without knowing their rank
  - Track2 : presentations the top 3 teams without knowing their rank
  - Track3 : presentations the top 3 teams without knowing their rank
  - Track4 : presentations the top 3 teams without knowing their rank
- Award ceremony
  - Best papers : revelation of the rankings
  - Best competition teams : revelation of the rankings

Information updates

The website (http://ipin2018.ifsttar.fr/) has the most up-to-date information. We invite you to consult it regularly to find answers to your questions.

Looking forward to your participation to IPIN competition!

Track1 "Camera based Positioning (on-site)" special features

Organizational aspects:

Meeting room

- A dedicated meeting room will be assigned for the on-site tracks competitors at the shopping mall. Exact time and location will be communicated at a later stage.

Setup day: 21st of September 2018

- Competitors are allowed to visit the shopping mall during normal opening hours the day before the competition.
- Competitors are **NOT** allowed to install any kind of hardware that could help their device to compute location estimates (no iBeacons, no BLE, …). Again, the competition must be compliant with the **Infrastructure-Free** requirement linked to the shopping mall regulation.
- No technical support from the organizers or from the shopping mall staff will be provided that day.

Evaluation day: 22nd of September 2018

- Evaluation path will be set up by the organizers at the opening time of the mall.
- During the evaluation day, competitors are not allowed anymore to setup or realize acquisitions (disqualification otherwise).
- The competition will take place while regular shopping center customers are there.
- Output file will be provided to the organizers immediately after the evaluation.

Inputs given to competitors

- The coordinates and heading of the starting point will be provided to the competition team.
- There is also the opportunity to reuse what has been proposed for previous editions of IPIN Track1 for smartphone based applications: http://evaal.aaloa.org/2017/software-for-on-site-tracks
- Map floors in raster format: http://ipin2018.ifsttar.fr/index.php?id=4902
    - 4 jpg bitmaps for the floor;
    - 1 calibration text file with "*.cal" extension (contains the Latitude, Longitude of central pixel in image, the image CCW rotation in order to be aligned to the North, and the scale of size of pixels) used to generate the route visualization. The calibration corresponds to an approximation.

Specific hardware requirements/setup

- All vision based technologies are accepted except laser based technology, like Lidar, that is excluded for the competition.
- Lidar technology is nowadays used for highly accurate mobile mapping system, similar to the one that was used for surveying the coordinates of the reference points. It motivates its exclusion for the competition.
- The equipment should be carried on the upper part of the human body, including trouser pockets. Location technology with equipment attached to the lower human body part is addressed in the off-site track 4 competition.

Contact points and information

- For any further question about this track, please contact us at ipin2018@ifsttar.fr

Track2 "Non Camera based Positioning (on-site)" special features

Organizational aspects:

Meeting room

- A dedicated meeting room will be assigned for the on-site tracks competitors at the shopping mall. Exact time and location will be communicated at a later stage.

Setup day: 21st of September 2018

- Competitors are allowed to visit the shopping mall during normal opening hours the day before the competition.
- Competitors are **NOT** allowed to install any kind of hardware that could help their device to compute location estimates (no iBeacons, no BLE, …). Again, the competition must be compliant with the **Infrastructure-Free** requirement linked to the shopping mall regulation.
- No technical support from the organizers or from the shopping mall staff will be provided that day.

Evaluation day: 22nd of September 2018

- Evaluation path will be set up by the organizers at the opening time of the mall.
- During the evaluation day, competitors are not allowed anymore to setup or realize acquisitions (disqualification otherwise).
- The competition will take place while regular shopping center customers are there.
- Output file will be provided to the organizers immediately after the evaluation.

Inputs given to competitors

- The coordinates and heading of the starting point will be provided to the competition team.
- There is also the opportunity to reuse what has been proposed for previous editions of IPIN Track1 for smartphone based applications: http://evaal.aaloa.org/2017/software-for-on-site-tracks
- Map floors in raster format: http://ipin2018.ifsttar.fr/index.php?id=4902
    - 4 jpg bitmaps for the floor;
    - 1 calibration text file with "*.cal" extension (contains the Latitude, Longitude of central pixel in image, the image CCW rotation in order to be aligned to the North, and the scale of size of pixels) used to generate the route visualization. The calibration corresponds to an approximation.

Specific hardware requirements/setup

- The equipment should be carried on the upper part of the human body, including trouser pockets. Location technology with equipment carried on the lower body part is addressed in the off-site track 4 competition.
- This track excludes vision based technology.

Contact points and information

- For any further question about this track, please contact us at ipin2018@ifsttar.fr

Track3 "Smartphone based Positioning (off-site)"special features

Organizational aspects:

Database/dataset download

- Participants can download the databases (logfiles) from this site: http://ipin-conference.org/2018/ipincompetition/
  Competitors can only use the data provided for the competition. They are not allowed to perform any additional on-site calibration.

