



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

### Organizational aspects:

#### Database/dataset access

- As initiated last in Spain last year, we decided to use new rules: even if Track4 is still an off-site track, we will ask to competitors to process data **as if they were in real time**. To do so, a new interface based on a web API has been developed: EvaalAPI. This API will be used by competitors for sending position estimates and reading the sensor readouts:  
<https://evaal.aaloo.org/evaalapi/>
- In the context of this EvaalAPI framework, two "scoring trial" ("scoring trial#1" and "scoring trial#2" described later) are proposed to competitors. **Each of these scoring trial will be usable only once**. Competitors have thus two trials, for the evaluation.
- In order to help competitors to be prepared for the evaluation, a "testing trial" is proposed. This "testing trial" is fully accessible or reloadable (ie not restricted to a single usage as scoring trials). GroundTruth positions are included in the "testing trial" under the POSI label, for validation purpose.
- Participants can still download data usable for sensors bias estimation. Files will be accessible at the following URL:  
"testing trial": <http://evaal.aaloo.org/images/2021/track4/>  
"scoring trials" : coming soon
- For information, competitors can find training datasets\* of previous Track4 edition on Zenodo:  
IPIN2018-Track4: <https://zenodo.org/record/3228012>  
IPIN2019-Track4: <https://zenodo.org/record/3937220>  
IPIN2020-Track4: <https://zenodo.org/record/4668618>  
\*:2018,2019,2020 are based on a different sensor than 2021 & 2022.

#### Submission of the processed results

- As mentioned earlier, results have to be submitted via a web API. See above.
- A participant team can run the process up to 2 times. This lets a chance to catch-up if any issues happen. Although the competition organizers will evaluate the two scoring trials, only the best one will be considered for the contest. For the first evaluation, dataset of "scoring trial#1" will be used. For the second trial, dataset of "scoring trial#2" will be used. These two datasets correspond to two different data collection performed on the same path but not at the same time.

#### Important deadlines:

- Datasheet, some useful LogFiles and GNSS files will be published the: **JUNE 30<sup>th</sup>, 2022**
- "testing trial" is accessible through web API the: **JUNE 30<sup>th</sup>, 2022**
- **"scoring trial#1" and "scoring trial#2" will be accessible the: AUGUST 30<sup>th</sup>, 2022**
- Proclamation of winners: **SEPTEMBER 7<sup>th</sup>, 2022**

### Scope

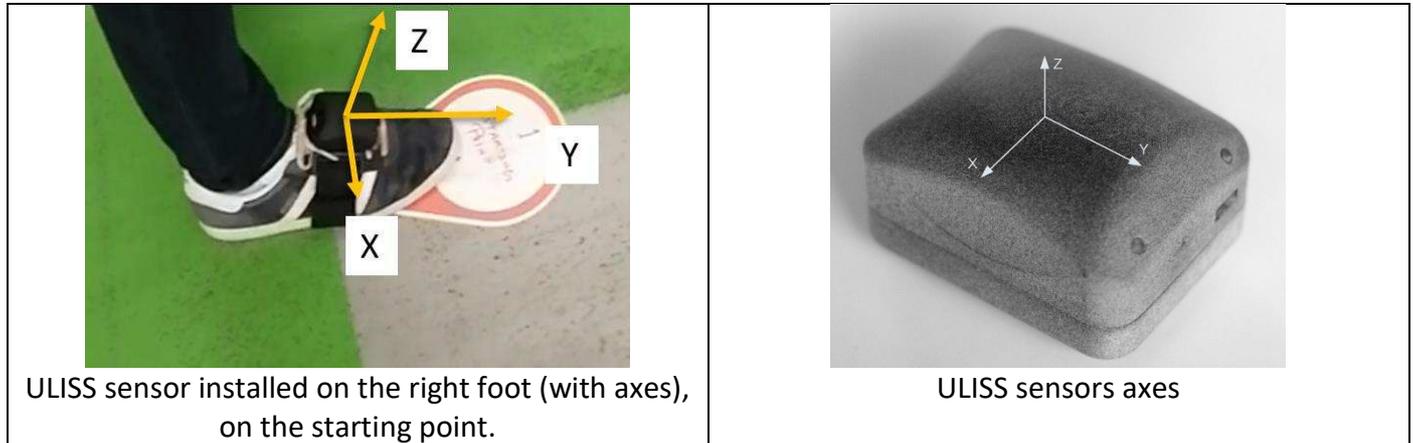
Many indoor navigation systems have been developed for pedestrians and assessing their performances is a real challenge. Benefiting from a reference solution that is accurate enough to evaluate other indoor navigation systems and assist novel research is of prime interest. According to ISO18305:2016 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.

This track4 is based on the same equipment named "ULISS" as previous competition hold during IPIN2021.



