

# Dataset description

Authors: Arslan Majal and Aamir Hussain Chughtai

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## 1 Introduction

The dataset contains range data obtained from the MDEK1001 Development Kit, by Qorvo, deployed at three different experimental scenarios at the Lahore University of Management Sciences (LUMS) at 3 different locations. The kit includes 12 UWB units based on the Ultra-Wide Band (UWB) DWM1001 module. The dataset can be used to evaluate and benchmark the performance of indoor localization algorithms in real-world scenarios using UWB modules. For indoor localization UWB sensors have gained traction in recent years due to high data rates and their potential of providing sub-meter accuracy. However, the readings are prone to suffer from positive bias when the anchor and the tag get in non-line-of-sight (NLOS).

There are a total of 12 UWB sensors in the kit. Figure 1 shows a UWB module included in the kit. Through the DRTL5 app provided by the company on their website several properties of these sensors can be altered. Using this app, all the sensors are added to a network, 11 out of the 12 sensors are configured as anchors and one is configured as a tag in the experimental campaigns. The tag is then connected to a laptop with a USB for serial communication where its data is recorded through a serial terminal. The anchors are then placed at known locations. Out of these 11 anchors only a maximum of 4 can send their range information to the tag[Win] at a given time in the default configuration of the kit. Fluctuations in the number and locations of the available anchors are observed as the tag traverses through predefined paths.



Figure 1: A DWM1001-based UWB Module from Qorvo

## 2 Data Collection Campaign

UWB modules were deployed to collect range data with 11 sensors acting as anchors and one sensor acts as a tag. A predefined path (ground truth) was created and measured in all 3 different environments. Anchors were placed randomly around the path and the tag was moved along the path. At each step along the path a maximum of 4 readings were recorded corresponding to different anchors. Anchors are selected according to the default device settings [Win]. The data is collected at 5 Hz which is

subsequently averaged out to provide final data at a given point. The anchors which are not selected at a step have their range reading set equal to 0 (missing observations).

## 2.1 Experimental Sites

### 2.1.1 SSE building

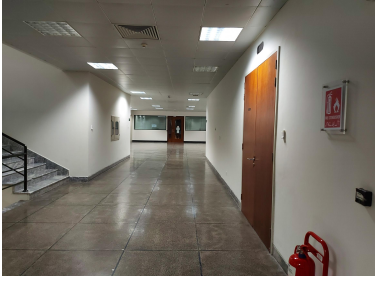


Figure 2: Corridor Section A

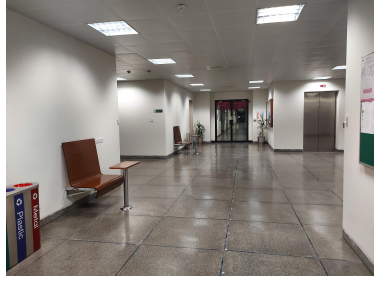


Figure 3: Corridor Section B

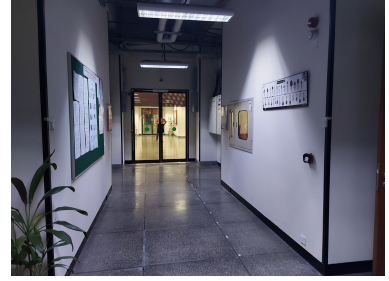


Figure 4: Corridor Section C

The data was collected in the corridor of the first floor of the School of Science and Engineering (SSE) for this scenario. Figures [2], [3], [4] show the setup for this scenario.

### 2.1.2 Academic Block



Figure 5: Corridor Section A



Figure 6: Corridor Section B



Figure 7: Corridor Section C

The data was collected in the corridors of the first floor of the Academic Block (AB). Figures [5], [6], and [7] show the setup for this scenario.

### 2.1.3 SSE Entrance

The data was collected at the entrance of the SSE building for this case. Figures [8], [9], and [10] show the setup for this scenario.