Submission of the post-processed results

- After processing the evaluation logfiles, participants must submit the position estimates to the contact points of the corresponding track. Each submission must fulfill the format detailed in "Output location file format" described below.
- A participant team can upload up to 3 different contributions, which will be evaluated by the competition organizers. Although the three alternatives will be evaluated on the final test set, only the best one will be considered for the contest.

Submission deadline of the post-processed indoor coordinates

- **The deadline** for submitting the post-processed results is: **SEPTEMBER 14th 2018**

Scope

A spectacular growth of indoor localization solutions has been witnessed during the last decade. Many different positioning approaches exist. Some of them propose the use of natively designed beacons for localization (such as UWB, ultrasound, infrared, pseudolites, etc.). Alternatively other solutions try to explore ways to localize a person by making use of already existing infrastructure in buildings (e.g., WiFi access points for wireless communication, etc.), as well as, other signals available from the embedded sensors in a smartphone (magnetic, inertial, pressure, light, sound, GNSS, etc.). This smartphone-based unmodified-space approach has significant practical benefits such as ubiquity, low cost, as well as being a constantly-updated technology (growing number of AP, improved smartphones, etc.). Several instances of this "smartphone-based" localization approach have been described in the literature; however, there is a need for testing and comparing their performances (e.g., accuracy and robustness) under a common evaluation framework like this competition.

Competition Goal

The goal of this competition track is to evaluate the performance of different indoor localization solutions based on the signals available to a smartphone (such as WiFi readings, Inertial measurements, etc…) and received while a person is walking along several regular unmodified multi-floor buildings.

Main features of the competition

Off-site competition approach

This track is done off-site, so all data for calibration and evaluation is provided by competition organizers before the celebration of the IPIN conference. The competition teams can calibrate their algorithmic models with several databases containing readings from sensors typically found in modern mobile phones and some ground-truth positions. Finally, each team will compete using additional database files, but in this case the ground-truth reference is not given and must be estimated by the competitors. This is an off-line competition where all competitors have the same data of the testing environment, so custom on-site calibration is not allowed.

Multiple sources of information

The multi-sensor data to be processed was captured using a conventional modern smartphone (Samsung A5 2017) at a shopping mall. The data recorded for evaluation is stored in a logfile that contains all the available signals captured in real-time with that smartphone.

The WiFi RSS data (the most important source of information for absolute positioning indoors) can be used to implement a fingerprinting localization method, as well as its magnetic data, while the inertial signals available at the phone can give important clues about the motion of a walking person. GPS information can be used if the user's trajectory is partially done outside (patio, main entrance,…). The pressure, sound and light data could also give some other clues about potential floor changes, or a particular discriminant sound/light intensity at some rooms.

Continuous motion and recording process

While recording the logfiles with the smartphone, the person moved along a continuous trajectory passing by some known landmarks. Every time a person stepped on a known landmark, this ground truth position information was added to the logfile. Ground truth position can be used for calibrating competitor's algorithms. The length of each individual training and validation trajectory is around 3 to 8 min moving to multiple corridors in the shopping mall.

There is no guarantee that the trajectory between two consecutive landmarks will be a perfect straight line. Inertial sensors should be used to detect the displacements with more detail.

Realistic walking style

The person in charge of recording the logfiles moved in a natural and realistic way: most of the time walking forward, but occasionally stopping, taking large turns (90 or 180 degrees at corridor ends), and even moving backward or laterally at certain points (e.g., when giving way at door accesses). The change to different floors is done through elevators and stairs.

Phone holding

The phone was kept always on the user's hand, mainly stable in front of his face or chest (typical position for reading or typing with the phone). No other strange handling conditions are expected. Competitors wishing to use the inertial information should process all data to make reliable relative displacement estimates.

Desired localization approaches

Any kind of positioning algorithm is admitted. In this competition, we strongly welcome:

- **Fingerprinting** approaches using WiFi RSS values, BLE RSS values, or Magnetic patterns. Competitors can use these data and the ground-truth position given in logfiles to calibrate their fingerprinting algorithms.
- **Multi-sensor fusion** algorithms trying to exploit, dynamic time-correlated information such as inertial data (for PDR or pedestrian dead-reckoning), and pressure/sound/illumination changes along each trajectory. For those competitors wishing to exploit this dynamic extra information, a potential benefit could probably be obtained over static fingerprinting.
- **Any other innovative approach.** The use of map information, or any other approach such as activity recognition (detecting states like going upstairs, in a lift, etc.), in order to complement the above-mentioned solutions are also acceptable.

Information from building

This year the competition takes place in the shopping mall *Atlantis le Centre* (Nantes, France). Multiple WiFi access points (AP) were registered in the logfiles, but the position of each AP is unknown. Several geo-referenced floor-map images are available; competitors are free to decide whether to use or not to use that information for positioning.