### Competition Goal

The goal of this competition is to evaluate how good up-to-date INS algorithm is. Each competitor will have access to a dataset logged with ULISS (Ubiquitous Localization with Inertial Sensors and Satellites), a state-of-the-art Inertial Navigation System producing IMU data, MAG data, PRESSURE data & GNSS data, without the help of any maps.



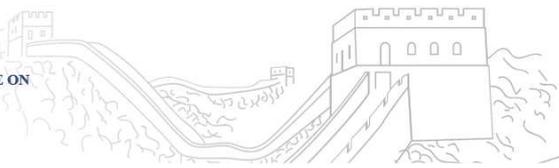
### Description of Datasets

Data is recorded from 3 different sensors:

<p>Xsens Mti-7</p> 	<p>IMU-Mag sensor:          -3D accelerometer          -3D gyrometer          -3D magnetometer</p> <p><a href="https://www.xsens.com/mti-7">https://www.xsens.com/mti-7</a></p>
<p>BMP280 sensor</p> 	<p>Operation range: Pressure: 300...1100 hPa          Absolute accuracy : <math>\sim \pm 1</math> hPa          Relative accuracy : <math>\pm 0.12</math> hPa (typical)</p> <p><a href="https://www.bosch-sensortec.com/products/environmental-sensors/pressure-sensors/bmp280/">https://www.bosch-sensortec.com/products/environmental-sensors/pressure-sensors/bmp280/</a></p>
<p>Ublox ZED-F9P dual freq. receiver</p> 	<p>Multi GNSS Receiver : BeiDou, Galileo, GLONASS, GPS / QZSS          Number of concurrent GNSS 4          Dual GNSS Bands : L1C/A, L2C, L1OF, L2OF, E1B/C, E5b, B1I, B2I</p> <p><a href="https://www.u-blox.com/en/product/zed-f9p-module">https://www.u-blox.com/en/product/zed-f9p-module</a></p>

Unit and meaning of the sensors outputs of ULISS are the following ones:

Column	Xsens MTi-1 (accelerometer)	Comments
1	Acceleration label	"ACCE"
2	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
3	Acc X ( $m/s^2$ )	
4	Acc Y ( $m/s^2$ )	



<b>5</b>	Acc Z (m/s <sup>2</sup> )	
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**Sample strings for accelerometer data**

```
ACCE,314410.003952000,-1.25709,-4.34142,8.75831
ACCE,314410.008947000,-1.23771,-4.28408,8.72497
ACCE,314410.013942000,-1.26714,-4.3795,8.72491
ACCE,314410.018937000,-1.26167,-4.29823,8.71566
ACCE,314410.023932000,-1.25662,-4.26479,8.71095
```

Column	Xsens MTi-1 (gyrometer)	Comments
<b>1</b>	Gyrometer label	"ROTA"
<b>2</b>	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
<b>3</b>	Gyro X (rad/s)	
<b>4</b>	Gyro Y (rad/s)	
<b>5</b>	Gyro Z (rad/s)	

**Sample strings for gyrometer data**

```
ROTA,314410.004573000,0.00275338,-0.000805736,0.006387
ROTA,314410.009578000,-0.00576329,-0.00401807,0.00535798
ROTA,314410.014582000,0.00813067,0.00989926,0.00747764
ROTA,314410.019587000,0.00594413,-0.00079453,0.00529695
ROTA,314410.024591000,0.00488472,0.00237882,0.0117271
```

Column	Xsens MTi-1 (magnetometer)	Comments
<b>1</b>	Magnetometer label	"MAGN"
<b>2</b>	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
<b>3</b>	Mag X (a.u.)	a.u. = arbitrary unit according to Xsens.
<b>4</b>	Mag Y (a.u.)	Tips : multiply by 0.49*1000,
<b>5</b>	Mag Z (a.u.)	In order to get milliGauss (mG)

**Sample strings for magnetometer data**

```
MAGN,314410.005162000,0.224368,0.435266,-1.14962
MAGN,314410.015162000,0.22387,0.434764,-1.14766
MAGN,314410.025162000,0.222876,0.438141,-1.1481
MAGN,314410.035162000,0.223393,0.433828,-1.14817
MAGN,314410.045162000,0.224333,0.431291,-1.1413
```

Column	BMP280 (pressure)	Comments
<b>1</b>	Pressure sensor label	"PRES"
<b>2</b>	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
<b>3</b>	Pressure (Pa)	

**Sample strings for pressure data**

```
PRES,314410.005162000,101144
PRES,314410.025162000,101152
PRES,314410.045162000,101138
PRES,314410.065162000,101151
PRES,314410.085162000,101151
```

Column	Temperature (temperature)	Comments
<b>1</b>	Temperature sensor label	"TEMP"
<b>2</b>	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
<b>3</b>	Temperature (Degree Celsius)	

