

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

## Organizational aspects:

#### Database/dataset access

- As initiated last in Spain last year, we decide 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.aaloa.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": <u>http://evaal.aaloa.org/images/2021/track4/</u>
   "scoring trials" : coming soon
- For information, competitors can find training datasets\* of previous Track4 edition on Zenodo: IPIN2018-Track4: <u>https://zenodo.org/record/3228012</u> IPIN2019-Track4: <u>https://zenodo.org/record/3937220</u> IPIN2020-Track4: <u>https://zenodo.org/record/4668618</u>
   \*: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: "testing trial" is accessible through web API the: "scoring trial#1" and "scoring trial#2" will be accessible the: The deadline for submitting the post-processed results is: Proclamation of winners: SEPTEMBER 7<sup>th</sup>, 2022
 SEPTEMBER

#### <u>Scope</u>

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 (Ubiquituous 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:

Xsens Mti-7	IMU-Mag sensor:
Alexandre and a second se	-3D accelerometer
And the second	-3D gyrometer
	-3D magnetometer
	https://www.xsens.com/mti-7
BMP280 sensor	Operation range: Pressure: 3001100 hPa
1240	Absolute accuracy : ~ ±1 hPa
	Relative accuracy : ± 0.12 hPa (typical)
	https://www.bosch-sensortec.com/products/environmental-
	sensors/pressure-sensors/bmp280/
Ublox ZED-F9P dual freq. receiver	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
• Color	
ZED-F9P	https://www.u-blox.com/en/product/zed-f9p-module

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 <sup>2</sup> )	





4	Acc Y (m/s <sup>2</sup> )	
5	Acc Z (m/s <sup>2</sup> )	

# 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
1	Gyrometer label	"ROTA"
2	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
3	Gyro X (rad/s)	
4	Gyro Y (rad/s)	
5	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
1	Magnetometer label	"MAGN"
2	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
3	Mag X (a.u.)	a.u. = arbitrary unit according to Xsens.
4	Mag Y (a.u.)	Tips : multiply by 0.49*1000,
5	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
2	

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

#### Sample strings for pressure data

	0				
PRES	s,314410.00	5162000,101144			
PRES	s,314410.02	25162000,101152			
PRES	s,314410.04	5162000,101138			
PRES	s,314410.06	5162000,101151			
PRES	s,314410.08	35162000,101151			

Column	Temperature (temperarure)	Comments
1	Temperature sensor label	"TEMP"
2	GPS Time of Week (ToW) in second	GPS Time of Week (ToW) in second
3	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/pavinedia/index.php/The_EGNOS_SBAS_Message_Format_Explained			

#### Sample strings for SBS (SBAS - EGNOS) data

GSBS,315499,9A494C000000000000000003F80003FC0003FE0001FF0001FF80 GSBS,315618,5363FBFFDC0000000000197BBBAA01848160A0580B185BFDFEF980900 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 http://rtcm.info/RINEX 3.04.IGS.RTCM Final.pdf 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,316465.40000000,G09	22053796.355	9 7	-2965.625	42.000	22053774.011 9
9 -2311.088 2	3.000				
GOBS,316465.40000000,G06	22958748.483	8 9	-3890.580	43.000	22958742.892 9
9 -3018.360 1	8.000				
GOBS,316465.40000000,G04	25190987.721	9 9	-3672.705	35.000	
GOBS,316465.40000000,G20	20618874.632	4 9	1326.448	48.000	
GOBS,316465.40000000,G07	20956968.745	8 9	-528.696	32.000	
GOBS,316465.40000000,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	key point 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 very first point (Key Point n°1) and the second point (Key Point n°2).

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

## Inputs given to competitors for "testing trial"

The materials and methods provided by the competition organizers are:

- <u>"Testing trial" of IPIN2022 is based on "Scoring trial#1" of IPIN2021; following links</u> pointing to IPIN2021 are ok.
- Datasheet of each individual sensors can be downloaded here:
  - Xsens MTI-1 : <u>http://evaal.aaloa.org/images/2021/track4/MTi-7\_Leaflet.pdf</u>
  - Ublox ZED F9P GNSS Receiver: <u>http://evaal.aaloa.org/images/2021/track4/ZED-F9P\_ProductSummary\_(UBX-17005151).pdf</u>

http://evaal.aaloa.org/images/2021/track4/RINEX\_3.04.IGS.RTCM\_Final.pdf

## • LogFiles to download and to use before evaluation (for testing trial <u>ONLY</u>):

 2021.09.02\_ULISS\_AllanVariance.zip : static logfile of more than 15 hours that can be used for sensors bias estimation

http://evaal.aaloa.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.aaloa.org/images/2021/track4/2021.09.15 ULISS MagCalib.zip

