深圳大学
SHENZHEN UNIVERSITY

广东省无线大数据与未来网络工程技术研究中心
Wireless Future DataNet Research Centre

mm-Humidity: Fine-grained Humidity Sensing with Millimeter Wave Signals

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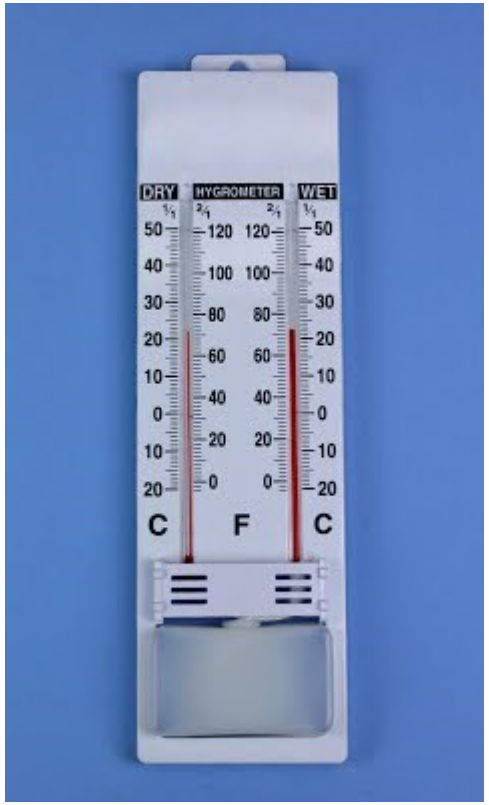
深圳大学物联网研究中心
The IoT Research Center