**Sample strings for temperature data**

```
TEMP,314410.025162000,44.1914
```



TEMP, 314411.025162000, 44.1758  
 TEMP, 314412.025162000, 44.1758

Column	Ublox F9P GNSS receiver (SBS)	Comments
1	GNSS SBAS information label	"GSBS"
2	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
3	Hexadecimal WORD	Corresponds to EGNOS SBAS Message Format*

\*: [https://gssc.esa.int/navipedia/index.php/The\\_EGNOS\\_SBAS\\_Message\\_Format\\_Explained](https://gssc.esa.int/navipedia/index.php/The_EGNOS_SBAS_Message_Format_Explained)

Sample strings for SBS (SBAS – EGNOS) data

GSBS, 315499, 9A494C0000000000000400001F00003F80003FC0003FE0001FF0001FF80  
 GSBS, 315618, 5363FBFFDC00000000000197BBAA01848160A0580B185BFDFEF980900  
 GSBS, 315619, 9A0A8003FE4027FFBFC7FEFFD4003FEC000003FB8003959559797BA380

Column	Ublox F9P GNSS receiver (SBS)	Comments
1	GNSS Observation label	"GOBS"
2	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
3	Observation data	Observation file based on RINEX 3.04 format <a href="http://rtcm.info/RINEX_3.04.IGS.RTCM_Final.pdf">http://rtcm.info/RINEX_3.04.IGS.RTCM_Final.pdf</a> Only data after header* is used in the context of IPIN2021-Track4.

\*Header of "OBSERVATION DATA" file under Rinex 3.04 format are given later in each session specific parts (headers are slightly different).

Sample strings for OBS (observation file, based on RINEX 3.04 format) data

```
GOBS, 314856.199000000, G04 24066762.037 8 126471694.10925 -3666.900 39.000
GOBS, 314856.199000000, G09 21204418.682 8 9 -2579.258 24.000
GOBS, 314856.199000000, G06 21843663.561 9 9 -3361.335 14.000
GOBS, 314856.199000000, C24 24066200.488 4 9 -1496.777 42.000
GOBS, 314856.199000000, C09 41038802.886 9 213699815.76337 -1391.943 30.000
GOBS, 314856.199000000, R10 20885796.375 8 111333055.23728 -1125.414 35.000
GOBS, 314856.199000000, R17 21027399.505 9 112521861.85837 1.771 31.000
GOBS, 314856.199000000, G16 24420695.497 9 9 -607.284 34.000
GOBS, 314856.199000000, E25 26416183.541 9 9 1623.139 22.000
GOBS, 314856.199000000, R09 23641111.957 9 9 -3901.952 26.000
GOBS, 314856.199000000, E24 27240945.515 8 9 -857.287 38.000
GOBS, 314856.199000000, E05 27154158.133 8 9 -2871.781 35.000
GOBS, 314856.399000000, G04 24066902.088 8 126472426.50726 -3656.825 35.000
GOBS, 314856.399000000, G09 21204516.880 8 9 -2576.887 25.000
GOBS, 314856.399000000, G06 21843791.401 9 9 -3361.335 14.000
GOBS, 314856.399000000, C24 24066258.112 4 125319321.10437 -1491.643 44.000
GOBS, 314856.399000000, C09 41038856.136 8 213700093.52228 -1387.629 30.000
GOBS, 314856.399000000, R10 20885839.907 8 111333279.85427 -1119.290 37.000

...

GOBS, 316465.400000000, G09 22053796.355 9 7 -2965.625 42.000 22053774.011 9
9 -2311.088 23.000
GOBS, 316465.400000000, G06 22958748.483 8 9 -3890.580 43.000 22958742.892 9
9 -3018.360 18.000
GOBS, 316465.400000000, G04 25190987.721 9 9 -3672.705 35.000
GOBS, 316465.400000000, G20 20618874.632 4 9 1326.448 48.000
GOBS, 316465.400000000, G07 20956968.745 8 9 -528.696 32.000
GOBS, 316465.400000000, C14 26537412.626 9 9 -3269.531 39.000
```



Column	ground truth position	Comments
1	ground truth position label	"POSI"
2	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
3	WGS84 longitude in decimal degrees	
4	WGS84 latitude in decimal	
5	Floor Number in integer	0 : Ground Floor, -1, 1, 2
6	POSI number index	

#### Sample strings for ground truth position data

```
POSI,308945.294,-1.6313191524195993,47.22617430160391,-1,1  
POSI,308960.836,-1.6310604539849840,47.22612380681056,-1,2
```

Note1: POSI frame is only used twice in scoring trials. For the first **Key Point** (n°1) and the second **Key Point** (n°2).

Note2: POSI frame is used in testing trial to help competitors to tune their algorithm.



