Measurement protocol Trilaterion / UWB

By Mark Schrauwen

Goals	1. Check and verify the simulated trilateration algorithms 2. Check the influence of the wheelchair on trilateration algorithms 3. Check the best place to position an UWB tag on the wheelchair 4. Check the influence of the human body in the wheelchair on ranging & positioning 5. Check the influence of speed of the tag on localization and transmission 6. Learn to use the IMU system of Rienk (WMS) and do measurements: System WMS + Optitrack + UWB
When	24-25 of August 2020, optionally stretch to the 26th of August
Where	Bewegingslab THUAS (see Figure 1)
Systems	• Optitrack system with 16 Flex 13 IR-camera's passive IR-marker system • Pozyx Creator system, 4 Anchors and 1 Tag • Wheelchair System of Rienk
Data output	• Optitrack: C3D format, containing the coordinate of IR-markers • Pozyx: csv file output format • WMS: IMU data?

Hardware	• Optitrack:
	  ○ 4 single markers (4 for each Anchor)
	  ○ 2 rigid bodies (1 for the Tag and 1 for the Wheelchair)
	• Pozyx:
	  ○ Wood attachment for UWB anchors (need at least 20 cm of distance)
	  ○ Some kind of attachment of the TAG onto the wheelchair
	  ○ Synchronization IR-Leds
	  ○ Pozyx system
	  ○ Arduino receiver results
	• WMS:
	• Pen, paper, post-its
	• RC car
	• Rope to pull empty wheelchair
	• USB Battery pack
	• Ramp to introduce height differences during measurements

Global planning

Monday 24th of August

Morning	Setup the Optitrack system, 6 meter by 12 meter setup.
Midday	Test measurements and in the good case a start of the measurement protocol

Tuesday 25th of August

Morning	Do measurement as described in the measurement protocol (see below)
Midday	Do combo measurements with WMS

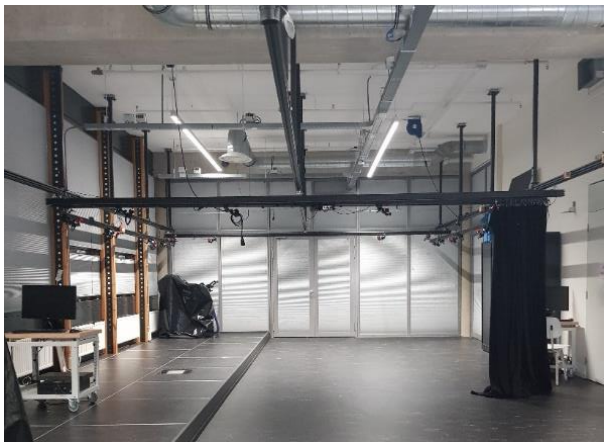

Figure 1: the Bewegingslab Optitrack system

Setup

Setup description

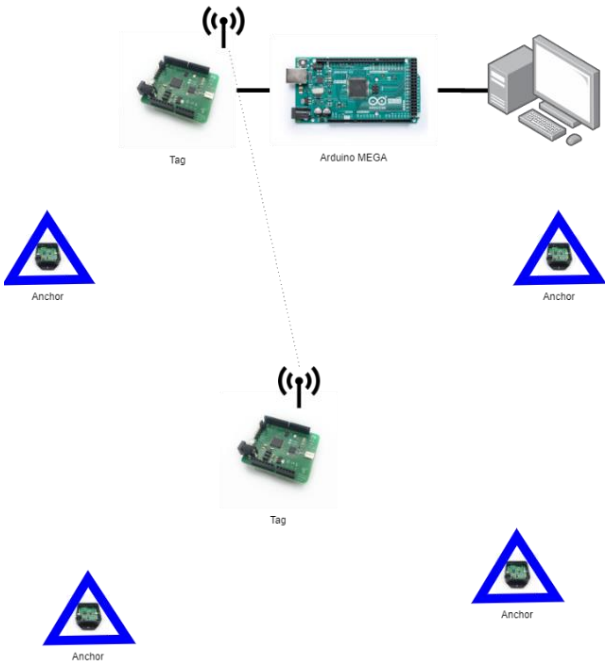

Figure 2: the UWB system setup. The Arduino and the Tag connected to it, are solely used for data transmission.

- Pozyx data is collected via Arduino MEGA (interface for Pozyx) which is connected to laptop (see: Figure 2) and datastream is logged with Coolterm
    - The laptop is placed on the WC
- Optitrack data is collected via Motive (Optitrack software) and exported each measurement in C3D format)
- RC car for LOS tag-movement (Figure 4)
- The Pozyx system comes with 2 options: FAST UWB ranging and PRECISE UWB ranging. Both consist of DS-TWR, but the FAST tries to optimize the number of measurements.

