

IPIN competition 2016

Track 3: Smartphone based (off-site)

Sponsored by



Chaired by

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Organized by



International Conference
on Indoor Positioning
and Indoor Navigation



EvAAL

Track3: Smartphone-based (off-site)

- **The goal:**
 - To **localize a pedestrian walking** under realistic conditions:
 - in several **multi-floor buildings**
 - using a **conventional smartphone** and its available signals (WiFi, inertial, magnetic, GPS, pressure, light,...)
- **Competitors:**
 - **Calibrate** their algorithms with some logfile data recordings with inserted ground truth marks (~1000 marks)
 - **Compete** using new unreferenced logfile data
- **Award:**
 - **TECNALIA** awards a €1.500 cash prize to the winner

Challenges (1/2)

- **Multiple buildings:**



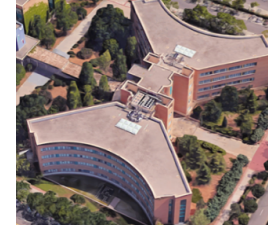
CAR (ID 10)
1 floor



UAH (ID 20)
4 floors



UJIB (ID 30)
6 floors



UJITI (ID 40)
4 floors

- **Multiple sources of information:**

- WiFi RSS, Inertial data (Accelerometer and Gyroscope), Magnetic, GPS, AHRs, Pressure, Temperature, Humidity, Sound intensity and Light intensity

- **Continuous motion & recording:**

- Different sampling time (WiFi every~6s),
- Acc (~50Hz), different for others

```
GYRO;4.410;-0.03726;-0.16860;-0.17318;3
AHRs;4.410;28.7201;0.4508;177.5888;0.00141;0.24804;0.96855;-106
LIGH;4.410;4767.0;0
ACCE;4.411;-0.67995;4.85544;8.30309;3
MAGN;4.411;1.26000;-39.48000;-17.76000;3
PRES;4.419;948.5206;0
GYRO;4.420;-0.04948;-0.13347;-0.16463;3
AHRs;4.420;28.7140;0.5296;177.4918;0.00095;0.24800;0.96855;122
LIGH;4.420;4748.0;0
ACCE;4.421;-0.69911;4.90333;8.35098;3
MAGN;4.421;1.26000;-39.36000;-17.76000;3
GYRO;4.430;-0.06017;-0.09407;-0.13347;3
AHRs;4.430;28.6960;0.6096;177.4190;0.00043;0.24786;0.96858;-3
ACCE;4.432;-0.70868;4.88417;8.34140;3
MAGN;4.432;1.38000;-39.42000;-17.64000;3
LIGH;4.432;4748.0;0
WIFI;4.432;eduroam;00:0b:86:27:36:c0;-73
WIFI;4.432;portal-csic;00:0b:86:27:36:c1;-74
WIFI;4.432;eduroam;00:0b:86:27:32:e0;-65
WIFI;4.432;portal-csic;00:0b:86:27:32:e1;-65
WIFI;4.432;eduroam;00:0b:86:27:35:90;-82
WIFI;4.432;portal-csic;00:0b:86:27:35:91;-80
WIFI;4.432;WiFiArganda;00:0d:97:00:d2:55;-89
WIFI;4.432;eduroam;00:0b:86:27:35:80;-97
WIFI;4.432;portal-csic;00:0b:86:27:35:81;-95
GYRO;4.440;-0.06353;-0.05528;-0.08460;3
AHRs;4.440;28.6667;0.7015;177.3758;-0.00026;0.24763;0.96863;-68
LIGH;4.441;4748.0;0
```