Testing trial: dataset recorded around 15h45 (local time), the 15th of 2021

The materials and methods provided by the competition organizers are:

- **“Testing trial” of IPIN2022 is based on “Scoring trial#1” of IPIN2021; even if following links pointing to IPIN2021 are ok, all data is accessible here:**
  - [https://evaal.aaloo.org/files/2022/IPIN2022\\_T4\\_Trials.7z](https://evaal.aaloo.org/files/2022/IPIN2022_T4_Trials.7z)
  - GroundTruth is given inside IPIN2022\_T4\_TestingTrial01.txt under POSI frames.
- **Datasheet of each individual sensors can be downloaded here:**
  - Xsens MTI-1 :  
[http://evaal.aaloo.org/images/2021/track4/MTi-7\\_Leaflet.pdf](http://evaal.aaloo.org/images/2021/track4/MTi-7_Leaflet.pdf)
  - Ublox ZED F9P GNSS Receiver:  
[http://evaal.aaloo.org/images/2021/track4/ZED-F9P\\_ProductSummary\\_\(UBX-17005151\).pdf](http://evaal.aaloo.org/images/2021/track4/ZED-F9P_ProductSummary_(UBX-17005151).pdf)  
[http://evaal.aaloo.org/images/2021/track4/RINEX\\_3.04.IGS.RTCM\\_Final.pdf](http://evaal.aaloo.org/images/2021/track4/RINEX_3.04.IGS.RTCM_Final.pdf)
- **LogFiles to download and to use before evaluation (for testing trial ONLY):**
  - 2021.09.02\_ULISS\_AllanVariance.zip : static logfile of more than 15 hours that can be used for sensors bias estimation  
[http://evaal.aaloo.org/images/2021/track4/2021.09\\_ULISS\\_AllanVariance.zip](http://evaal.aaloo.org/images/2021/track4/2021.09_ULISS_AllanVariance.zip) :
    - acceleration.csv
    - rotation.csv
    - magnetic.csv
    - pressure.csv
    - temperature.csv
  - 2021.09.15\_ULISS\_MagCalib.zip: logfile of about 1 minute that can be used to calibrate the magnetometer sensor  
[http://evaal.aaloo.org/images/2021/track4/2021.09.15\\_ULISS\\_MagCalib.zip](http://evaal.aaloo.org/images/2021/track4/2021.09.15_ULISS_MagCalib.zip)
    - acceleration.csv
    - rotation.csv
    - magnetic.csv
- **GNSS Navigation files that contain ephemeris for those who want to use GNSS sensor:**
  - testing\_trial\_gnss.nav: GNSS Navigation file for testing trial (format RINEX 3.04)  
[http://evaal.aaloo.org/images/2021/track4/session1\\_gnss.nav](http://evaal.aaloo.org/images/2021/track4/session1_gnss.nav)
- **Coordinates of Key Point n°1:**
  - WGS84 longitude in decimal degrees: *-1.631319152*
  - WGS84 latitude in decimal degrees: *47.226174301*
  - Floor Number in integer: *-1*
- **Coordinates of Key Point n°2:**
  - WGS84 longitude in decimal degrees: *-1.631060453*



- WGS84 latitude in decimal degrees: 47.226123806
- Floor Number in integer: -1

○ **Note about Maps use**

- Even if maps may be allowed in others tracks, for this one, **it is NOT**. Track chairs, in such a case, could cancel contributions of competitor.
- Algorithms are not supposed to embed or access maps to enhance positioning.

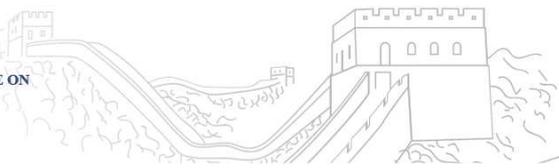
● **Timing of expected Key Points:**

- 83 key points will be evaluated in Track4 : from 3 to 85
- Key Points timestamps are expressed in GPS Time of Week in seconds (s), hereafter in the table.

Key Point	GPS Time of Week (s)	Key Point	GPS Time of Week (s)	Key Point	GPS Time of Week (s)
1*	308945.294	30	309778.168	59	310502.561
2*	308960.836	31	309881.752	60	310567.480
3	308976.111	32	309893.883	61	310580.113
4	308990.088	33	309906.198	62	310592.378
5	309002.014	34	309917.817	63	310601.509
6	309014.780	35	309972.535	64	310615.558
7	309022.926	36	309984.353	65	310628.286
8	309029.910	37	309993.111	66	310676.329
9	309039.174	38	310002.843	67	310688.873
10	309145.224	39	310024.502	68	310699.335
11	309186.323	40	310039.365	69	310783.689
12	309202.144	41	310054.263	70	310810.773
13	309207.260	42	310071.496	71	310823.555
14	309225.605	43	310087.427	72	310980.767
15	309250.396	44	310106.513	73	311008.253
16	309263.674	45	310173.810	74	311035.611
17	309279.550	46	310183.035	75	311052.397
18	309291.084	47	310205.504	76	311064.380
19	309305.375	48	310258.708	77	311094.500
20	309320.843	49	310293.343	78	311282.676
21	309330.410	50	310306.095	79	311361.069
22	309512.491	51	310324.789	80	311390.255
23	309527.796	52	310343.358	81	311412.163
24	309556.105	53	310353.269	82	311418.497
25	309568.216	54	310363.170	83	311428.756
26	309594.479	55	310372.852	84	311439.655
27	309677.148	56	310446.256	85	311460.997
28	309755.879	57	310476.495		
29	309768.646	58	310485.099		

\*: coordinates given (see above)

The output format is described in the chapter “Description of the Output File” here after.