- acceleration.csv
- rotation.csv
- magnetic.csv
- $\circ$  GNSS Navigation files that contain ephemeris for those who want to use GNSS sensor:



Version 1.2 (July 14th, 2022)

 testing\_trial\_gnss.nav: GNSS Navigation file for testing trial (format RINEX 3.04) <u>http://evaal.aaloa.org/images/2021/track4/session1\_gnss.nav</u>

## • 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.

## Inputs given to competitors for the 2 "scoring trials"

The materials and methods provided by the competition organizers are:

- Datasheet of each individual sensors can be downloaded here:
  - Xsens MTI-1 : <u>http://evaal.aaloa.org/images/2021/track4/MTi-7\_Leaflet.pdf</u>
  - Ublox ZED F9P GNSS Receiver: <u>http://evaal.aaloa.org/images/2021/track4/ZED-F9P\_ProductSummary\_(UBX-17005151).pdf</u>

http://evaal.aaloa.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 (<u>same as IPIN2021</u>)
     <u>http://evaal.aaloa.org/images/2021/track4/2021.09 ULISS AllanVariance.zip</u> :
    - 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 <a href="http://evaal.aaloa.org/images/2022/track4/2022.07.12">http://evaal.aaloa.org/images/2022/track4/2022.07.12</a>





- acceleration.csv
- rotation.csv
- magnetic.csv
- $\circ$  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.aaloa.org/images/2022/track4/ScoringTrial1 ephemeris.zip

ScoringTrial2\_ephemeris.zip: GNSS Navigation file for scoring trial#2 (format RINEX 3.04)

http://evaal.aaloa.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.



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

# • Timing of expected Key Points:

- $\circ$   $\,$  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	Key Point	GPS Time of	Key Point	GPS Time of
	Week		Week		Week
	(s)		(s)		(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 g	iven (see above)				

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



Version 1.2 (July 14th, 2022)

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

3.04 OBSERVATION DATA M: Mixed B	INEX VERSION / TYPE
RTKCONV demo5 b34c 20210930 154220 UTC	PGM / RIIN BY / DATE
format: u-blox UBX	COMMENT
log: D:\TPIN2021\DataCollection\2021 09 15 15h30 Acmui1\ULT	SCOMMENT
	MARKER NAME
	MARKER NUMBER
	MARKER TYPE
	OBSERVER / AGENCY
	REC # / TYPE / VERS
	ANT # / TYPE
4337853 3676 -123576 7925 4658733 9793	APPROX POSTTION XYZ
	ANTENNA: DELTA H/E/N
G = 8 C1C L1C D1C S1C C2X L2X D2X S2X	SYS / # / OBS TYPES
$\begin{array}{c} \mathbf{B} \\ \mathbf{B} \\ \mathbf{B} \\ \mathbf{C} \\ \mathbf{C} \\ \mathbf{L} \\ \mathbf{C} \\ \mathbf{D} \\ \mathbf{C} \\ $	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
	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
B L1C	SYS / PHASE SHIFT
B L2C	SYS / PHASE SHIFT
E L1X = 0.00000	SYS / PHASE SHIFT
$E L_{7X} = 0.00000$	SYS / PHASE SHIFT
S L1C	SYS / PHASE SHIFT
C L2T	SYS / PHASE SHIFT
C L7T	SYS / PHASE SHIFT
12 R01 1 R02 -4 R07 5 R08 6 R09 -2 R10 -7 R11 0 R16 -1	GLONASS SLOT / FRO #
R17 4 R22 -3 R23 3 R24 2	GLONASS SLOT / FRO #
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

# • Timing of expected Key Points:

- 88 key points will be evaluated in Track4 : from 3 to 90
- Key Points timestamps are expressed in GPS Time of Week in seconds (s), hereafter in the table.