Description of Datasets (Logfiles)

Data Format

Each logfile is a "txt" file containing multiple rows with different types of data. Each row registers the data received from a particular sensor type in the phone at a given time. The stream of sensor data generated in the phone is stored, row by row, in the logfile in sequence as they are received. Each row begins with an initial header (4 capital letters followed by a semicolon, e.g., 'WIFI', 'ACC','MAGN', 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:

```
MAGN;6.600;78.290;-9.66000;-83.64000;0.48000;0
GYRO;6.600;78.295;-0.95845;1.41782;1.94194;3
ACCE;6.600;78.296;4.23534;2.35829;2.30322;3
AHRS;6.601;78.296;65.1936;-18.4234;54.2739;0.53475;0.12253;0.30257;3
WIFI;6.601;78.268;Livebox-f436;48:83:c7:65:f4:3a;-62
WIFI;6.601;78.268;Carpe Diet;08:3e:5d:7e:ce:0e;-81
WIFI;6.601;78.268;Wifi Gratuit Atlantis;00:27:22:e6:ff:d3;-66
WIFI;6.601;78.268;TE-Mobile;84:d4:7e:32:07:b1;-69
WIFI;6.601;78.268;Itinerants;84:d4:7e:32:07:b0;-69
WIFI;6.601;78.268;TPV;84:d4:7e:32:07:b3;-69
WIFI;6.601;78.268;TE-Print;84:d4:7e:32:07:b2;-69
WIFI;6.601;78.268;;0e:18:0a:7b:51:c6;-78
WIFI;6.601;78.268;BK Staff;06:18:1a:7b:51:c6;-72
WIFI;6.601;78.268;;0e:18:1a:7b:51:c6;-71
WIFI;6.601;78.268;Coyote_Store;a0:1b:29:b0:b1:c0;-74
WIFI;6.601;78.268;TE-Mobile;84:d4:7e:32:07:a1;-71
WIFI;6.601;78.268;Itinerants;84:d4:7e:32:07:a0;-68
WIFI;6.601;78.268;TPV;84:d4:7e:32:07:a3;-67
WIFI;6.601;78.268;HUAWEI-E5186-5G-BCA0;1c:8e:5c:82:bc:a2;-84
WIFI;6.601;78.268;Bbox-0086973C-5GHz;a0:1b:29:b0:b1:c4;-80
WIFI;6.601;78.268;TE-Print;84:d4:7e:32:07:a2;-67
WIFI;6.601;74.737;BK Staff;06:18:0a:7b:51:c6;-74
WIFI;6.601;78.268;Freebox-A2A715;68:a3:78:93:16:5c;-72
WIFI;6.601;78.268;FreeWifi_secure;68:a3:78:93:16:5e;-72
WIFI;6.601;74.737;;06:18:0a:7b:51:c6;-76
WIFI;6.601;78.268;GIE;98:de:d0:2e:ad:34;-81
WIFI;6.601;78.268;;7c:26:64:64:4d:a5;-85
WIFI;6.601;74.737;Bbox-97E1E84D;b8:d9:4d:d0:41:60;-85
WIFI;6.601;74.737;;0a:18:1a:7b:51:c6;-76
WIFI;6.601;74.737;;0a:18:0a:7b:51:c6;-73
WIFI;6.601;78.268;REUNION GIE;40:9b:cd:1d:57:08;-80
WIFI;6.601;78.268;Bbox-97E1E84D-5GHz;b8:d9:4d:d0:41:64;-90
WIFI;6.601;78.268;GARSYS_STHERBLAIN_ATLANTIS;00:26:4d:7e:97:d1;-83
WIFI;6.601;74.737;Bbox-F0B81CAB-5GHz;00:78:9e:79:e8:74;-92
WIFI;6.601;78.268;HP-Print-21-Officejet Pro 6230;c8:d3:ff:67:04:21;-80
WIFI;6.601;78.268;Bbox-F0B81CAB;00:78:9e:79:e8:70;-83
WIFI;6.601;78.268;validation_nocibe;70:3a:0e:ba:04:02;-89
WIFI;6.601;78.268;Wifi Gratuit Atlantis;dc:9f:db:02:3f:ae;-83
GYRO;6.620;78.306;-1.06168;1.36834;1.91262;3
MAGN;6.620;78.311;-11.88000;-82.92000;0.30000;0
GYRO;6.620;78.316;-1.06352;1.23700;1.86375;3
ACCE;6.621;78.317;5.84425;2.81079;3.12922;3
AHRS;6.621;78.317;63.2730;-20.4402;58.3712;0.52434;0.11984;0.32733;3
GYRO;6.629;78.326;-0.97555;1.07512;1.73974;3
```

Figure 1. Log file example of the format used for sensor data registration. The registered measurements correspond to the time interval from 6.600 to 6.629 seconds (29 milliseconds).