• Header of GNSS "OBSERVATION DATA" file under Rinex 3.04 format

```

3.04      OBSERVATION DATA      M: Mixed      RINEX VERSION / TYPE
RTKCONV demo5 b34c      20210930 154220 UTC PGM / RUN BY / DATE
format: u-blox UBX      COMMENT
log: D:\IPIN2021\DataCollection\2021.09.15_15h30_Acquil\ULISCOMMENT
MARKER NAME
MARKER NUMBER
MARKER TYPE
OBSERVER / AGENCY
REC # / TYPE / VERS
ANT # / TYPE
APPROX POSITION XYZ
4337853.3676 -123576.7925 4658733.9793 ANTENNA: DELTA H/E/N
0.0000 0.0000 0.0000
G 8 C1C L1C D1C S1C C2X L2X D2X S2X SYS / # / OBS TYPES
R 8 C1C L1C D1C S1C C2C L2C D2C S2C SYS / # / OBS TYPES
E 8 C1X L1X D1X S1X C7X L7X D7X S7X SYS / # / OBS TYPES
S 4 C1C L1C D1C S1C SYS / # / OBS TYPES
C 8 C2I L2I D2I S2I C7I L7I D7I S7I SYS / # / OBS TYPES
2021 09 15 13 48 01.2070000 GPS TIME OF FIRST OBS
2021 09 15 14 33 04.2070000 GPS TIME OF LAST OBS
G L1C SYS / PHASE SHIFT
G L2X -0.25000 SYS / PHASE SHIFT
R L1C SYS / PHASE SHIFT
R L2C SYS / PHASE SHIFT
E L1X 0.00000 SYS / PHASE SHIFT
E L7X 0.00000 SYS / PHASE SHIFT
S L1C SYS / PHASE SHIFT
C L2I SYS / PHASE SHIFT
C L7I SYS / PHASE SHIFT
12 R01 1 R02 -4 R07 5 R08 6 R09 -2 R10 -7 R11 0 R16 -1 GLONASS SLOT / FRQ #
R17 4 R22 -3 R23 3 R24 2 GLONASS SLOT / FRQ #
C1C 0.000 C1P 0.000 C2C 0.000 C2P 0.000 GLONASS COD/PHS/BIS
END OF HEADER
  
```



Scoring trial#1: dataset recorded around 10h30 (local time), the 12<sup>th</sup> of July 2022

The materials and methods provided by the competition organizers are:

- **Datasheet of each individual sensors can be downloaded here:**
  - Xsens MTI-1 :  
[http://evaal.aaloo.org/images/2021/track4/MTi-7\\_Leaflet.pdf](http://evaal.aaloo.org/images/2021/track4/MTi-7_Leaflet.pdf)
  - Ublox ZED F9P GNSS Receiver:  
[http://evaal.aaloo.org/images/2021/track4/ZED-F9P\\_ProductSummary\\_\(UBX-17005151\).pdf](http://evaal.aaloo.org/images/2021/track4/ZED-F9P_ProductSummary_(UBX-17005151).pdf)  
[http://evaal.aaloo.org/images/2021/track4/RINEX\\_3.04.IGS.RTCM\\_Final.pdf](http://evaal.aaloo.org/images/2021/track4/RINEX_3.04.IGS.RTCM_Final.pdf)
- **LogFiles to download and to use before evaluation (for both scorings):**
  - 2021.09.02\_ULISS\_AllanVariance.zip : static logfile of more than 15 hours that can be used for sensors bias estimation (same as IPIN2021)  
[http://evaal.aaloo.org/images/2021/track4/2021.09\\_ULISS\\_AllanVariance.zip](http://evaal.aaloo.org/images/2021/track4/2021.09_ULISS_AllanVariance.zip) :
    - acceleration.csv
    - rotation.csv
    - magnetic.csv
    - pressure.csv
    - temperature.csv
  - 2022.07.12\_ULISS\_MagCalib.zip : logfile of about 1 minute that can be used to calibrate the magnetometer sensor  
[http://evaal.aaloo.org/images/2022/track4/2022.07.12\\_ULISS\\_MagCalib.zip](http://evaal.aaloo.org/images/2022/track4/2022.07.12_ULISS_MagCalib.zip)
    - acceleration.csv
    - rotation.csv
    - magnetic.csv
- **GNSS Navigation files that contain ephemeris for those who want to use GNSS sensor:**
  - ScoringTrial1\_ephemeris.zip: GNSS Navigation file for scoring trial#1 (format RINEX 3.04)  
[http://evaal.aaloo.org/images/2022/track4/ScoringTrial1\\_ephemeris.zip](http://evaal.aaloo.org/images/2022/track4/ScoringTrial1_ephemeris.zip)
  - ScoringTrial2\_ephemeris.zip: GNSS Navigation file for scoring trial#2 (format RINEX 3.04)  
[http://evaal.aaloo.org/images/2022/track4/ScoringTrial2\\_ephemeris.zip](http://evaal.aaloo.org/images/2022/track4/ScoringTrial2_ephemeris.zip)
- **Note about Maps use**
  - Even if maps may be allowed in others tracks, for this one, **it is NOT**. Track chairs, in such a case, could cancel contributions of competitor.
  - Algorithms are not supposed to embed or access maps to enhance positioning.