Motivation

Comfortable 45%-55%

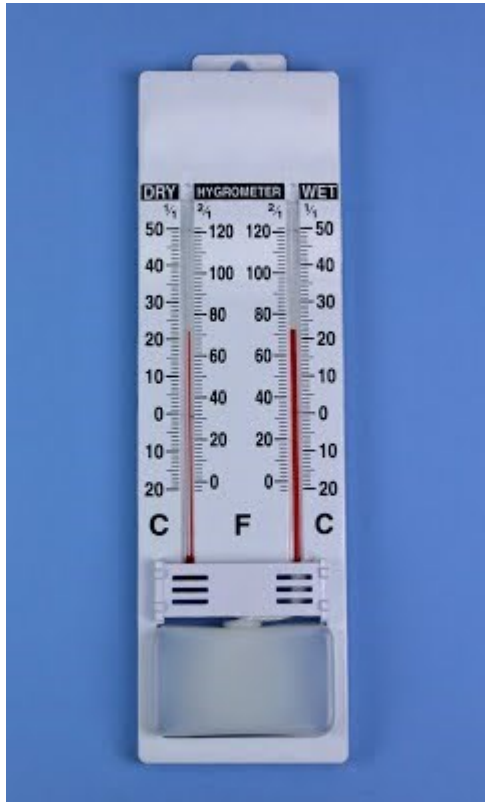
Motivation

- Humidity Detection
  - Dry and Wet Bulb Hygrometers
  - Humidity Sensors

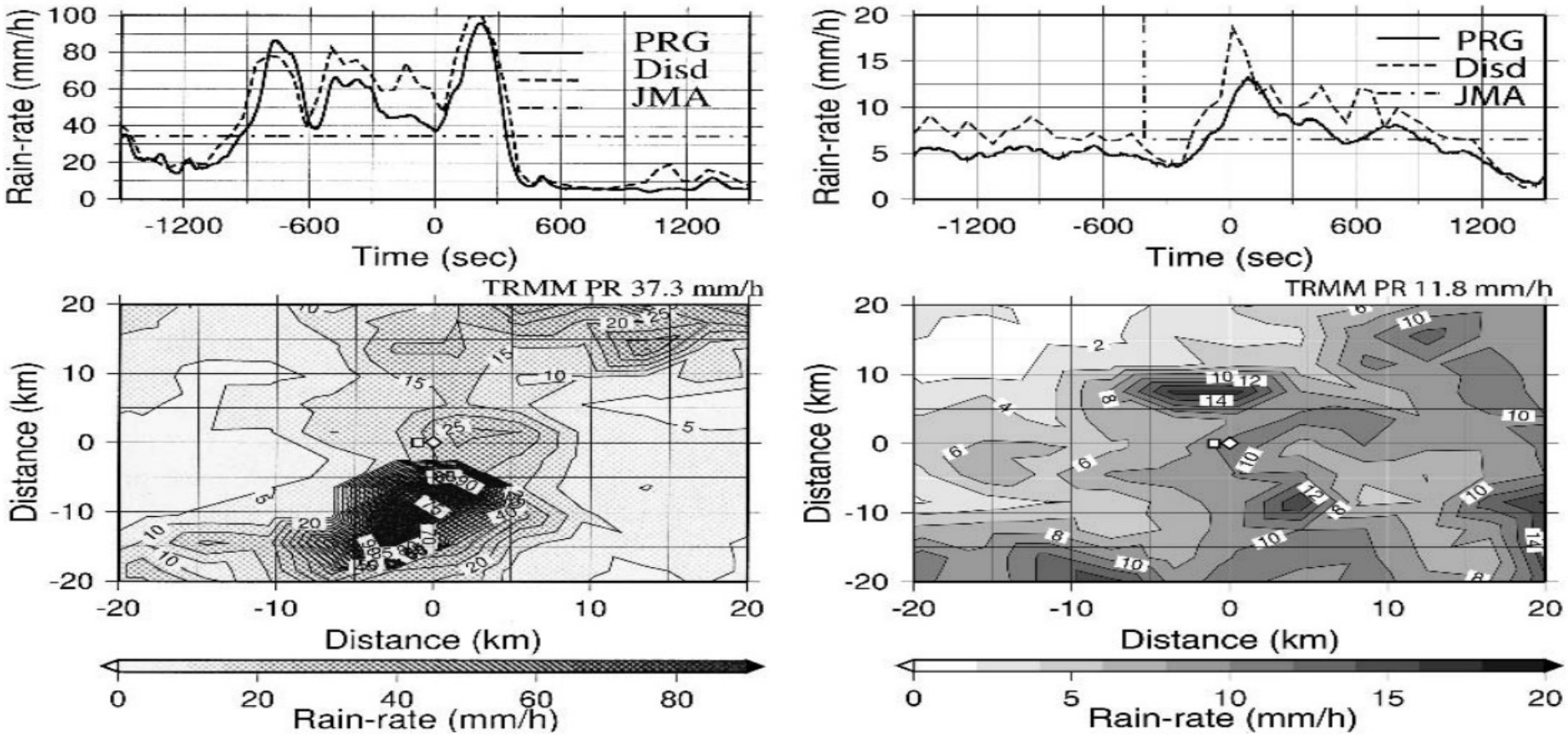


Limitation

- A Labor and Resource Intensive Task
- Insensitive

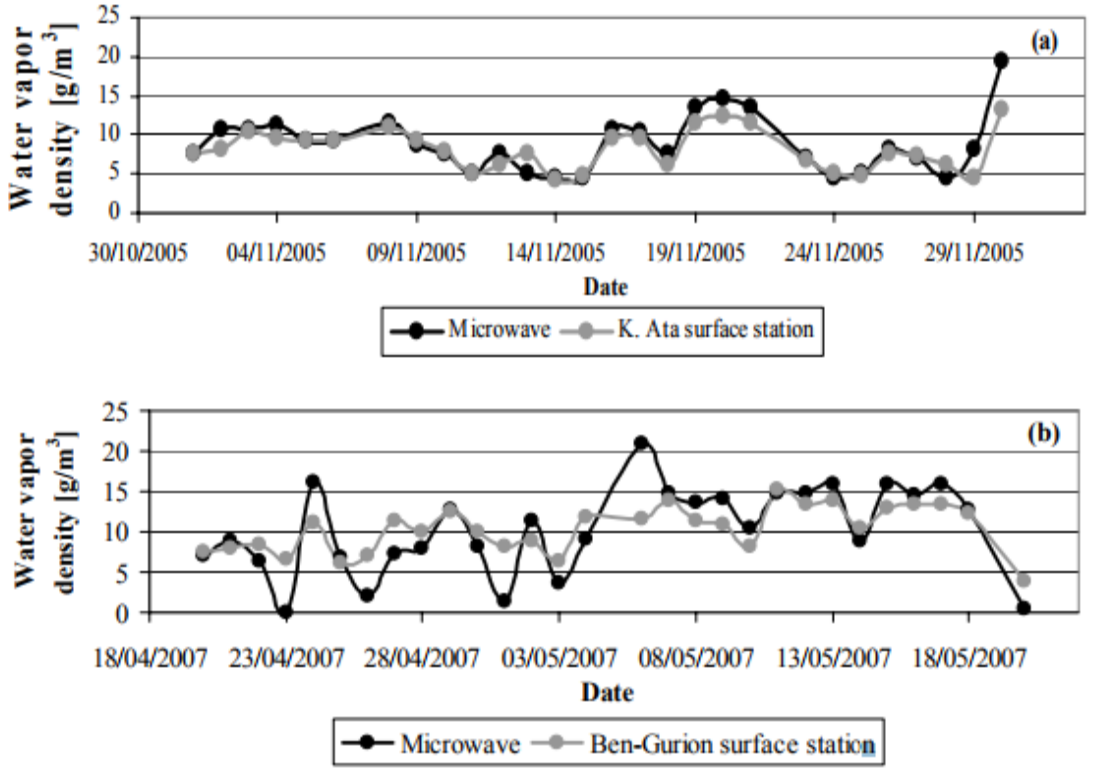


Related Work

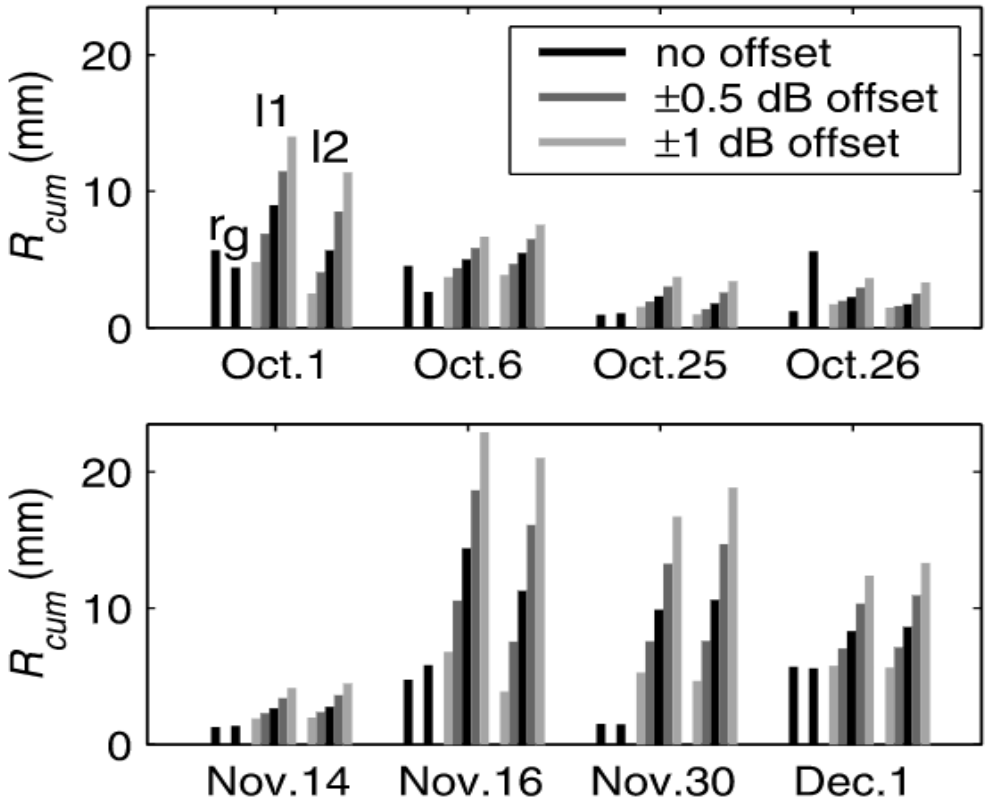


H.Minda etc. Journal of Atmospheric and Ocenic Technology'05 [11]