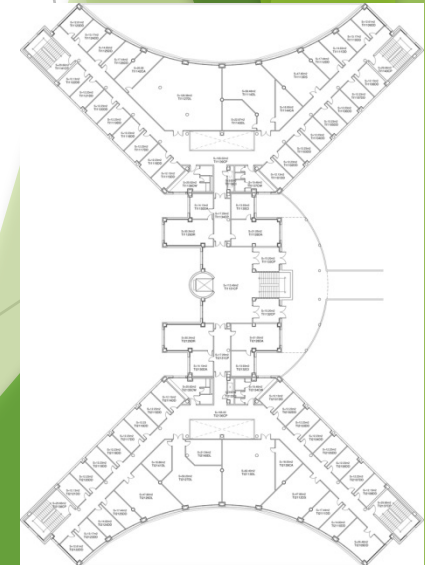
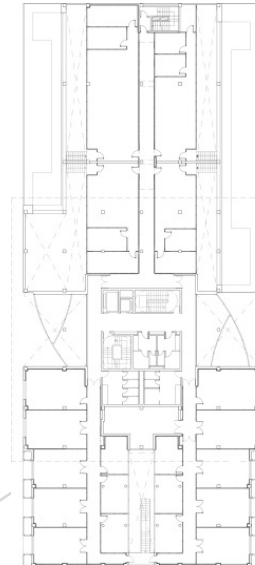
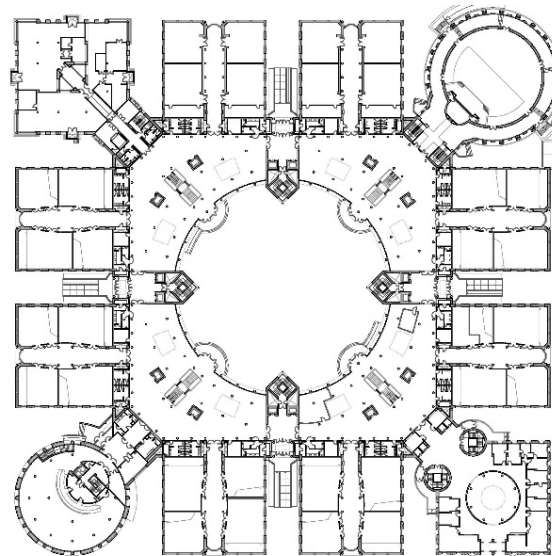
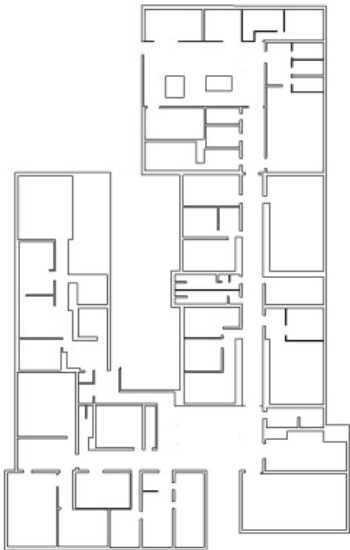
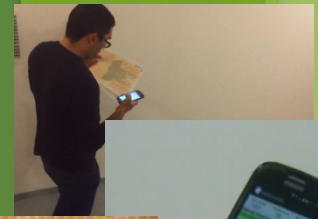
Challenges (2/2)

- **Realistic walking style:**

- Mainly forward, also lateral/backwards, turns 90° & 180°, elevators/stairs, giving way to other people.

- **Limited info of buildings:**

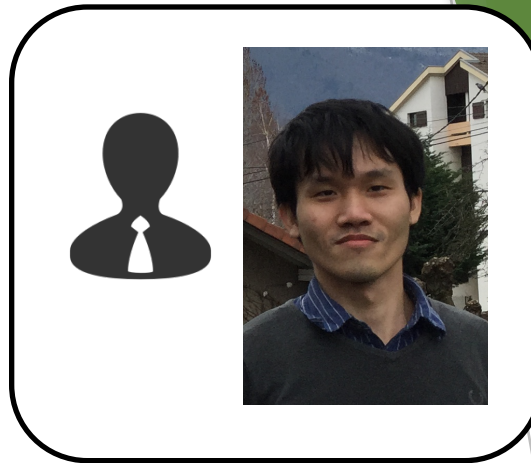
- Multiple WiFi AP, but position of each AP is unknown.
- Geo-referenced floor-map bitmaps (no vector format)



Competitors



Yair Beer
Block Dox (UK)



Viet Cuong Ta
Inria/U.Hanoi (France)



Filipe Meneses
U. Minho
(Portugal)



Toni Fetzer
FHWS (Germany)