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

WIFI: the RSS (in dBm) received from a particular AP	
Format	WIFI;AppTimestamp(s);SensorTimeStamp(s);Name_SSID;MAC_BSSID;RSS(dBm)
Example	WIFI;1.184;130.671;eduroam;00:0b:86:27:37:b0;-91
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(int.)
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
SOUN: the sound pressure level in dB	
Format	SOUN;AppTimestamp(s);RMS;Pressure(Pa);SPL(dB)
Example	SOUN;0.248;594.57;0.01815;59.15
TEMP: the temperature in degrees Celsius.	
Format	TEMP;AppTimestamp(s);SensorTimestamp(s);temp(ºC);Accuracy(integer)
Example	TEMP;0.505;134.194;26.9;1
PROX: Proximity	
Format	PROX;AppTimestamp(s);SensorTimestamp(s);prox(1/0);Accuracy(integer)
Example	
HUMI: Humidity	
Format	HUMI;AppTimestamp(s);SensorTimestamp(s);humi(%);Accuracy(integer)
Example	HUMI;0.501;134.194;47.0;1
GNSS: the Latitude, Longitude and Height estimated from GPS/Glonass	
Format	GNSS;AppTimestamp(s);Latit(º);Long(º);Altitude(m);Bearing(º);Accuracy(m);Speed(m/s); UTCTime(ms);SatInView;SatInUse
Example	GNSS;0.611;40.313524;-3.483137;600.865;0.000;4.0;0.0;1358782729999; 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
BLE4: Bluetooth Low Energy 4.0 data	
Format	BLE4;AppTS(s);MajorID;MinorID;RSS(dBm)
Example	BLE4;0.420;2016;12;-86
POSI: ground-truth position (only in calibration files)	
Format	POSI;Timestamp(s);Latitude(degrees); Longitude(degrees);floor ID(0,1,2..4);Building ID(0,1,2..3)
Example	POSI; 0.0330;41.12245678,-3.12355678,2,0

Note that for most sensors there are two timestamps (both in seconds):

1. 'AppTimestamp' is set by the mobile App as data is read. It is not representative of when data is actually captured by the sensor (but it is in a time reference common to all sensors).
2. 'SensorTimestamp' is set by the sensor itself. The sampling interval is the difference between SensorTimestamp(k) and SensorTimestamp(k-1).

The sampling rate of each type of sensor can be different from logfile to logfile, since it is dependent on the embedded sensor chips used by a particular phone. Typical sampling frequency values for the inertial data is about 50Hz. Pressure, Sound, Light sensors have a much lower update rate (<10Hz). WiFi scans are available approximately every 6 seconds (0.17 Hz).

Each logfile includes in its firsts rows (those starting with character '%') some informative text about the sensor data format, the date of recording and identification of the used phone (model and android version). The provided logfiles should be parsed by the competitor's teams in case they need to rearrange data into another preferred format. A parser in Matlab code is available in the supplementary materials to competitors want to use it to help to manipulate and rearrange data.
Important note: the evaluation key points (landmarks) are not publicly available in off-site tracks and they will be inserted by the organizers using the timestamp in the submitted files. In track 3, the first row starts in apptimestamp 0, which corresponds to 1515688724000 (Thu Jan 11 17:38:44 GMT+01:00 2018) in Unix Timestamp.

Calibration process for fingerprinting

It is known that Wi-Fi Fingerprinting methods require to be calibrated before being operative for localization. In order to do this calibration, the competitors should extract the ground-truth position within the logfile ('POSI' header) and get the WiFi readings closest in time to each reference landmark. Several logfiles are available for calibration, so each competitor should extract the relevant information from the different logfiles.

Dataset types and download link

The are some datasets available for calibration: the **training** and **validation** logfiles. Both training and validation logfiles include reference ground-truth positions (lines with a "POSI" header, followed by Latitude, Longitude, floor ID and Building ID). The validation logfiles will be explicitly provided by the organizers and should be used to have an estimation of the IPS accuracy for the IPIN Conference paper.
In addition to the validation logfiles, two special validation logfiles will be also provided. Those two special validation logfiles correspond to longer trajectories with a limited number of landmark positions, which will be of special interest to competitors to detect if their algorithms have good accuracy under extreme evaluation conditions with very limited feedback. Moreover, the initial part of the bonus trajectories (between the first and second POSI labels) is placed outside the competition area. This will be useful to test the indoor positioning systems in unexpected conditions.
Another type of logfiles, the **evaluation** logfiles, are used for evaluation at the competition and do not contain any position reference (no 'POSI' header). These logfiles contain measurements taken following the same procedure used in the training and validation logfiles, although possibly by different users or phone models. The evaluation of the competitor's algorithm will rank its performance according to the metrics previously described in section "Evaluation criterion". In Track 3 of the 2018 IPIN competition, a single evaluation logfile is provided.

Sensor Calibration

All training and validation logfiles start with a calibration. First, the phone is arbitrary moved during around 15-30 seconds. Then, it remains static in from of user's face for around 15-30 additional seconds. After that, the first landmark is provided. A similar calibration procedure is done in the evaluation logfile.