Related Work



N.David etc. Atmospheric Chemistry and Physics'09 [11]



H. Leijnse etc. WATER RESOURCES RESEARCH'07 [12]

Related Work

- Large Data Traffic Requirement of Future Mobile networks [14]
- IEEE 802.15TG3c & IEEE 802.11TGad

Modeling

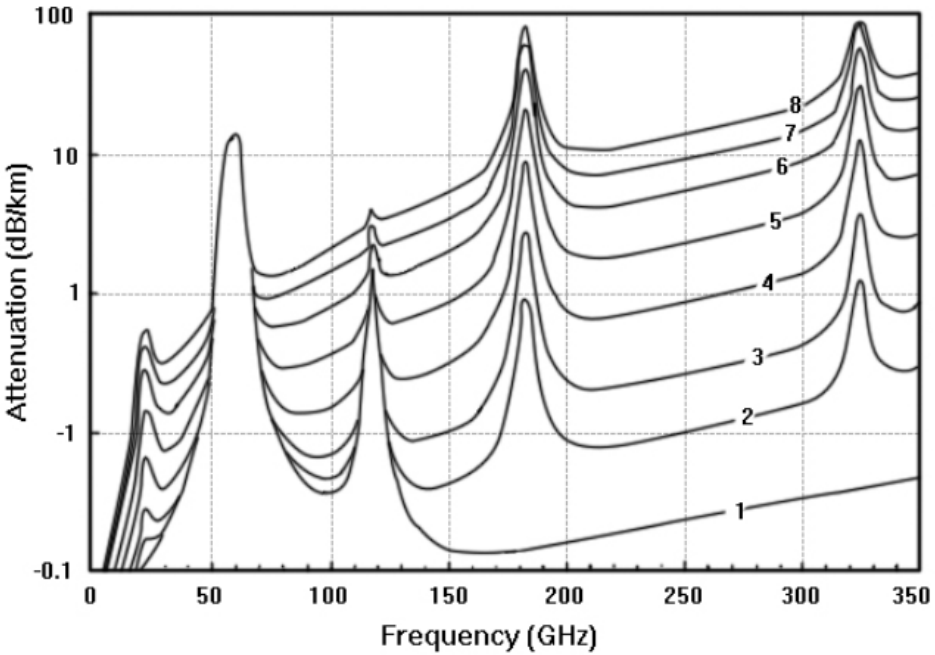
- Millimeter-Wave Propagation Model[6]