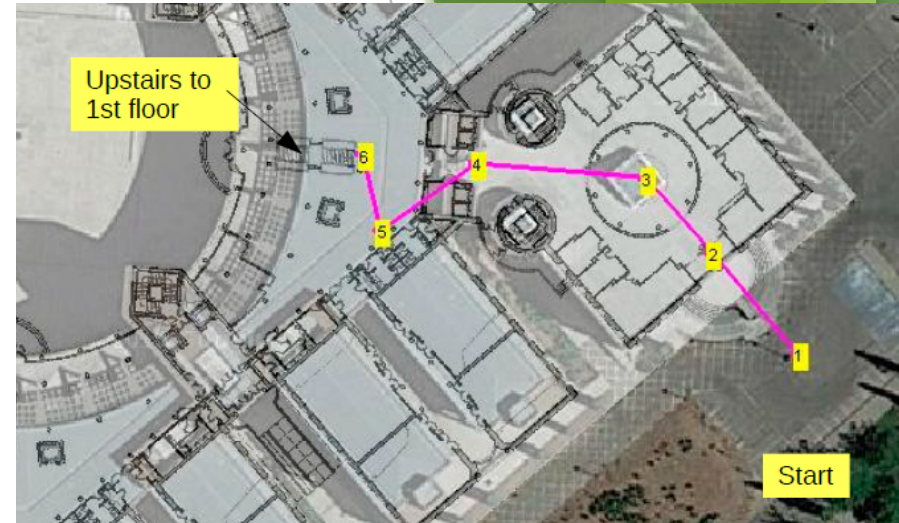
S. Knauth
HFTS (Germany)

Results: Recording Ground Truth

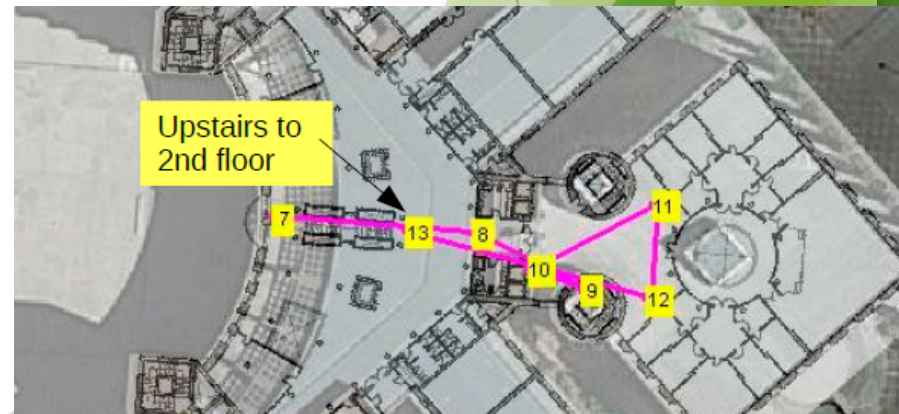
- UAH Route3:
 - Logfile 7 (signals captured with a Samsung S4 phone)