Preparation

Optitrack

1. Setup the Optitrack system
2. Extend the volume capture space (VCS) to a 6 x 12 meter
3. Calibrate the system
    a. Make picture of ground base to know the coordinate system
4. Test the system with a rigid body for spots with missing markers and adjust accordingly
5. Optionally: create a rigid body in the software for the Wheelchair and the Tag

Pozyx

1. Place the anchors in the corners of the VCS with at least 20 cm distance from metal. Place anchors vertical
    a. Place 2 diagonal anchors ‘high’ (see Figure 5)
    b. Place 2 off-diagonal anchors ‘low’
2. Place on each anchor an Optitrack marker and make sure they are clearly visible in the software
    a. Note the coordinates of the respective anchors via Optitrack on paper with their hex id’s (used for Pozyx positioning)
3. Connect the power to the anchors
4. Test the tag for missing samples and try to improve this

Test Measurements

1. Setup the RC-car and check it
2. Perform test measurements and check the results

Wheelchair

1. Place several IR-markers on the wheelchair (WC), see Figure 3
2. Make a rigid body of it in Motive

Global

1. Mark the path as visualized in Figure 5 on the floor

Figure 3: wheelchair planned to use in measurements

Measurements

Filename name giving

In the table below the naming convention is given. Every category is separate by an underscore.

Ranging	RANG	**Random path**	(~)
Pozyx positioning Fast	PFST	**Predefined path**	(K)
Pozyx positioning Precise	PISE	**Standing still**	(S)
WCS	W	**Herre 3 Tags**	HF3
		Verification or Test measurements	VT
Use of RC car	CAR		
Use of WC, tag on TOP	WET		
Use of WC, tag on the Seat	WES		
No person in WC	O		
Person in WC	I		
Number of measurements	##		
Extension of output file	.		

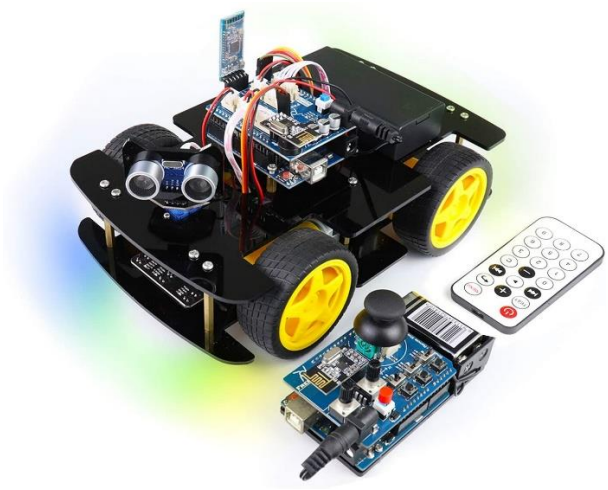

Figure 4: RC car used for LOS movement of the TAG

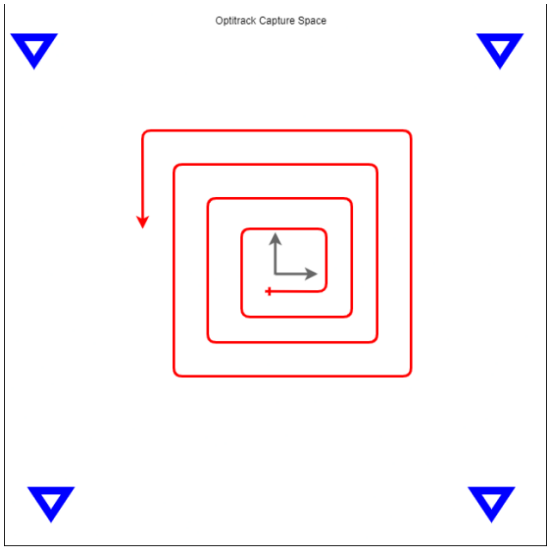

Figure 5: The path of the tag (red) relative to the UWB anchors (blue triangles)

Protocol

Every measurement:

- Should be repeated 3 times and last at least 1 minute.
- Should be checked for missing data and be rejected when too much missing data is present (more than 1 second).

#	Setup	Filename
0	**Test measurements**	TV_CAR_(S)_##.
1	**Ranging** standing still on random spot	RANG_CAR_(S)_##.
2	**Pozyx positioning fast** standing still	PFST_CAR_(S)_##.
3	**Ranging** with known path	RANG_CAR_(K)_##.
4	**Pozyx positioning fast** with known path	PFST_CAR_(K)_##.
5	**Ranging** with random path	RANG_CAR_(~)_##.
6	**Pozyx positioning fast** with random path	PFST_CAR_(~)_##.
7	**Ranging standing still** for Rigid Body Matching Algorithm of Herre Faber	RANG_CAR_(S)_HF3_##.
8	**Ranging** with random path for Rigid Body Matching Algorithm of Herre Faber	RANG_CAR_(~)_HF3_##.
9	**Ranging** with known path with WC on top	RANG_WET_(K)_O_##.
10	**Pozyx positioning fast** known path with WC on top	PFST_WET_(K)_O_##.
11	**Ranging** with random path with WC on top	RANG_WET_(~)_O_##.
12	**Ranging** with known path with WC on the seat	RANG_WET_(K)_O_##.
13	**Pozyx positioning fast** with WC on the seat	PFST_WET_(K)_O_##.
14	**Ranging** with random path with WC on the seat	RANG_WET_(~)_O_##.
15	Combine with WCS, Ranging with known path	W_RANG_CAR_(K)_I_##.
16	Combine with WCS, Pozyx positioning with known path	W_PFST_CAR_(K)_I_##.
17	Combine with WCS, Ranging with random path	W_RANG_CAR_(~)_I_##.