Inputs given to competitors

The materials and methods provided by the competition organizers are:

- **Supplementary materials**
  http://ipin-conference.org/2018/ipincompetition/files/ipin2018track3-supplementarymaterials.zip
  - **Matlab Parser**
  - **Map floors** in raster format:

        - 3 jpg bitmaps for the floor;
        - 1 calibration text file with "*.cal" extension (contains the Latitude, Longitude of central pixel in image, the image CCW rotation in order to be aligned to the North, and the scale of size of pixels) used to generate the route visualization. The calibration corresponds to an approximation.
    - Visualization of the routes using the map floors in raster format as reference

- **LogFiles** with ground-truth inserted (POSI lines): http://ipin-conference.org/2018/ipincompetition/files/ipin2018track3-logfiles.zip
    - Training Logfiles:
        - 2 log_files for Route T01-2018 with 16 landmarks
        - 1 log_files for Route T01-2018 with 17 landmarks
        - 2 log_files for Route T02-2018 with 12 landmarks
        - 1 log_file for Route T02-2018 with 11 landmarks
        - 3 log_files for Route T03-2018 with 12 landmarks
        - 1 log_files for Route T03-2018 with 24 landmarks
        - 3 log_files for Route T04-2018 with 10 landmarks
        - 3 log_files for Route T05-2018 with 16 landmarks
        - 3 log_files for Route T06-2018 with 13 landmarks
        - 3 log_files for Route T07-2018 with 20 landmarks
    - Validation Logfiles:
        - 2 log_files for Route V01-2018 with 16 landmarks
        - 3 log_files for Route V02-2018 with 14 landmarks
        - 2 log_files for Route V03-2018 with 10 landmarks
        - 2 log_files for Route V04-2018 with 10 landmarks
        - 2 log_files for Route V05-2018 with 12 landmarks
        - 2 log_files for Route V06-2018 with 17 landmarks
        - 1 log_file for Route Bonus01-2018 with 10 landmarks
        - 1 log_file for Route Bonus02-2018 with 10 landmarks

- **LogFiles** without ground-truth:
  http://ipin-conference.org/2018/ipincompetition/files/ipin2018track3-logfiles.zip
    - Evaluation Logfiles:
        - 1 log_file for Route EVAL-2018 without landmarks

Contact points and information

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

Joaquín Torres (jtorres@uji.es) at Institute of New Imaging Technologies, Universitat Jaume I, Castellón, Spain. Please carbon copy (CC) also to Antonio R. Jiménez (antonio.jimenez@csic.es) at the Center of Automation and Robotics (CAR)-CSIC/UPM, Madrid, Spain.

Track4 "Foot-Mounted IMU based Positioning (off-site)" special features

Organizational aspects:

Database/dataset download

- Participants can download the databases (logfiles) from this site: http://ipin-conference.org/2018/ipincompetition/
  Competitors can only use the data provided for the competition. They are not allowed to perform any additional on-site calibration.

Submission of the post-processed results

- After processing the evaluation logfiles, participants must submit the position estimates to the contact points of the corresponding track. Each submission must fulfill the format previously detailed in Section "Description of the Output File".
- A participant team can upload up to 3 different contributions, which will be evaluated by the competition organizers. Although the three alternatives will be evaluated on the final test set, only the best one will be considered for the contest.

Submission deadline of the post-processed indoor coordinates

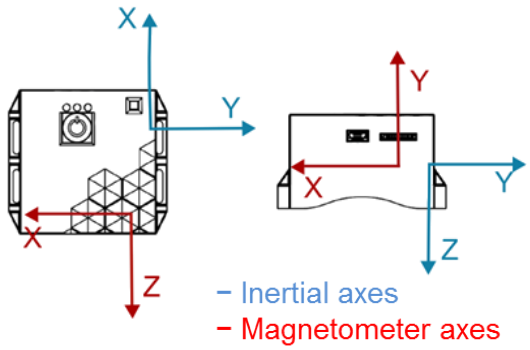
- **The deadline** for submitting the post-processed results is: **SEPTEMBER 14th 2018**

Scope

Many indoor navigation systems have been developed for pedestrians and assessing their performances is a real challenge. Benefiting from a reference solution that is accurate enough to evaluate other indoor navigation systems and assist novel research is of prime interest. According to ISO18305:2016 two different ways can be used for assessing indoor localization system: "Off-line surveyed test point" that is commonly used, or "reference system" with an accuracy at least one order of magnitude better the system you want to test. The scope of this track4 is clearly focused on the second way of assessing.

Competition Goal

The goal of this competition is to evaluate how good up-to-date INS algorithm is. Each competitor will be given a dataset logged with PERSY (PEdestrian Reference SYstem).



Description of Datasets (Logfiles)

Each dataset is composed of the following files:

- HKBxx_mag.csv : magnetometer data from an Honeywell HMC5983 sensor
- HKBxx_sti.csv : accelerometer / gyrometer / inclinometer from a Sensonor STIM300 IMU
- HKBxx_ublox.ubx : GNSS rawdata and NMEA (GGA/ZDA) from a Ublox NEO-M8T receiver

- HKBxx_INFO.txt : parameter of acquisition.