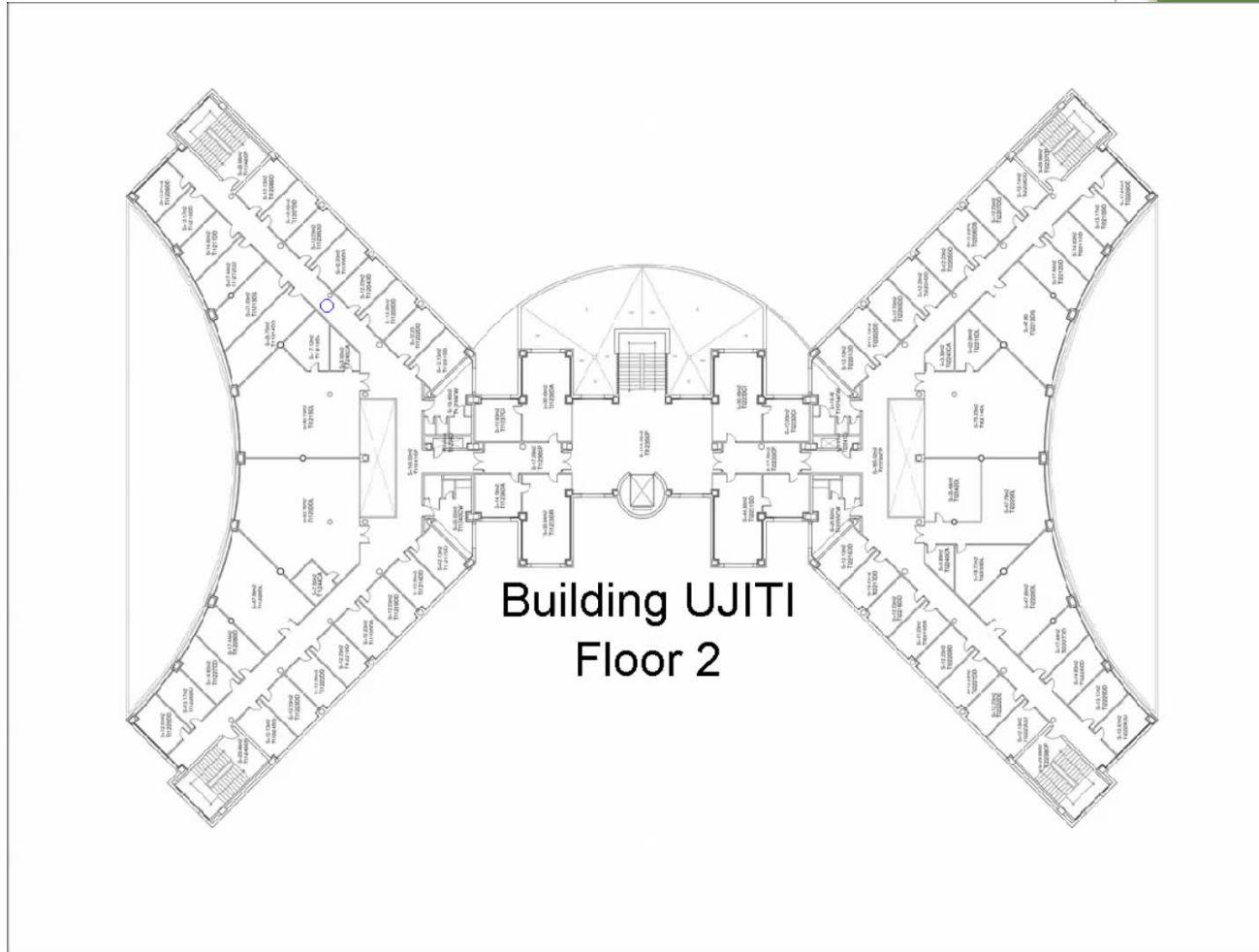
Sample video of route recording



Some ground-truth points of route 3 (UAH)

