

## Track 2 “Pedestrian Dead Reckoning Positioning (on-site)”

### Introduction

This version is intended to give a complete overview on the criteria used to organize the track 2 (Pedestrian dead reckoning positioning) competitions and evaluate the competing systems.

### Competition Goal

This competition track is to evaluate the performance of state-of-the-art PDR solutions worldwide based on the inertial, compass and pressure sensors, etc. It is well known that PDR alone can offer good short to medium-term tracking of the pedestrian, but still the long-term use is quite challenging for many researchers. The published approaches have shown the results under restricted conditions (closed loop walk in a single floor, less than 5 minutes of walk, etc.) and a few of acceptable results are drawn with the aid of external infra-based information. Therefore, the goal of this competition track 2 is to assemble the state of the art of self-contained PDR approaches which can invoke the interest of common research group.

This track is organized in two reasons: One is to compete each other to identify the topmost approach in this area. The other is to provide an opportunity for common interest group can share the ideas and application areas in near future.

### Main features of the competition (Track 2)

#### General

This track will be done on-site, where the IPIN 2016 main conference will be hold (detailed location of the competition site will be given later). Competing system should be engineered or implemented in a form of localization system that exploits MEMS sensors (such as inertial, compass and pressure sensors), without limits on the number of devices and the mounting position, too. Mobile laptop or tablet PC, etc. can be used to process the sensor data stream. Competitors will be provided a detailed map of the area, while the predefined path followed by the actor will not be disclosed to competitors before the application of the benchmarks. A competing system is carried by the competitor himself, and it should record the log file of sensor raw data, estimated position, key point index etc.. An actor from organizer side will accompany with the competitor, and will guide the tracking path and where to record the key point index.

After completing the spanning path, the competitor should submit the log file (Please refer “Description of Output File”) to competition organizers. Any kind of data manipulation is not allowed. Final scores will be resulted by comparing the position errors between the estimated coordinates and the key point coordinates. Alternatively, he/she can use the measurement app provided by IPIN. A competing system, while carried by the competitor, can continuously communicate real-time estimates of its position to the measurement app. For more detailed information, please contact to SOYEON LEE (sylee@etri.re.kr).

No instrumentation of the area by competitors is allowed. Straps or any other devices necessary for the actor to carry the sensors should be provided by the competitors. Possible specific requirements of the proposed localization system should be communicated at an early stage in order be approved and to make the necessary arrangements. For any technical inquiries please e-mail the competition chairs and the TPC chair.

## Sensor System

The competitor can use any of the COTS (Commercial off the Shelf) MEMS sensor or self-developed sensors. Sensors such as inertial, compass, pressure and barometer etc. can be used to estimate the position of the competitor. Any kind of sensor manipulation system (mobile laptop, tablet, wired/wireless communication) is allowed for competitor convenience.

## Measurement procedure

Before attending to the competition, the competitor should develop their own algorithm which manipulating real time data capture and processing with final result in the requested format of text file. There is no need to interface with the other program. The competitor who carries the user terminal, which is communicating with the MEMS sensor on the body, just press the 'space bar' to indicate whether the location is key point or not.

The score for each competing artefact will be evaluated in the course of the time slot assigned to each competitor. At the beginning of the time slot, the competing team will configure their artefact and deploy it on his/her body. The configuration time will be restricted within 20 minutes.

Subsequently, the competitor will start moving and the measurement will take place; during this phase the competitors will have the opportunity to perform only short reconfigurations of their systems, in the order of few seconds. The competitor walks at a natural pace along a loosely-defined reference path, equal for all competitors. The path connects some tens of key points. When the competitor and actor pass through these key points, the competitor will set a time mark using his/her implemented application. The list of time marks together with the ID and positions of the key points will be the ground truth used to compute the localization errors.

Coordinates will need to be in the WGS84 coordinate system (longitude and latitude) for x, y, and the number of floor (an integer starting from 0) or altitude in the unit of meters for z. The timestamp should be in milliseconds from the epoch, retrieved from `currentTimeMillis()`.