With xx being an integer number.

Column	HKBxx_mag.csv	HKBxx_sti.csv
1	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
2	Mag X (Gauss)	Acc X (m/s²)
3	Mag Y (Gauss)	Acc Y (m/s²)
4	Mag Z (Gauss).	Acc Z (m/s²)
5	-	Gyro X (rad/s)
6	-	Gyro Y (rad/s)
7	-	Gyro Z (rad/s)
8	-	Inc X (m/s²)
9	-	Inc Y (m/s²)
10	-	Inc Z (m/s²)

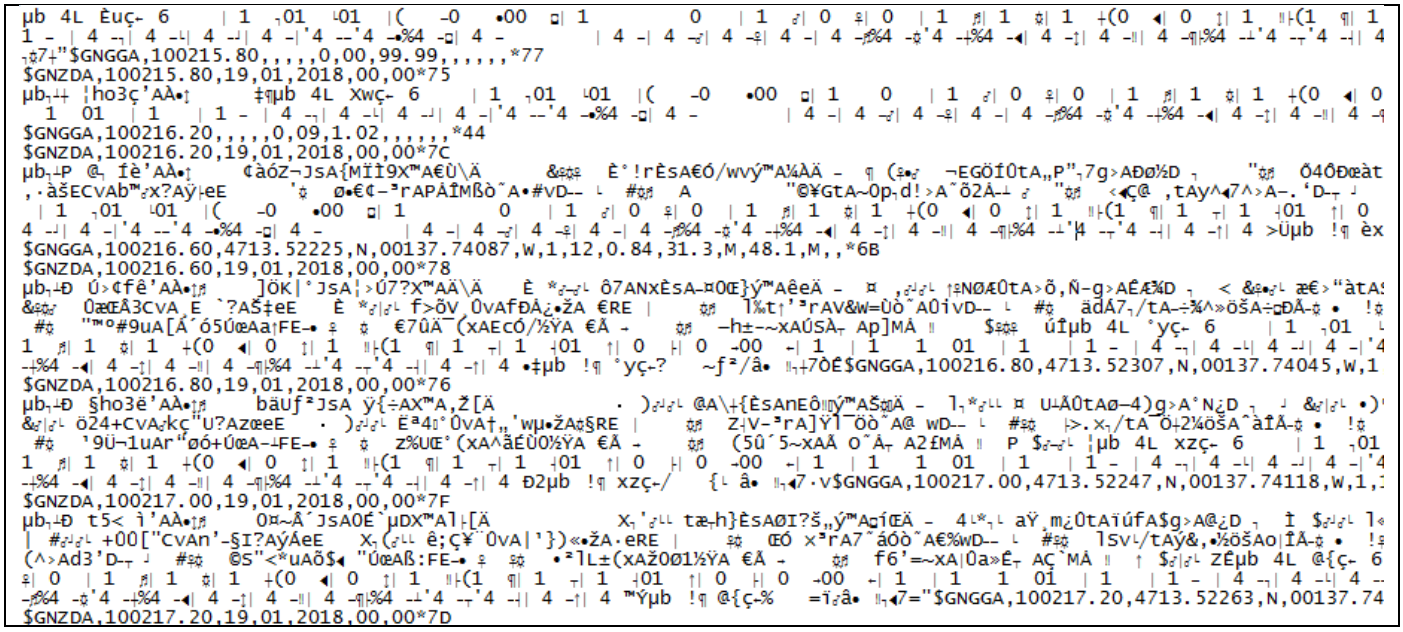
Sample of HKBxx_mag.csv

```
468159.9399756390,-1.763636,-0.688636,-0.052273
468159.9462234838,-1.770455,-0.677273,-0.054545
468159.9524873283,-1.811364,-0.681818,-0.054545
468159.9587211735,-1.793182,-0.688636,-0.050000
468159.9649740182,-1.827273,-0.661364,-0.050000
468159.9712228630,-1.765909,-0.684091,-0.045455
468159.9774877075,-1.881818,-0.661364,-0.059091
468159.9837235526,-1.747727,-0.675000,-0.050000
468159.9899743974,-1.863636,-0.656818,-0.047727
468159.9962232422,-1.815909,-0.659091,-0.043182
```