$$N = 3.336[N_0 + N'(f)] + j \cdot 0.1820 f N''(f)$$

Refractive Index

Dispersion

Absorption

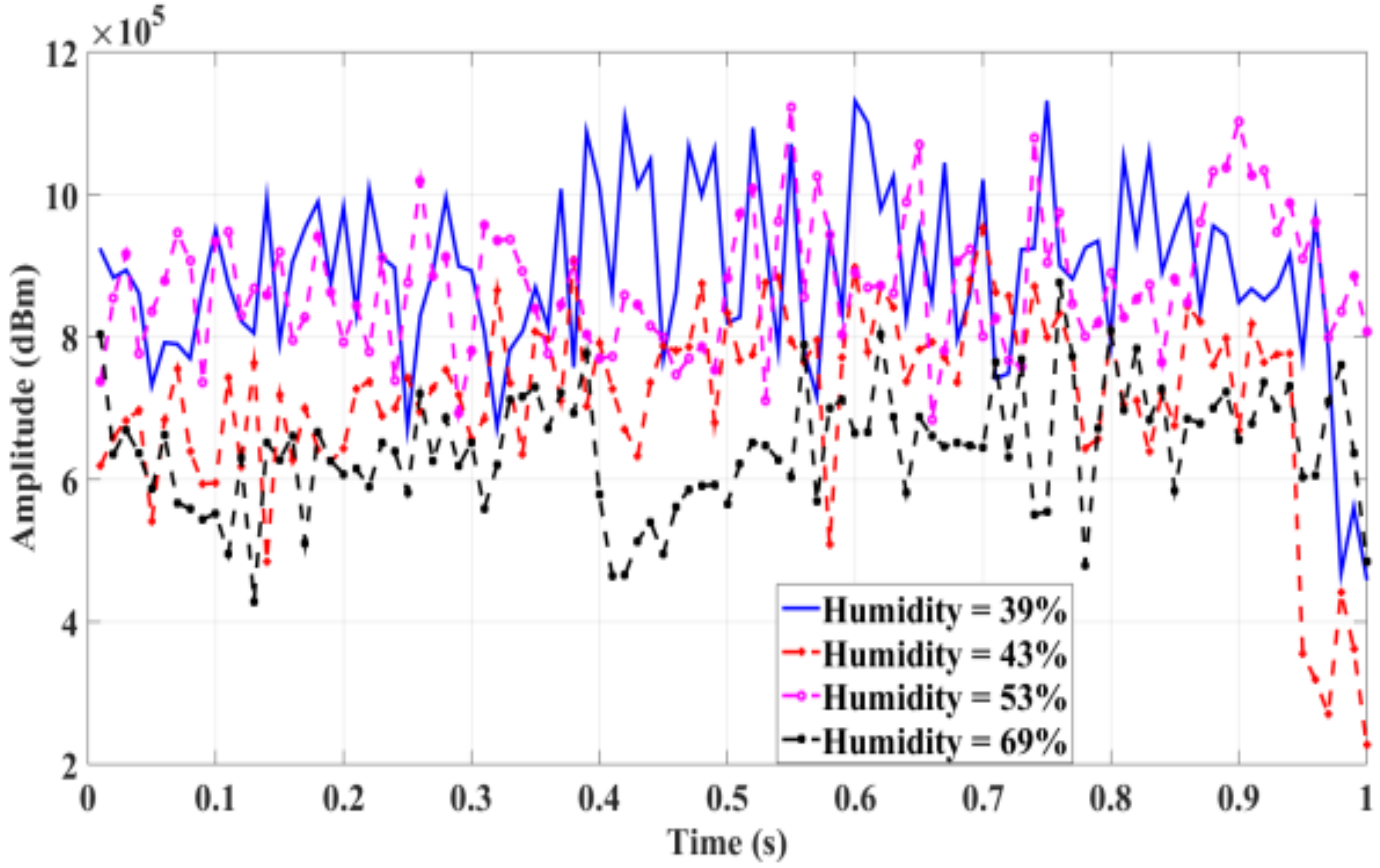


Challenges

- Whether Humidity Affects the Millimeter Wave Signal of 60GHz ?

Challenges

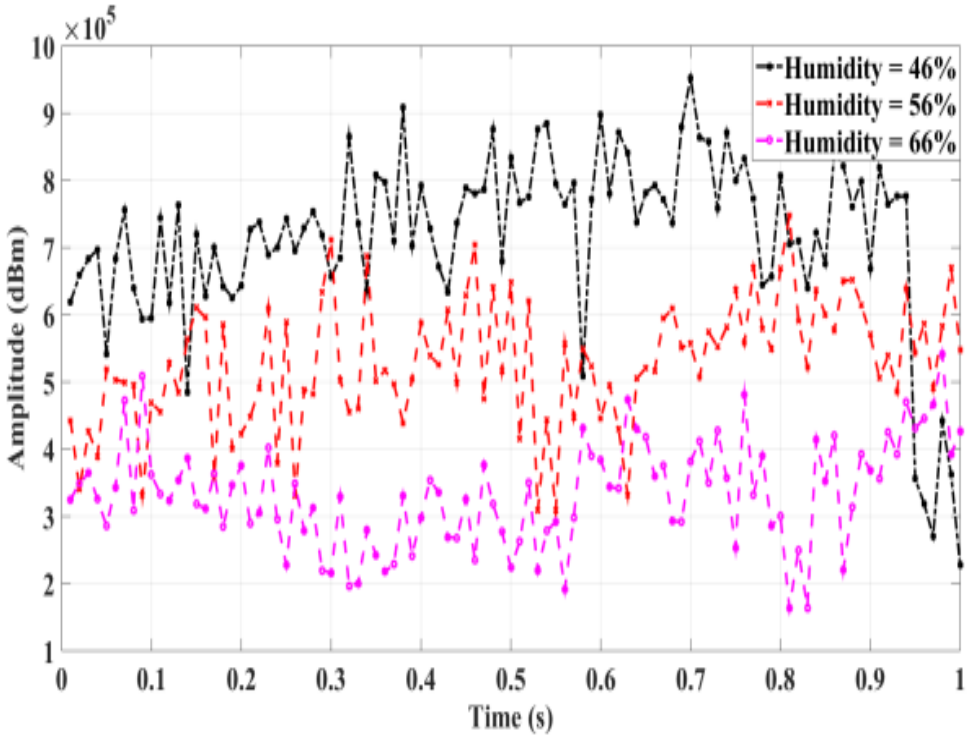
- How to Denoise other Influences ?



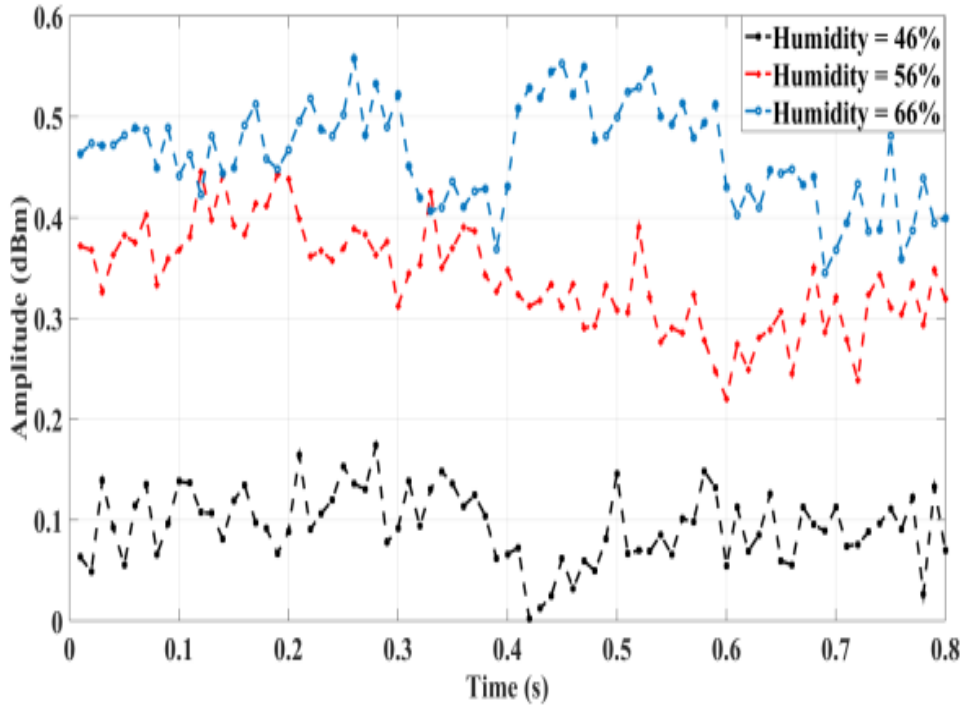
Denoise

- Subspace Projection Method
  - Principle Component Analysis
  - Linear Discriminant Analysis