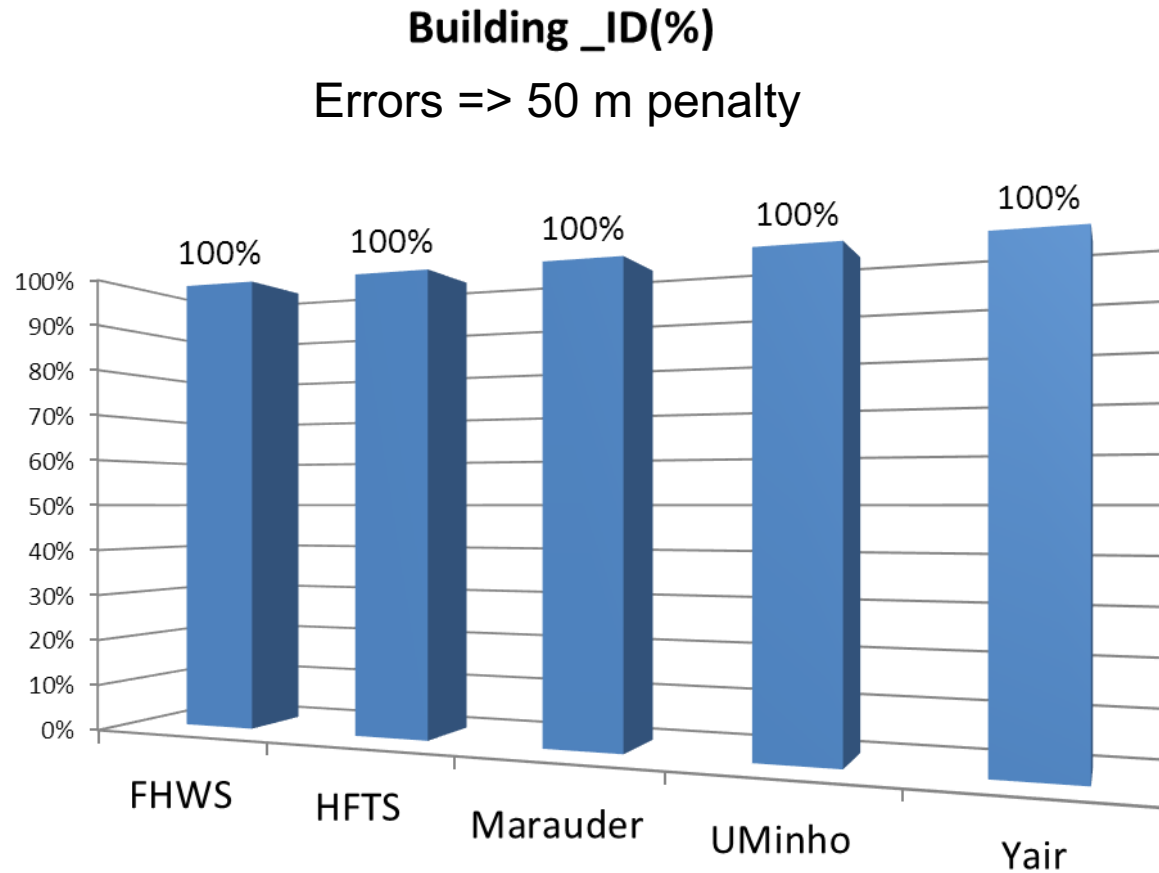


Results: Evaluating results



Example of competitor's trajectory estimation & error w.r.t GT

Results: Building & Floor Identification

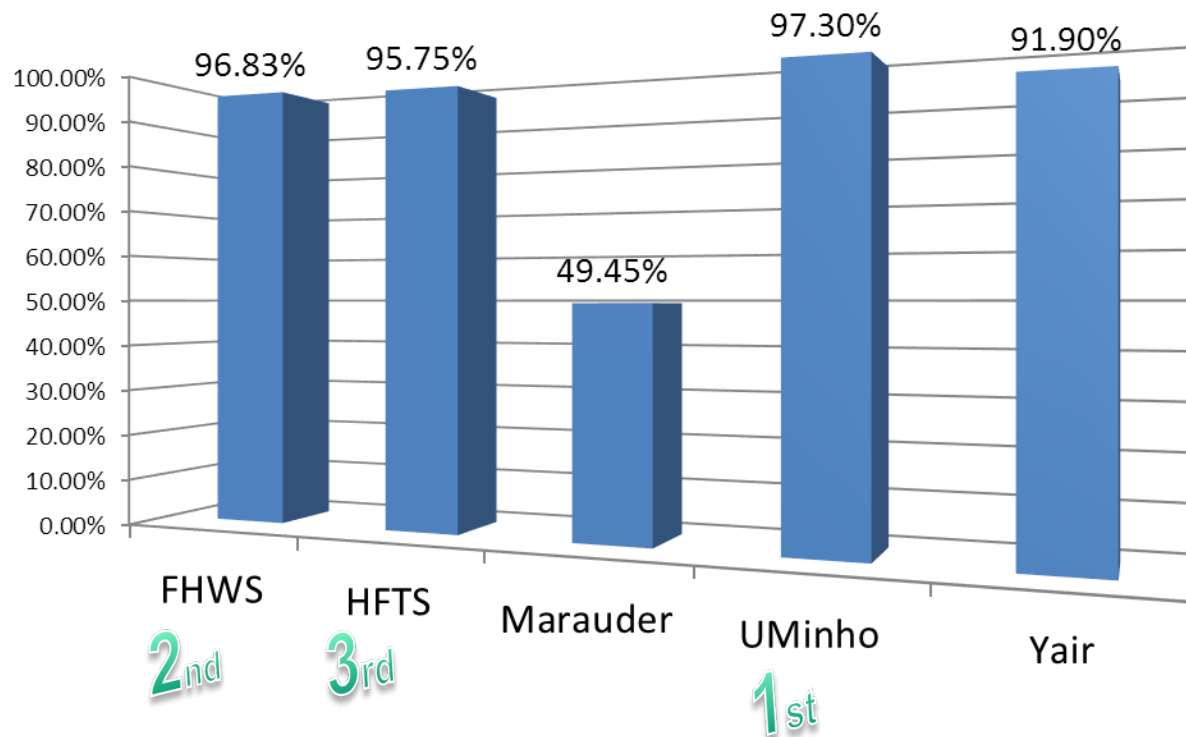


All perfect!!