- **Timing of expected Key Points:**

- 90 key points will be evaluated in Track4
- **But** exact timings are not given anymore. This is the major change of version 1.3 of this document. Even if a timings list has been given in previous versions, this will **NOT** be used for the final evaluation.
- Evaluation is now based like other Tracks: i.e. position has to be computed and sent twice a second (~2Hz), synchronized with the eval data stream, and thus corresponding to the end of each dataset window of 0.5s.
- The output format is described in the chapter “Description of the Output File” here after.

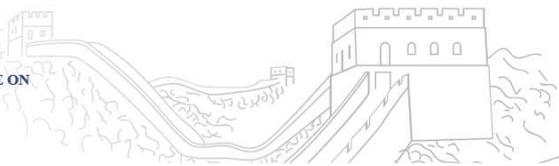
- **Points given in order to get a good first heading:**

- **Coordinates and time of Key Point n°1:**

- GPS Time of Week in seconds: 210818.000
- WGS84 longitude in decimal degrees: -1.542615053
- WGS84 latitude in decimal degrees: 47.217688611
- Floor Number in integer: 0
- **Corresponding POSI line:**  
POSI, 210818.000, -1.542615053, 47.217688611, 0, 1

- **Coordinates and time of Key Point n°2:**

- GPS Time of Week in seconds: 210861.000
- WGS84 longitude in decimal degrees: -1.542635114
- WGS84 latitude in decimal degrees: 47.217559581
- Floor Number in integer: 0
- **Corresponding POSI line:**  
POSI, 210861.000, -1.542635114, 47.217559581, 0, 2



- Header of GNSS "OBSERVATION DATA" file under Rinex 3.04 format

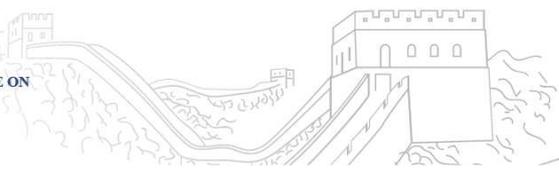
3.04	OBSERVATION DATA	M: Mixed	RINEX VERSION / TYPE
RTKCONV demo5 b34c		20220714 135445 UTC	PGM / RUN BY / DATE
format: u-blox UBX			COMMENT
log: D:\IPIN2022\ULISS Pied Track4\uliss-1-trace-171\gnss.ub			COMMENT
			MARKER NAME
			MARKER NUMBER
			MARKER TYPE
			OBSERVER / AGENCY
			REC # / TYPE / VERS
			ANT # / TYPE
4338424.4163	-116837.9032	4658280.1705	APPROX POSITION XYZ
0.0000	0.0000	0.0000	ANTENNA: DELTA H/E/N
G 8 C1C L1C D1C S1C C2X L2X D2X S2X			SYS / # / OBS TYPES
R 8 C1C L1C D1C S1C C2C L2C D2C S2C			SYS / # / OBS TYPES
E 8 C1X L1X D1X S1X C7X L7X D7X S7X			SYS / # / OBS TYPES
0.200			INTERVAL
2022 07 12 10 33 38.0020000		GPS	TIME OF FIRST OBS
2022 07 12 10 57 48.8040000		GPS	TIME OF LAST OBS
G L1C			SYS / PHASE SHIFT
G L2X -0.25000			SYS / PHASE SHIFT
R L1C			SYS / PHASE SHIFT
R L2C			SYS / PHASE SHIFT
E L1X 0.00000			SYS / PHASE SHIFT
E L7X 0.00000			SYS / PHASE SHIFT
12 R01 1 R02 -4 R07 5 R08 6 R13 -2 R14 -7 R15 0 R16 -1			GLONASS SLOT / FRQ #
R17 4 R18 -3 R23 3 R24 2			GLONASS SLOT / FRQ #
C1C 0.000 C1P 0.000 C2C 0.000 C2P 0.000			GLONASS COD/PHS/BIS
			END OF HEADER