Sample of HKBxx_ sti.csv

```
468159.9413936038,0.973037,-0.039822,-9.691205,-0.096551,0.209446,-0.102691,0.878616,-0.026245,-9.806030
468159.9473904549,0.888735,-0.009072,-10.158242,-0.092510,0.121487,-0.118683,0.898719,-0.014653,-9.710660
468159.9538922934,1.070751,0.012644,-10.062848,-0.067220,0.078188,-0.156850,0.920395,-0.028249,-9.792823
468159.9598871445,1.193360,0.044648,-9.892860,-0.065414,0.072983,-0.196963,0.994653,0.027185,-9.784277
468159.9663939829,1.147926,0.057012,-10.037952,-0.087818,0.048152,-0.224686,1.099507,0.063140,-9.799905
468159.9724008338,1.104344,-0.010175,-9.981745,-0.102824,0.030513,-0.236167,1.128660,0.058324,-9.854417
468159.9788936725,1.120187,-0.033781,-9.874043,-0.102832,0.030752,-0.243609,1.099098,0.023119,-9.846171
468159.9848875237,1.125125,-0.071714,-9.757157,-0.111005,0.053351,-0.234590,1.100033,-0.033238,-9.813517
468159.9913943621,1.098527,-0.173467,-9.769615,-0.106166,0.065569,-0.216283,1.105233,-0.092217,-9.743791
468159.9973902132,1.083657,-0.155492,-9.841609,-0.101822,0.062026,-0.203116,1.084391,-0.159098,-9.719481
468160.0038900518,1.128791,-0.005181,-9.921329,-0.108073,0.054697,-0.211873,1.082584,-0.159163,-9.752542
```

Sample of Ublox NEO-M8T (binary and asci are mixed)



Inputs given to competitors

The materials and methods provided by the competition organizers are:

- **Supplementary material:**
  - **Ublox file Parser**
    - u-center software: https://www.u-blox.com/en/product/u-center-windows
    - RTKLIB: https://github.com/tomojitakasu/RTKLIB_bin
  - **Datasheet of each individual sensors can be downloaded here:**
    - Honeywell HMC5983: http://ipin-conference.org/2018/ipincompetition/files/Datasheet_HMC5983.pdf
    - Sensonor STIM300 IMU: http://ipin-conference.org/2018/ipincompetition/files/Datasheet_STIM300.pdf
    - Ublox NEO-M8T GNSS Receiver: http://ipin-conference.org/2018/ipincompetition/files/Datasheet_NEO-M8T.pdf
- **LogFiles**:
  - HKB08.zip : for sensors bias estimation: http://ipin-conference.org/2018/ipincompetition/files/HKB08.zip
    - HKB08_mag.csv
    - HKB08_sti.csv
    - HKB08_ublox.ubx
    - HKB08_INFO.txt
  - HKB82.zip : for trajectory estimation: http://ipin-conference.org/2018/ipincompetition/files/HKB82.zip

- HKB82_mag.csv
- HKB82_sti.csv
- HKB82_ublox.ubx
- HKB82_INFO.txt

- **Timing of expected Key Points**:
  - 103 key points will be evaluated in Track4 (from 1 to 103)
  - Key Points timestamps are expressed in GPS Time of Week in milliseconds (ms)