The path followed by the person will be approximately the same for each test, will take approximately the same time and will pass through all the key points in the same order. It may include pauses, loops and any kind of natural movement. It will be disclosed to competitors few days before the competition.

## Description of Output File (Logfile)

For each trial, you must submit the following form of text file (.txt), containing the raw data information of your sensors, estimated position and the indices representing the key points in the following format.

### Logfile Data Format

```
utctimestamp,millisec,acc_x,acc_y,acc_z,gyr_x,gyr_y,gyr_z,mag_x,mag_y,mag_z,x,y,z,index
1422349963,002,0.3,0.33,0.4,0.01,0.3,0.5,0,0,0,0,0,0
1422349963,012,0.29,0.30,0.41,0.01,0.3,0.5,0,0,0,0.005,0.1,0.001,0
1422349963,022,0.24,0.25,0.35,....,0
...
1422349983,032,0.24,0.25,0.35,....,0
1422349983,042,0.24,0.25,0.35,....,1
1422349983,042,0.24,0.25,0.35,....,0
...
```

```

1422350003,032,0.24,0.25,0.35,...,0
1422350003,042,0.24,0.25,0.35,...,4
1422350003,042,0.24,0.25,0.35,...,0
1422350003,052,0.24,0.25,0.35,...,0
...
1422350003,032,0.24,0.25,0.35,...,0
1422350003,042,0.24,0.25,0.35,...,N
1422350003,042,0.24,0.25,0.35,...,0
...

```

**\*Note:**

1. utctimestamp and millisec represent the time of your local machine when you take the data entry
2. utctimestamp is in utctimestamp format, and millisec is in '%03d'.
3. acc\_x, acc\_y, and acc\_z represent the raw accelerometer of IMU.
4. gyr\_x, gyr\_y, and gyr\_z represent the raw accelerometer of IMU.
5. mag\_x, mag\_y, mag\_z represent the raw accelerometer of IMU.
  - This can be ignored if your IMU does not support magnetometer. In this case, assign 0 for all mag\_x, mag\_y, and mag\_z.
6. x, y, and z are the estimated position at the time based on your algorithm.
7. 'index' represents the key point number from 1 to N (integer). 0 represents no land mark. Each specific integer represents the specific key point.

**\*\*Note:**

1. Evaluation will be proceeded with the estimated position x, y, z at each indexed key point position.
2. Raw data will be used for flawed detection of the submitted file

**Evaluation criterion**

The accuracy score will be the third quartile of the localization errors at the key points. The localization error is the Euclidean distance between the competitor's estimate and the real position of a key point.

The error will be measured based on **xy** coordinates (longitude and latitude). To this, a penalty  $P = 15$  m will be added for each floor error. For example, if the xy error is 4 m and the estimated floor is 2 while it should be 0, the computed error for that estimate will be  $4 + 2P = 34$  m.

Competitors for which the third quartile of error is greater than 25 m are not eligible for the winner prize.

Final scores will be disclosed at the end of the competition, and the competing systems ranked according to this final score. Additional details on the evaluation criteria will be provided as part of this document.

**Organizational aspects**

The coordinates of the starting point for the path will be provided the day of the competition, at least half an hour before the competition starts. You will have at least a full day before the competition to survey the area yourself, take measurements where needed and make measurements of the network signals.

A number of markers will be put on the floor. You cannot tune your application after the official start of the competition. However, if you notice that things are clearly going wrong in your app (crashing, for example), you may ask for a second chance, which will be normally given if time permits. In any case, the path will be run twice for all competitors, and the best result will be retained.

All competitors in track 2 are NOT required to integrate their app with the dedicated app that we use. We need only a final result text file which is formatted as organizer's request. We are sure this approach can

reduce the time of environmental setting and interfacing between the competitor's app and organizer's app.

### **Clarifications and additions**

Maps and AP positions are available at <http://eval.aaloo.org/2016/tracks-1-2-info>, on the EvAAL web site.

### **Contact Information**

For any question about this competition track, please write to the [contest@eval.aaloo.org](mailto:contest@eval.aaloo.org) mailing list.

If you need a private contact, you can write to

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