Scoring Trial#2: dataset recorded around 12h20 (local time), the 12<sup>th</sup> of July 2022

The materials and methods provided by the competition organizers are:

- **Datasheet of each individual sensors can be downloaded here:**
  - Xsens MTI-1 :  
[http://evaal.aalooa.org/images/2021/track4/MTi-7\\_Leaflet.pdf](http://evaal.aalooa.org/images/2021/track4/MTi-7_Leaflet.pdf)
  - Ublox ZED F9P GNSS Receiver:  
[http://evaal.aalooa.org/images/2021/track4/ZED-F9P\\_ProductSummary\\_\(UBX-17005151\).pdf](http://evaal.aalooa.org/images/2021/track4/ZED-F9P_ProductSummary_(UBX-17005151).pdf)  
[http://evaal.aalooa.org/images/2021/track4/RINEX\\_3.04.IGS.RTCM\\_Final.pdf](http://evaal.aalooa.org/images/2021/track4/RINEX_3.04.IGS.RTCM_Final.pdf)
- **LogFiles to download and to use before evaluation (for both scorings):**
  - 2021.09.02\_ULISS\_AllanVariance.zip : static logfile of more than 15 hours that can be used for sensors bias estimation (same as IPIN2021)  
[http://evaal.aalooa.org/images/2021/track4/2021.09\\_ULISS\\_AllanVariance.zip](http://evaal.aalooa.org/images/2021/track4/2021.09_ULISS_AllanVariance.zip) :
    - acceleration.csv
    - rotation.csv
    - magnetic.csv
    - pressure.csv
    - temperature.csv
  - 2022.07.12\_ULISS\_MagCalib.zip : logfile of about 1 minute that can be used to calibrate the magnetometer sensor  
[http://evaal.aalooa.org/images/2022/track4/2022.07.12\\_ULISS\\_MagCalib.zip](http://evaal.aalooa.org/images/2022/track4/2022.07.12_ULISS_MagCalib.zip)
    - acceleration.csv
    - rotation.csv
    - magnetic.csv
- **GNSS Navigation files that contain ephemeris for those who want to use GNSS sensor:**
  - ScoringTrial1\_ephemeris.zip: GNSS Navigation file for scoring trial#1 (format RINEX 3.04)  
[http://evaal.aalooa.org/images/2022/track4/ScoringTrial1\\_ephemeris.zip](http://evaal.aalooa.org/images/2022/track4/ScoringTrial1_ephemeris.zip)
  - ScoringTrial2\_ephemeris.zip: GNSS Navigation file for scoring trial#2 (format RINEX 3.04)  
[http://evaal.aalooa.org/images/2022/track4/ScoringTrial2\\_ephemeris.zip](http://evaal.aalooa.org/images/2022/track4/ScoringTrial2_ephemeris.zip)
- **Note about Maps use**
  - Even if maps may be allowed in others tracks, for this one, **it is NOT**. Track chairs, in such a case, could cancel contributions of competitor.
  - Algorithms are not supposed to embed or access maps to enhance positioning.



- **Timing of expected Key Points:**

- 90 key points will be evaluated in Track4
- **But** exact timings are not given anymore. This is the major change of version 1.3 of this document. Even if a timings list has been given in previous versions, this will **NOT** be used for the final evaluation.
- Evaluation is now based like other Tracks: i.e. position has to be computed and sent twice a second (~2Hz), synchronized with the eval data stream, and thus corresponding to the end of each dataset window of 0.5s.
- The output format is described in the chapter “Description of the Output File” here after.

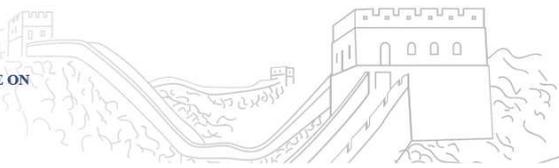
- **Points given in order to get a good first heading:**

- **Coordinates of Key Point n°1:**

- GPS Time of Week in seconds: 217034.000
- WGS84 longitude in decimal degrees: -1.542614572
- WGS84 latitude in decimal degrees: 47.217689856
- Floor Number in integer: 0
- Corresponding POSI line:  
POSI, 217034.000, -1.542614572, 47.217689856, 0, 1

- **Coordinates of Key Point n°2:**

- GPS Time of Week in seconds: 217076.200
- WGS84 longitude in decimal degrees: -1.542664061
- WGS84 latitude in decimal degrees: 47.217563242
- Floor Number in integer: 0
- Corresponding POSI line:  
POSI, 217076.200, -1.542664061, 47.217563242, 0, 2