Кеу	GPS Time of Week	Кеу	GPS Time of Week	Кеу	GPS Time of Week
Point	(s)	Point	(s)	Point	(s)
1*	210818.000	31	211358.072	61	211775.027
2*	210861.000	32	211365.639	62	211779.276
3	210887.392	33	211372.910	63	211796.079
4	210911.485	34	211390.651	64	211826.785
5	210918.090	35	211397.186	65	211840.049
6	210926.986	36	211403.671	66	211877.092
7	210937.841	37	211429.271	67	211885.972
8	210953.373	38	211442.351	68	211919.489
9	210958.035	39	211452.724	69	211926.420
10	211000.473	40	211486.995	70	211934.387
11	211024.444	41	211501.030	71	211937.760
12	211026.910	42	211506.452	72	211947.912
13	211030.278	43	211517.081	73	211951.325
14	211058.554	44	211534.529	74	211990.253
15	211097.168	45	211586.844	75	211999.754
16	211108.785	46	211602.573	76	212009.515
17	211137.244	47	211603.575	77	212012.046
18	211144.846	48	211604.623	78	212018.194
19	211207.658	49	211613.943	79	212021.491
20	211208.771	50	211630.810	80	212057.636
21	211241.640	51	211644.289	81	212099.471
22	211273.879	52	211650.803	82	212101.867
23	211286.773	53	211668.104	83	212106.527
24	211322.977	54	211691.941	84	212131.668
25	211328.615	55	211733.107	85	212139.329
26	211331.973	56	211737.306	86	212150.504
27	211334.132	57	211742.507	87	212183.663
28	211337.380	58	211750.925	88	212194.591
29	211339.670	59	211757.224	89	212238.574
30	211352.720	60	211766.689	90	212260.000
*: coordina	tes given (see <mark>below</mark> )				

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

Floor Number in integer:

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\UI	LISS Pied Track4\ulis	s-1-trace-171\gnss.ul	DCOMMENT
			MARKER NAME
			MARKER NUMBER
			MARKER TYPE
			OBSERVER / AGENCY
			REC # / TYPE / VERS
			ANT # / TYPE
4338424.4163 -11	6837.9032 4658280.1	705	APPROX POSITION XY7
0.0000	0.0000 0.0	000	ANTENNA: DELTA H/E/N
G 8 C1C L1C D1C	S1C C2X L2X D2X S2X		SYS / # / OBS TYPES
B 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 38.002	0000 GPS	TIME OF FIRST OBS
2022 07 12	10 57 48 804	0000 GPS	TIME OF LAST OBS
G L1C	10 07 10.001	315	SYS / PHASE SHIFT
C I 2 X = 0.25000			eve / Dunge Guten
P 110			eve / DHAGE CHIET
P I 2C			eve / DHAGE CHIET
F 11Y 0 00000			eve / pulse cutem
E 17X 0 00000			SIS / FRASE SHIFT
12 001 1 002 4 1	07 5 009 6 012 0	D14 7 D15 0 D16 1	CIONNES CIOR / EDO #
12 KUI I KUZ -4 P	107 - 5 - 500 - 0 - 813 - 2	RI4 -/ RI5 0 RI6 -1	CLONING CLOW / TOL / TOL CCANIOLU
KI/ 4 RI8 -3 F	X23 3 K24 2	635 0.000	GLONASS SLUT / MKU #
CIC 0.000 CIP	0.000 626 0.000	CZF 0.000	GLUNASS CUD/PHS/BIS
			END OF HEADER

0



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

# • Timing of expected Key Points:

- 88 key points will be evaluated in Track4 : from 3 to 90
- Key Points timestamps are expressed in GPS Time of Week in seconds (s), hereafter in the table.