Denoise



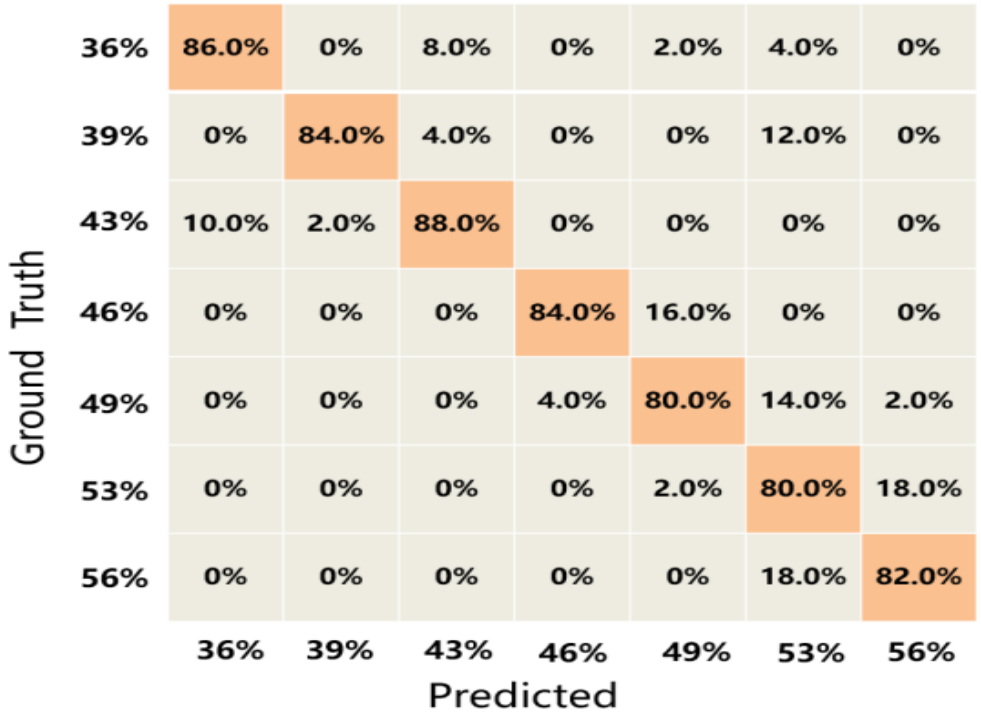
Before Denoise



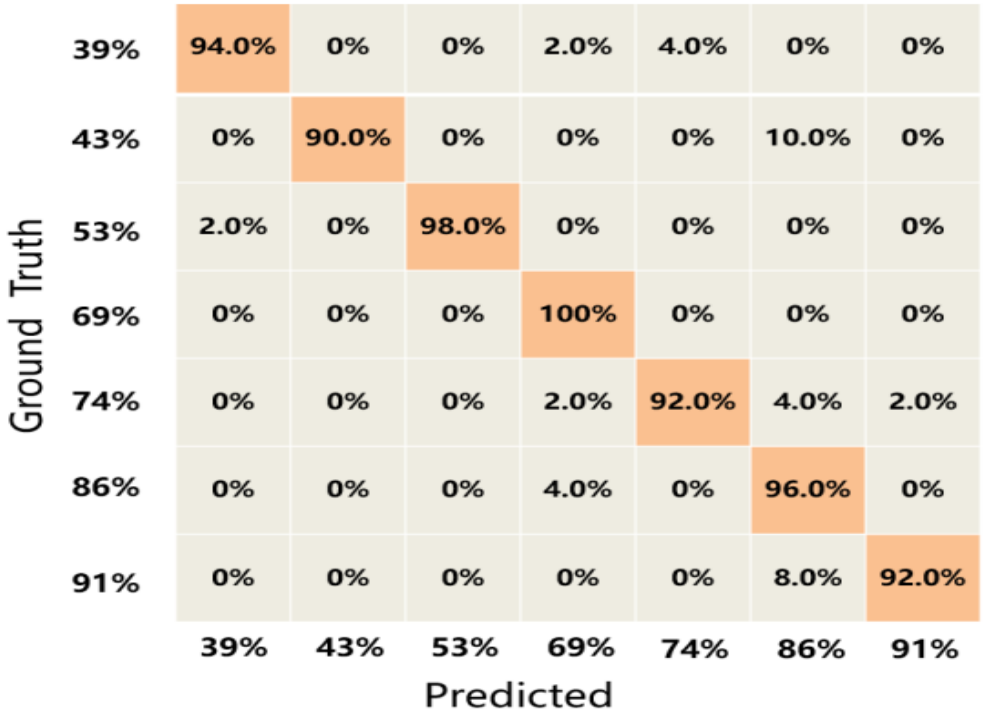
After Denoise

Classification

- Support Vector Machine (SVM)