- Header of GNSS "OBSERVATION DATA" file under Rinex 3.04 format

```

3.04          OBSERVATION DATA      M: Mixed          RINEX VERSION / TYPE
RTKCONV demo5 b34c          20220714 141347 UTC PGM / RUN BY / DATE
format: u-blox UBX          COMMENT
log: D:\IPIN2022\ULISS Pied Track4\uliss-1-trace-172\gnss.ubCOMMENT
MARKER NAME
MARKER NUMBER
MARKER TYPE
OBSERVER / AGENCY
REC # / TYPE / VERS
ANT # / TYPE
APPROX POSITION XYZ
ANTENNA: DELTA H/E/N
SYS / # / OBS TYPES
SYS / # / OBS TYPES
SYS / # / OBS TYPES
INTERVAL
TIME OF FIRST OBS
TIME OF LAST OBS
SYS / PHASE SHIFT
GLONASS SLOT / FRQ #
GLONASS SLOT / FRQ #
GLONASS COD/PHS/BIS
END OF HEADER

0.0000          0.0000          0.0000
0.0000          0.0000          0.0000
G 8 C1C L1C D1C S1C C2X L2X D2X S2X
R 8 C1C L1C D1C S1C C2C L2C D2C S2C
E 8 C1X L1X D1X S1X C7X L7X D7X S7X
0.200
2022 07 12 12 20 17.7900000 GPS
2022 07 12 12 40 40.7910000 GPS
G L1C
G L2X -0.25000
R L1C
R L2C
E L1X 0.00000
E L7X 0.00000
11 R01 1 R02 -4 R03 5 R04 6 R09 -2 R10 -7 R16 -1 R17 4
R18 -3 R19 3 R24 2
C1C 0.000 C1P 0.000 C2C 0.000 C2P 0.000
  
```



### Description of the Output stream to return by competitor

For each trial, competitor is asked to give processed data with the following format:

- 5 fields :
  - Field 1: Timestamp in seconds
  - Field 2: WGS84 longitude in decimal degrees with at least 9 decimal digit resolution
  - Field 3: WGS84 latitude in decimal degrees with at least 9 decimal digit resolution
  - Field 4: Floor Number in integer (0 : Ground Floor, -1, 1, 2)
  - Field 5: **Incrementing counter starting from 1. 1 being the first point computed by competitor, 2 being the second, and so on...**
- Comma ("," ) used as data delimiter

Evaluation will take into account the **Timestamp** in order to estimate **Time when position has to be assess**.  
In others words : **Field 1 is VERY important**.

Example:

```
315014.273,141.346893310,43.070755004,-1,1  
315534.042,141.346908569,43.070758815,1,2  
315947.424,141.347000152,43.070770262,2,3
```

...



### 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:

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

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

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.
- $\text{Distance}(R_i, E_i)$  calculates the Euclidean distance between coordinates (longitude and latitude) of  $R_i$  and  $E_i$ .

The team with the lower “Accuracy Score” wins.

### Contact points and information

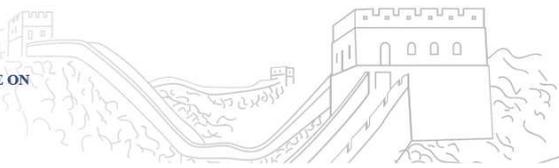
For any further question about the database and this competition track, please contact to:

- Miguel Ortiz ([miguel.ortiz@univ-eiffel.fr](mailto:miguel.ortiz@univ-eiffel.fr)) at the University Gustave Eiffel, France.
- Ni Zhu ([ni.zhu@univ-eiffel.fr](mailto:ni.zhu@univ-eiffel.fr)) at the University Gustave Eiffel, France.

### Introduced changes

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

Version 1.0	June 10 <sup>th</sup>	First version
Version 1.1	July 5 <sup>th</sup>	Testing Trial added, based on last edition of IPIN Link is : <a href="https://evaal.aaloo.org/files/2022/IPIN2020_T4_Trials.7z">https://evaal.aaloo.org/files/2022/IPIN2020_T4_Trials.7z</a>
Version 1.2	July 14 <sup>th</sup>	Scoring Trials information added -2 first points of ScoringTrial#1 are given (Lat,Long, floor) -2 first points of ScoringTrial#2 are given (Lat,Long, floor) -Magnetometer calibration file available for ScoringTrials (same for both) - static logfile of ~15 hours that can be used for sensors bias estimation (Allan deviation) is given -GNSS Ephemeris files are available for ScoringTrials -Expected timing for both ScoringTrials are given
Version 1.3	August 24 <sup>th</sup>	Modification of the Scoring Trial assessment: -it is no more based on Timings table as in previous versions of this document



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- it is now based like other Tracks: i.e. position has to be computed and sent twice a second ( $\sim 2\text{Hz}$ ) synchronized with the eval data stream, and thus corresponding to the end of each dataset window of 0.5s.
  - the 5 fields required before have not changed. They are still expected in order to minimize modification for competitors. However, field n°5 (key point number) is not use anymore for evaluation. It is recommended to write a incrementing counter starting from 1.

Simplification of structure of the document:

- Three unique section for TestingTrial / ScoringTrial#1 / ScoringTrial#2, instead of more before.
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