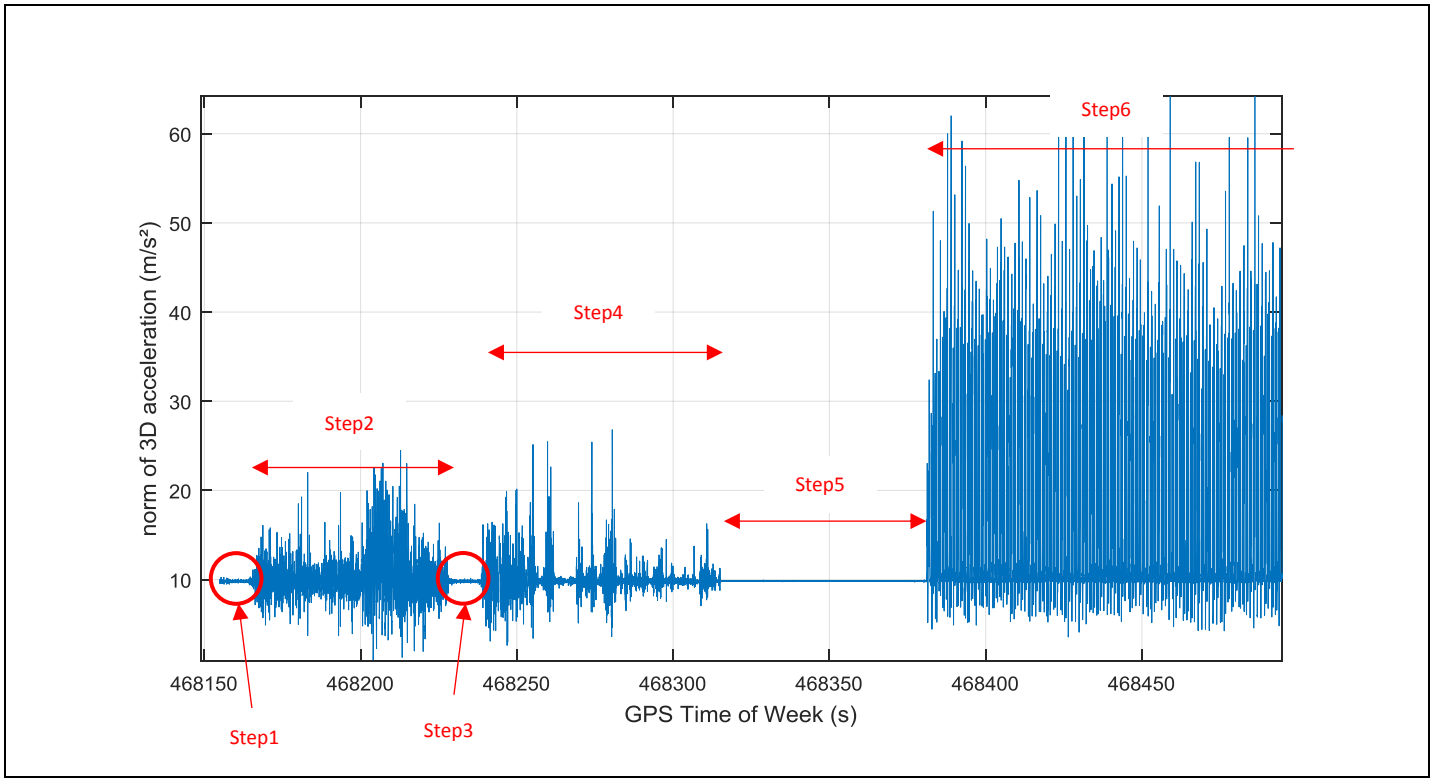
Key Point	GPS Time of Week (ms)	Key Point	GPS Time of Week (ms)	Key Point	GPS Time of Week (ms)
1	468460228	**36**	468774383	**71**	469113136
2	468478259	**37**	468782576	**72**	469116817
3	468496795	**38**	468790832	**73**	469123911
4	468509095	**39**	468804944	**74**	469132742
5	468521695	**40**	468811957	**75**	469139061
6	468527370	**41**	468819944	**76**	469148661
7	468536620	**42**	468824937	**77**	469155817
8	468543457	**43**	468835456	**78**	469165285
9	468549413	**44**	468844499	**79**	469174966
10	468558744	**45**	468855149	**80**	469179779
11	468563438	**46**	468866830	**81**	469184641
12	468568138	**47**	468878117	**82**	469189478
13	468573612	**48**	468892711	**83**	469192966
14	468578031	**49**	468897436	**84**	469222065
15	468584650	**50**	468903429	**85**	469225946
16	468591855	**51**	468912460	**86**	469253714
17	468597549	**52**	468916454	**87**	469259945
18	468606724	**53**	468923160	**88**	469265776
19	468614711	**54**	468934979	**89**	469271745
20	468624299	**55**	468940672	**90**	469277463
21	468650436	**56**	468945897	**91**	469281301
22	468662960	**57**	468952747	**92**	469289395
23	468668341	**58**	468956609	**93**	469300857
24	468673228	**59**	468963934	**94**	469310056
25	468682628	**60**	468984802	**95**	469318837
26	468693191	**61**	468995333	**96**	469325037
27	468701690	**62**	469002420	**97**	469332206
28	468709240	**63**	469010214	**98**	469395823
29	468726971	**64**	469015702	**99**	469405929
30	468734208	**65**	469030607	**100**	469416873
31	468743352	**66**	469040951	**101**	469423035
32	468751964	**67**	469062375	**102**	469430597
33	468755714	**68**	469082487	**103**	469435810
34	468763201	**69**	469088549		
35	468768213	**70**	469109412		

GPS time of week being the same as ones used in datasets, excepted those are in ‘s’ instead of ‘ms’.

The common output format as described in the chapter "Output location file format" shall be used. The table above shall be used for columns 1 & 5 of output location file, as illustrated here after:

```
468460228,141.346893310,43.070755004,-1,1
468478259,141.346908569,43.070758815,1,2
468496795,141.347000152,43.070770262,2,3
…
469435810,141.347020152,44.070770262,2,103
```

- **Description of different phases of evaluated trajectory**:
  - Step1: 10s hand held static phase
  - Step2: 60s magnetometer calibration.
  - Step3: 10s hand held static phase
  - Step4: PERSY setup on the foot
  - Step5: 60s static phase with PERSY on the foot
  - Step6: evaluation track including Key Points from 1 to 103.



- **Coordinates of static phase at <u>Step5</u> is given below:**
    - WGS84 longitude in decimal degrees: `-1.628948317`
    - WGS84 latitude in decimal degrees: `47.225394226`
    - Floor Number in integer: 0 (Outdoor environment)
- **Coordinates of Key Point n°1:**
    - WGS84 longitude in decimal degrees: `-1.629684709`
    - WGS84 latitude in decimal degrees: `47.225371463`
    - Floor Number in integer: 0 (Outdoor environment)
- **Note about Maps use**
    - Even if maps is allowed in others tracks, for this one, **it is NOT**.
    - Algorithms are not supposed to embed or access maps to enhance positioning.
    - As Track4 is an off-line competition, we encourage competitor to use maps in a validation purpose (only).

Contact points and information

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

Miguel Ortiz (miguel.ortiz@ifsttar.fr) at the French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR) France.