Кеу	GPS Time of Week	Кеу	GPS Time of Week	Кеу	GPS Time of Week
Point	(s)	Point	(s)	Point	(s)
1*	217034.000	31	217603.745	61	217966.245
2*	217076.200	32	217638.403	62	217994.870
3	217100.001	33	217647.334	63	218000.212
4	217119.442	34	217659.704	64	218002.346
5	217130.608	35	217663.011	65	218039.270
6	217139.945	36	217669.612	66	218054.475
7	217144.531	37	217693.945	67	218073.939
8	217146.696	38	217696.110	68	218082.219
9	217161.862	39	217702.746	69	218111.186
10	217178.151	40	217715.893	70	218114.418
11	217186.791	41	217718.124	71	218115.475
12	217209.265	42	217720.349	72	218158.133
13	217238.627	43	217727.992	73	218174.514
14	217274.930	44	217739.419	74	218185.569
15	217278.273	45	217746.140	75	218223.381
16	217302.662	46	217755.061	76	218236.335
17	217304.551	47	217773.483	77	218293.852
18	217325.473	48	217792.809	78	218301.669
19	217333.538	49	217794.964	79	218309.456
20	217355.581	50	217807.843	80	218332.093
21	217395.551	51	217829.473	81	218338.482
22	217411.099	52	217856.003	82	218358.927
23	217465.622	53	217886.339	83	218362.184
24	217482.714	54	217896.357	84	218363.271
25	217491.701	55	217899.755	85	218370.116
26	217498.547	56	217900.877	86	218379.156
27	217511.684	57	217917.020	87	218386.873
28	217523.347	58	217923.600	88	218406.392
29	217545.747	59	217959.780	89	218426.501
30	217556.097	60	217960.893	90	218436.000
*: coordina	tes given (see <mark>below</mark> )				

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

Floor Number in integer:

3 04 OBSERVATI	ON DATA M. Mixed	d BINEX VERSION / TYPE
BTKCONV demo5 b34c	20220714	4 141347 UTC PGM / RUN BY / DATE
format: u-blox UBX	20220711	COMMENT
log. D. IDIN2022/ULISS Died T	rack()ulies_1_trace	e=172\grass ubCOMMENT
109. D. (111N2022 (01105 11ed 1	Lacky (ulliss i clace	MADEED NAME
		MARKER NAME
		MARKER NORDER
		OPERDUED / ACENCY
		OBSERVER / AGENCI
		REC # / TIPE / VERS
0.0000 0.0000	0,0000	ANT # / TIPE
0.0000 0.0000	0.0000	APPROX POSITION XYZ
	0.0000	ANTENNA: DELTA H/E/N
G 8 CIC LIC DIC SIC C2X L2	X DZX SZX	SYS / # / OBS TYPES
R 8 CIC LIC DIC SIC C2C L2	C D2C S2C	SYS / # / OBS TYPES
E 8 CIX LIX DIX SIX C'/X L'	X D'/X S'/X	SYS / # / OBS TYPES
0.200		INTERVAL
2022 07 12 12 2	0 17.7900000	GPS TIME OF FIRST OBS
2022 07 12 12 4	0 40.7910000	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
11 R01 1 R02 -4 R03 5 R04	6 R09 -2 R10 -7 R1	16 -1 R17 4 GLONASS SLOT / FRQ #
R18 -3 R19 3 R24 2		GLONASS SLOT / FRQ #
C1C 0.000 C1P 0.000 C2	C 0.000 C2P 0	0.000 GLONASS COD/PHS/BIS
		END OF HEADER

0



# 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
  - $\circ$  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: index in integer (key point number from 1 to N. 0 represents no key point. Each specific integer represents the specific key point)
- Comma (",") used as data delimiter

#### Example 1:



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).

<u>In others words</u>: column 1 will not be assessed, and thus can be slightly different from the expected time. <u>What is important is to put correctly the right key point id in field n°5</u>. For instance, returning following stream (example2) is equivalent to the previous example1 from evaluation point of view Example 2:

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:

**Accuracy Score** =  $3rdQuartile{SampleError(R_i, E_i)}, \forall$  groundtruth reference in all final test sets SampleError(R\_i, E\_i) = Distance(R\_i, E\_i) + (penalty × 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.
- 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 (<u>miguel.ortiz@univ-eiffel.fr</u>) at the University Gustave Eiffel, France.
- Ni Zhu (<u>ni.zhu@univ-eiffel.fr</u>) 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 :
		https://evaal.aaloa.org/files/2022/IPIN2020_T4_Trials.7z
Version 1.2	July 14 <sup>th</sup>	Scoring Trials information added
		<ul><li>-2 first points of ScoringTrial#1 are given (Lat,Long, floor)</li></ul>
		<ul> <li>-2 first points of ScoringTrial#2 are given (Lat,Long, floor)</li> </ul>
		-Magnetometer calibration file available for ScoringTrials (same
		for both)
		<ul> <li>static logfile of ~15 hours that can be used for sensors bias</li> </ul>
		estimation (Allan deviation) is given
		-GNSS Ephemeris files are avaible for ScoringTrials
		<ul> <li>Expected timing for both ScoringTrials are given</li> </ul>