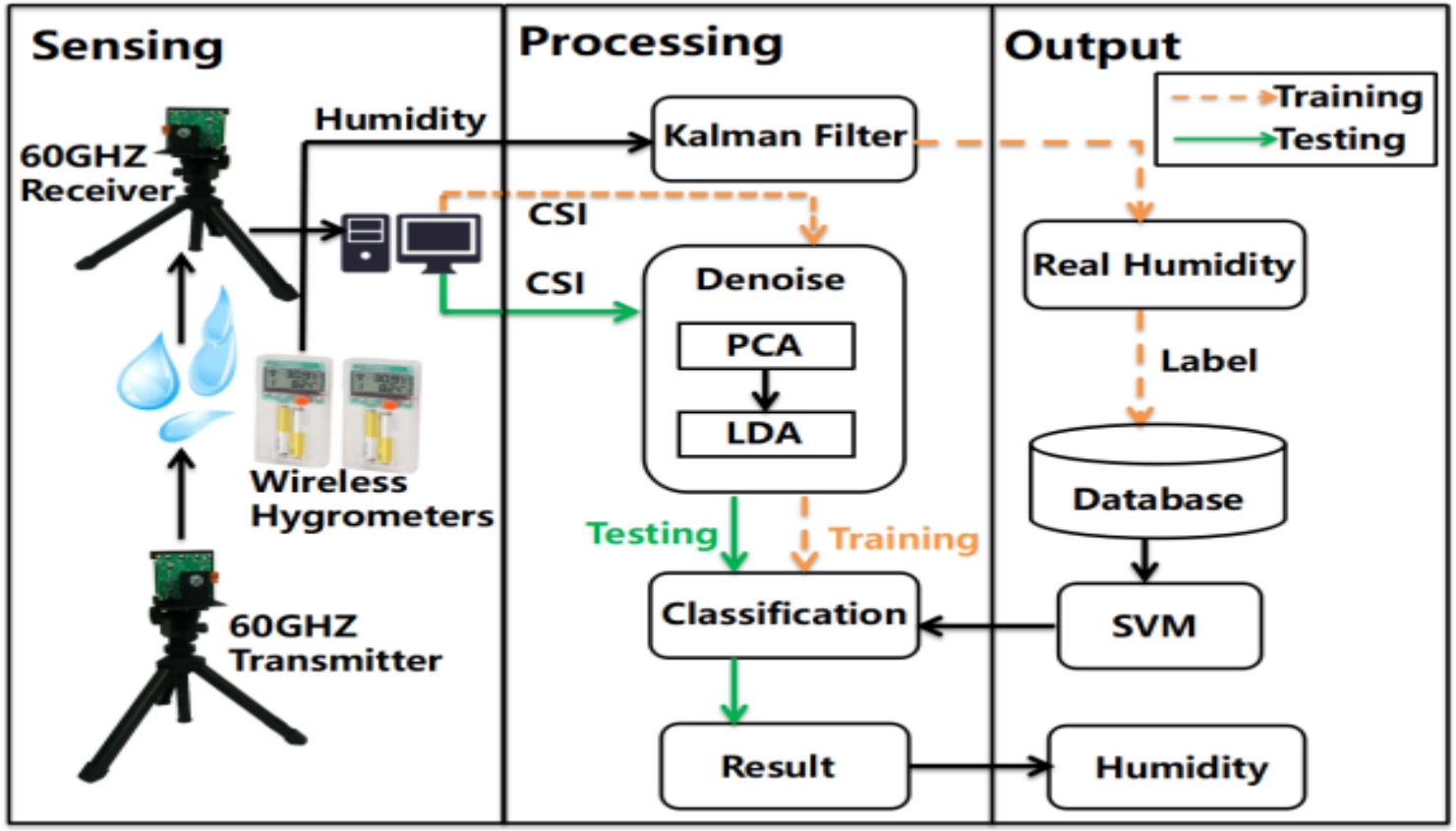
The humidity interval in 3%



The humidity interval in 5%

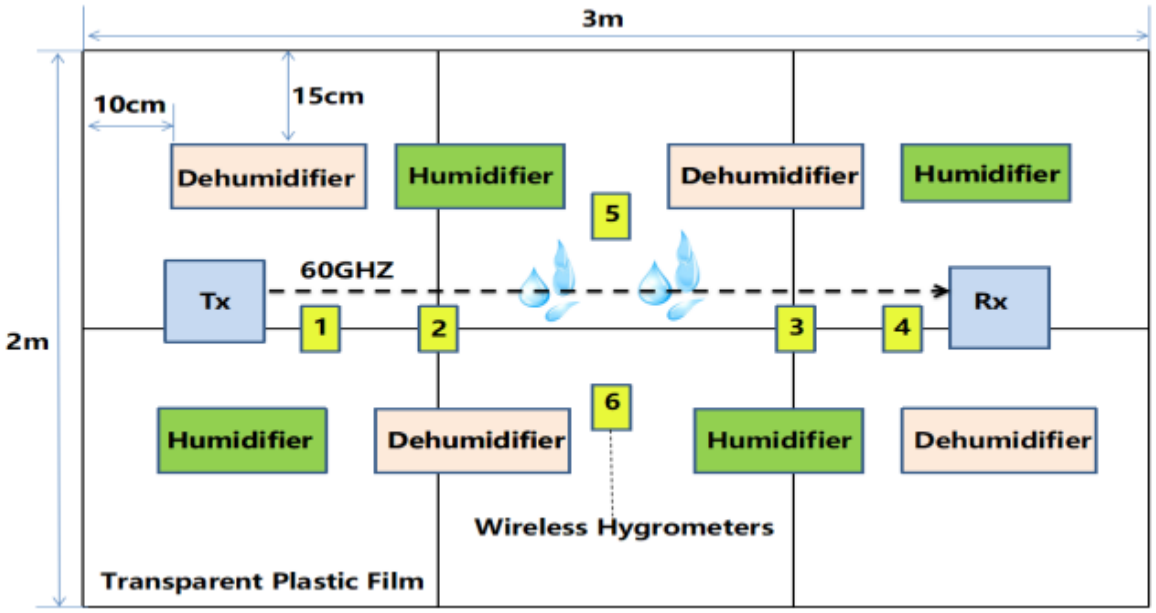
System Design

- System Overview

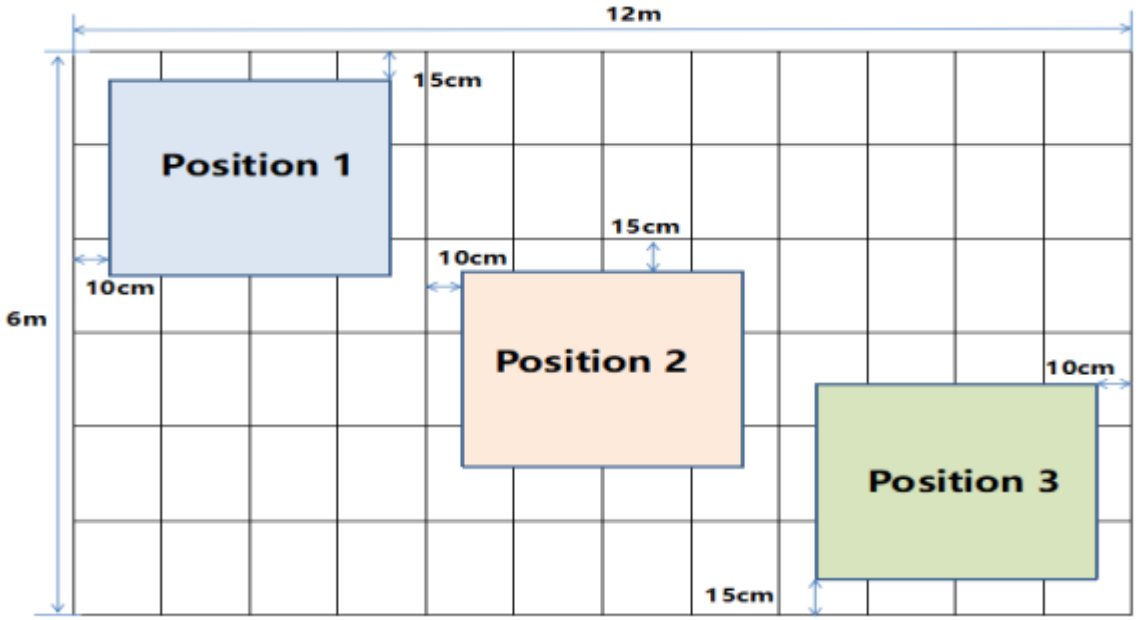