Results: Building & Floor Identification

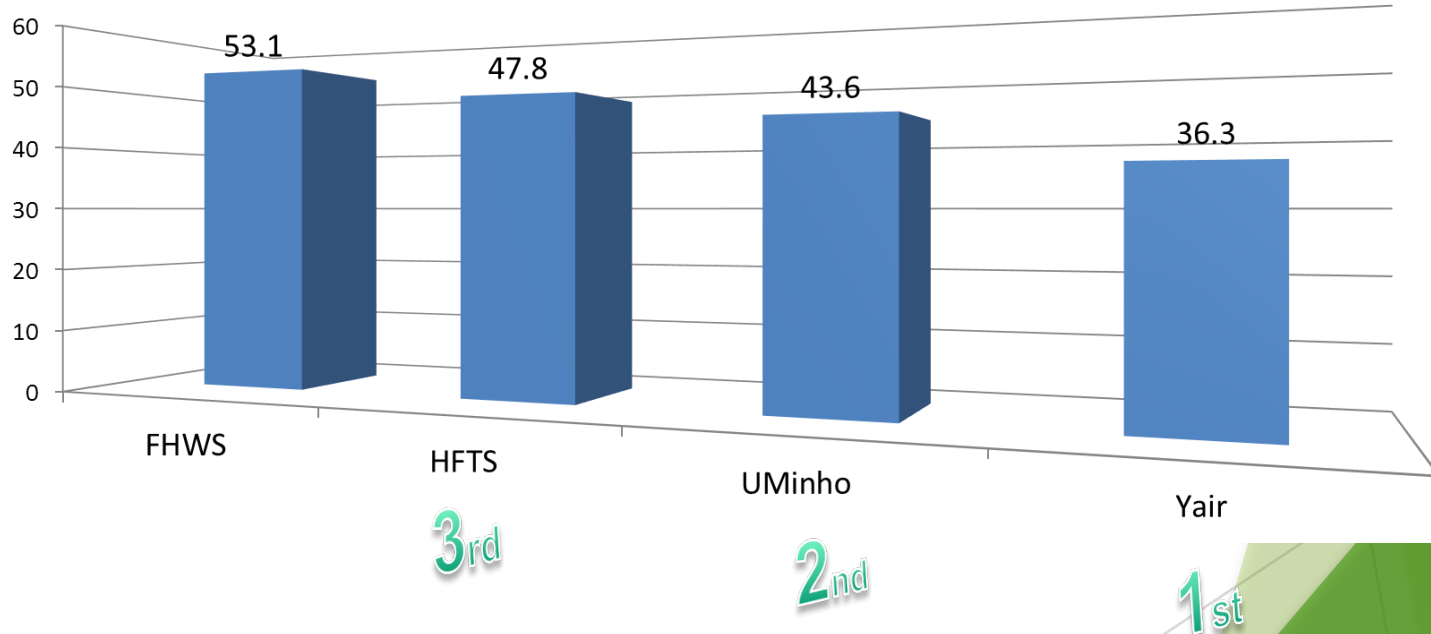
Floor_ID(%)