Figure 8: SSE Entrance Section A



Figure 9: SSE Entrance Section B



Figure 10: SSE Entrance Section C

### 3 Files

For each of the location, 3 data files are provided. ACX, GTX and RangeX contain the anchor coordinates, the ground truth for the path, and the range measurements for the sensors for the Xth scenario.

Each ACX contains coordinates for each of the eleven anchors. For example, in Table [1], each row shows the x, y, and z coordinates of an anchor in an ACX file.

Sr	X	Y	Z
1	2.45	2.05	1.5
2	2.45	6.37	1.5
3	6.55	1.65	1.5
$\vdots$	$\vdots$	$\vdots$	$\vdots$

Table 1: ACX file

Each GTX contains the actual coordinates of the tag for each of the steps traversed during each of the Xth case. The TAB[2] shows the organization of a GTX file. The step column shows the indices of the step number along the path. The x, y, and z columns show the ground truth of 3D location of the tag. Note that the z coordinate of the tag remains constant.

Step	X	Y	Z
1	0	0	0.97
2	0.406	0	0.97
3	1.222	0	0.97
$\vdots$	$\vdots$	$\vdots$	$\vdots$

Table 2: GTX file

Each RangeX contains the measured ranges of the tag from each anchor for each step traversed for the Xth case. Table [3] shows the organization of a RangeX file. The step column refers to the index of the step travelled in the path. A1, A2, ...A11 represent different anchors in order of the corresponding ACX file. In each row, the zero entry for an anchor represent that the anchor was not selected at that step along the path and a missing observation was noted for that anchor. Similarly, the nonzero readings corresponding to each anchor are also provided.

Step	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
1	0	0	0	8.61	0	0	6.134	0	2.676	0	0
2	0	0	0	8.355	0	0	5.67	0	2.315	0	13.715
3	0	0	0	8.04	0	0	5.512	0	2.076	0	11.604
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

Table 3: RangeX file

### 4 Sample Visualization Code

Supplied with the data are MATLAB scripts, plotsX.m, which can be used to plot measured ranges along with the actual ranges all the anchors for each of the Xth case. Figure [11] shows an example of such plot. The blue curve shows the actual ground truth of the range, calculated by finding the euclidean distance between each step along the path and Anchor 5's actual coordinates. The orange circles represent the corresponding measured range from Anchor 5. The file can be used to visualize the outliers appearing in the data.

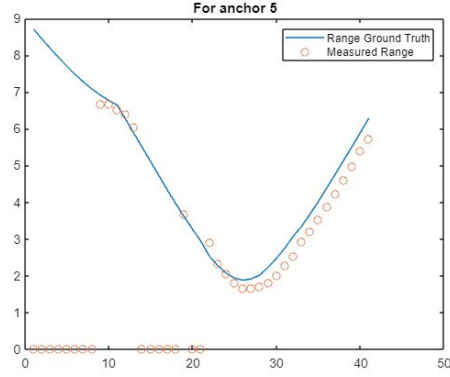


Figure 11: Range Graph

## 5 Authors and License

Mr. Arslan Majal (arslan.majal@lums.edu.pk) and Aamir Hussain Chughtai (aamir.chughtai@lums.edu.pk) are working in the Smart Data Systems and Applications Laboratory (SDSA) Lab in the Electrical Engineering Department at LUMS: <http://sdsa.lums.edu.pk/>. Copyright (C) 2021 SDSA, LUMS, tahir@lums.edu.pk.

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## 6 Citation

Citation of the following paper would be greatly appreciated if you are using our dataset.

### Bibtex

```
@article{chughtai2021outlier, title=Outlier-Robust Filtering For Nonlinear Systems With Selective Observations Rejection, author=Chughtai, Aamir Hussain and Tahir, Muhammad and Uppal, Momin, journal=arXiv preprint arXiv:2106.05706, year=2021}
```

## References

[Win] Accessing distances from more than 4 anchors. <https://decaforum.decawave.com/t/accessing-distances-from-more-than-4-anchors/4881>. Accessed: 2021-09-07.