System Design

System Design



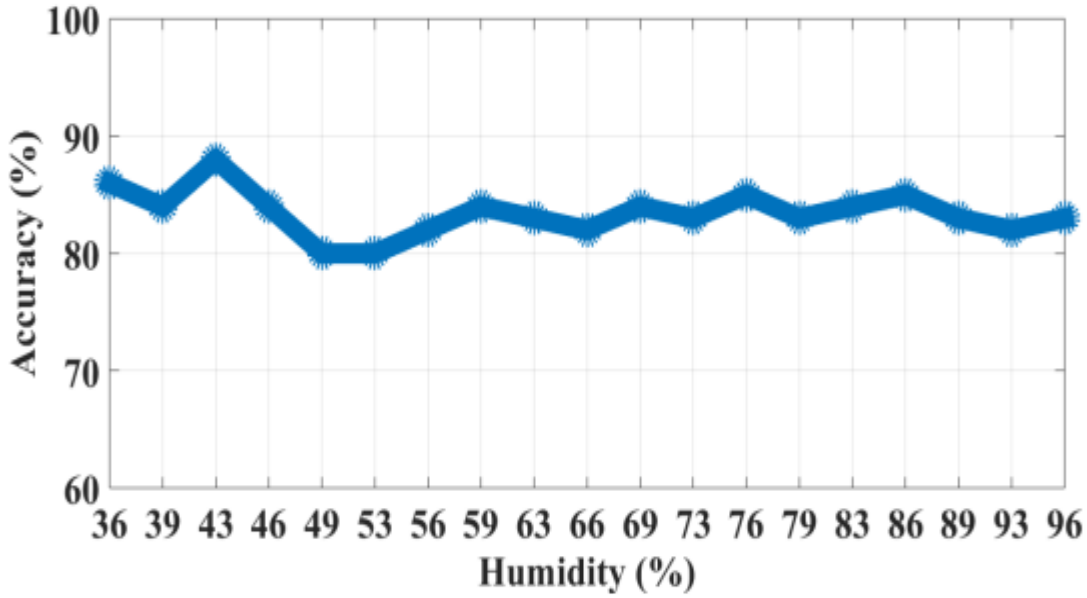
The Equipment Placement



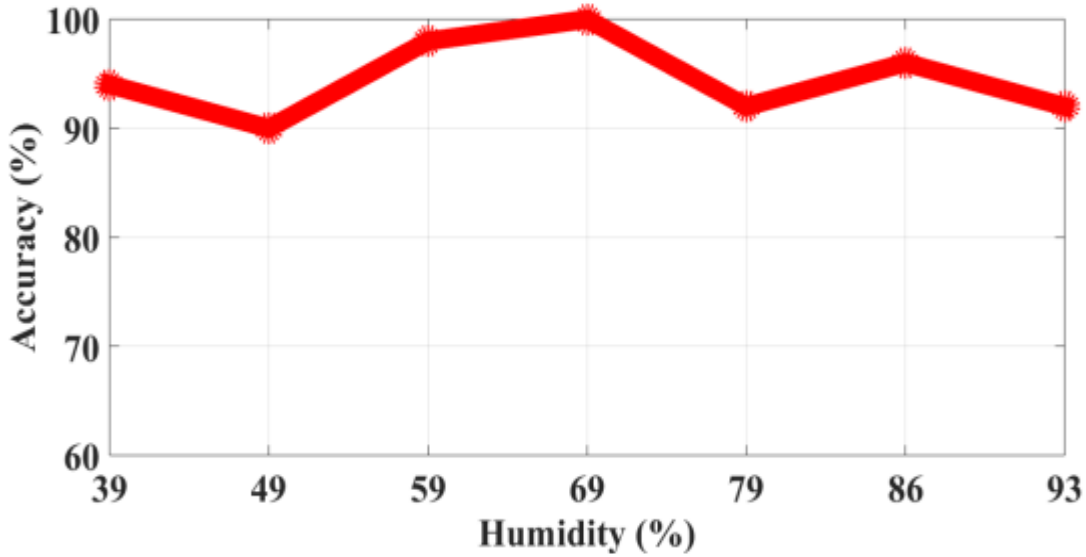
Three Different Positions of the experiment