Errors => 15 m penalty



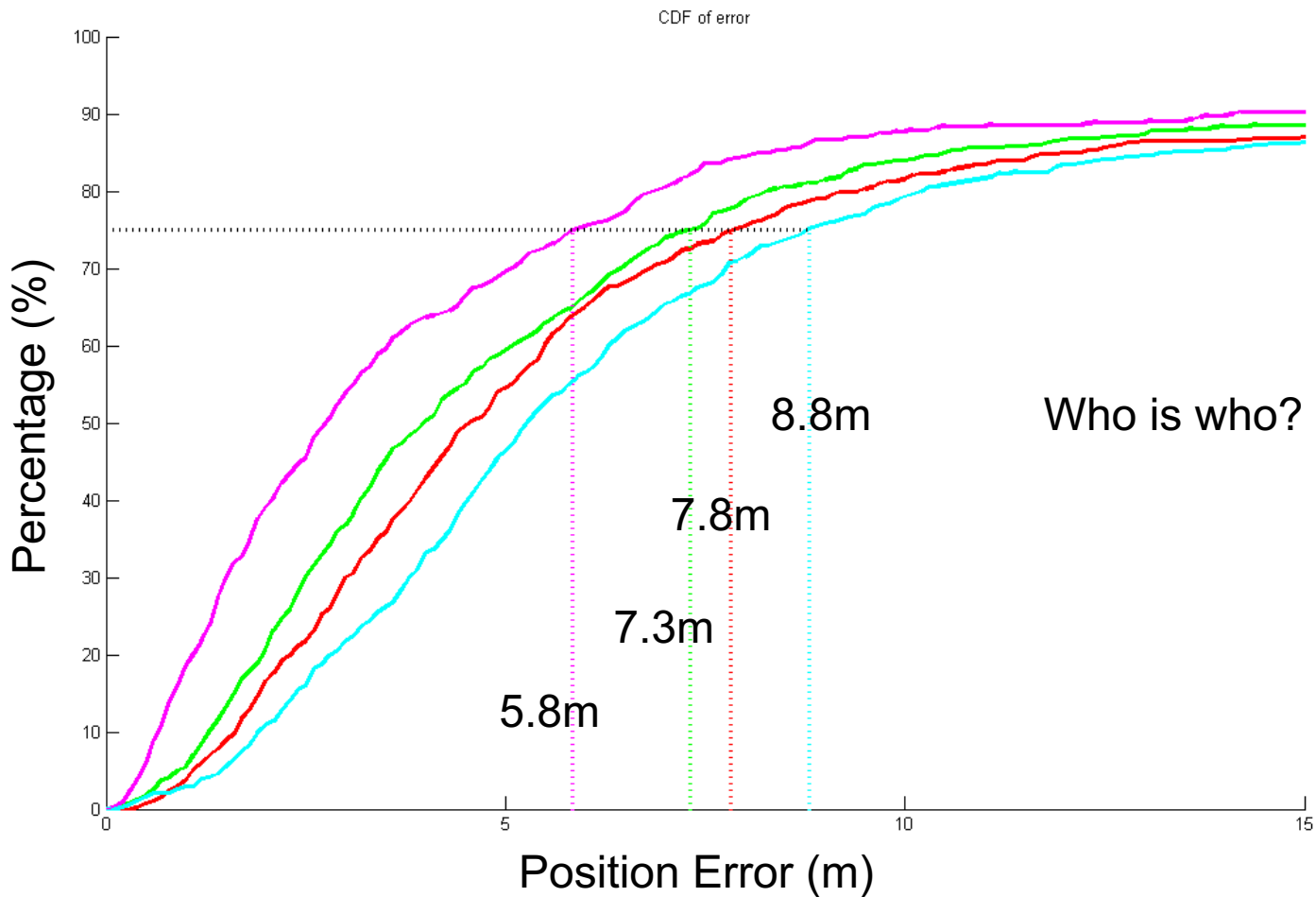
Results: Position estimation errors (1/3)

Max_XY_error (m)



Results: Position estimation errors (2/3)

Cumulative Error Distribution Function (CDF)



Results: Position estimation errors (3/3)

Podium:

#	Competition metric

Results: Position estimation errors (3/3)

Podium:

#	Competition metric
3 rd	7.826 m



Results: Position estimation errors (3/3)

Podium:

#	Competition metric
 3 rd	7.826 m Yair

Results: Position estimation errors (3/3)

Podium:

	#	Competition metric	
	2 nd	7.317 m	
	3 rd	7.826 m	Yair

Results: Position estimation errors (3/3)

Podium:

	#	Competition metric	
	2 nd	7.317 m	UMinho
	3 rd	7.826 m	Yair

Results: Position estimation errors (3/3)

Podium:

	#	Competition metric	
	1 st	5.846 m	
	2 nd	7.317 m	UMinho
	3 rd	7.826 m	Yair

Results: Position estimation errors (3/3)

Podium:

	#	Competition metric	
	1 st	5.846 m	HFTS
	2 nd	7.317 m	UMinho
	3 rd	7.826 m	Yair

The winner of Track 3 IPIN 2016 is.....

A. Koukofikis and S. Knauth

Hochschule
für Technik
Stuttgart



unsere Glückwünsche!