Evaluation

- Different Interval



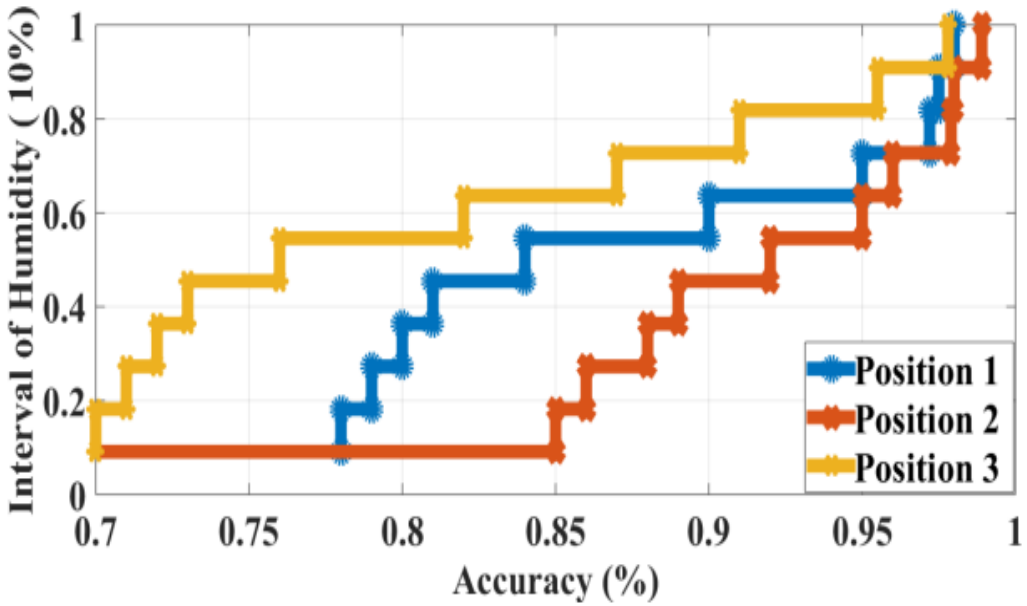
The humidity interval in 3%



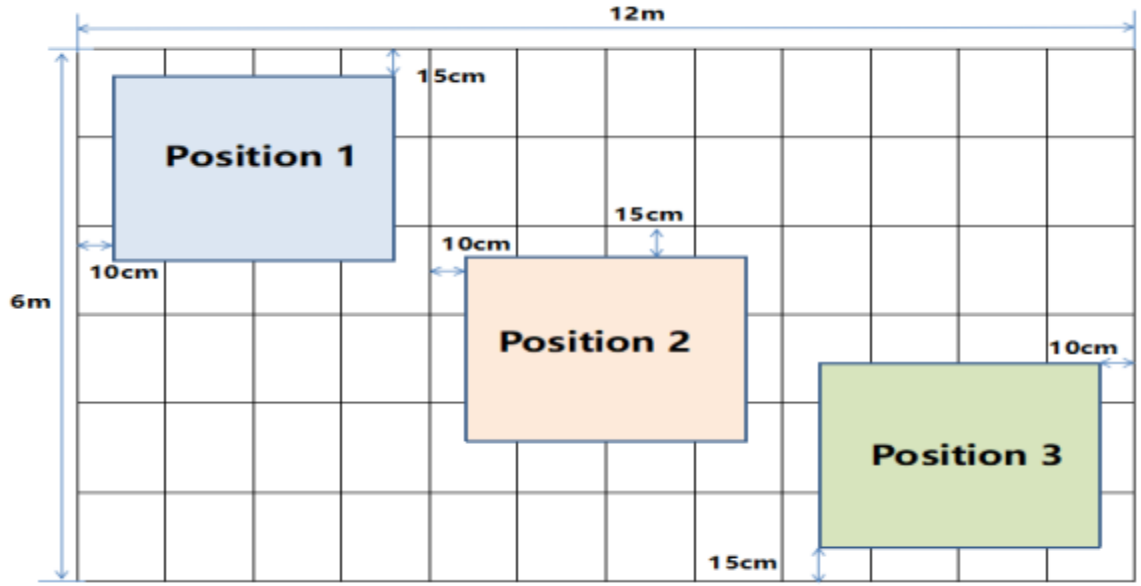
The humidity interval in 5%

Evaluation

- Different Position



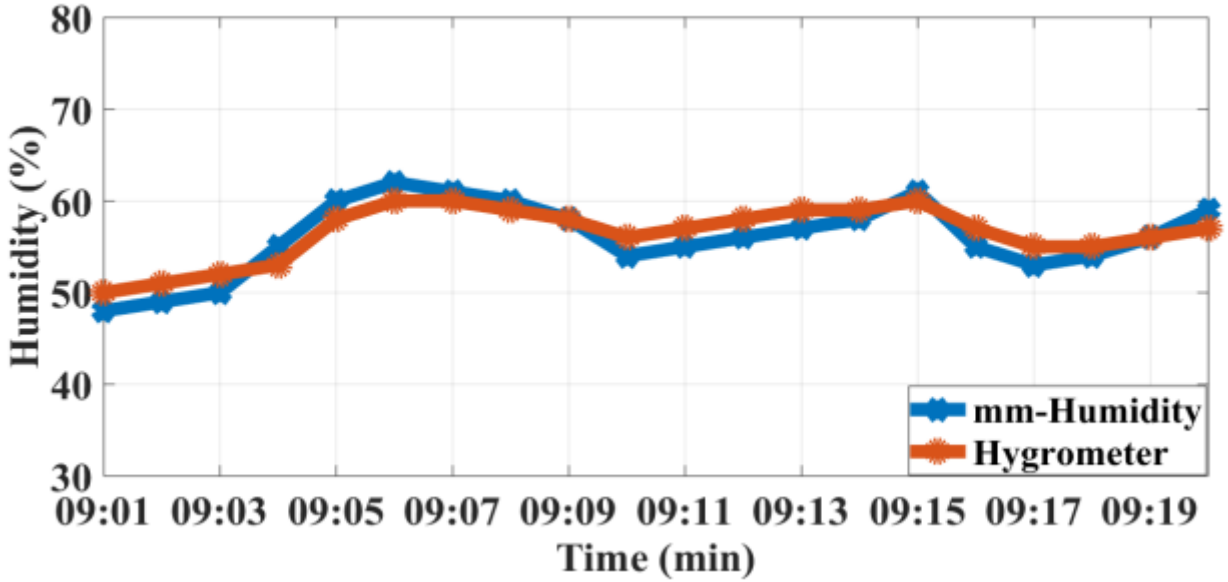
Accuracy Of Different Humidity Values Under Different Positions.



Three Different Positions of the experiment

Evaluation

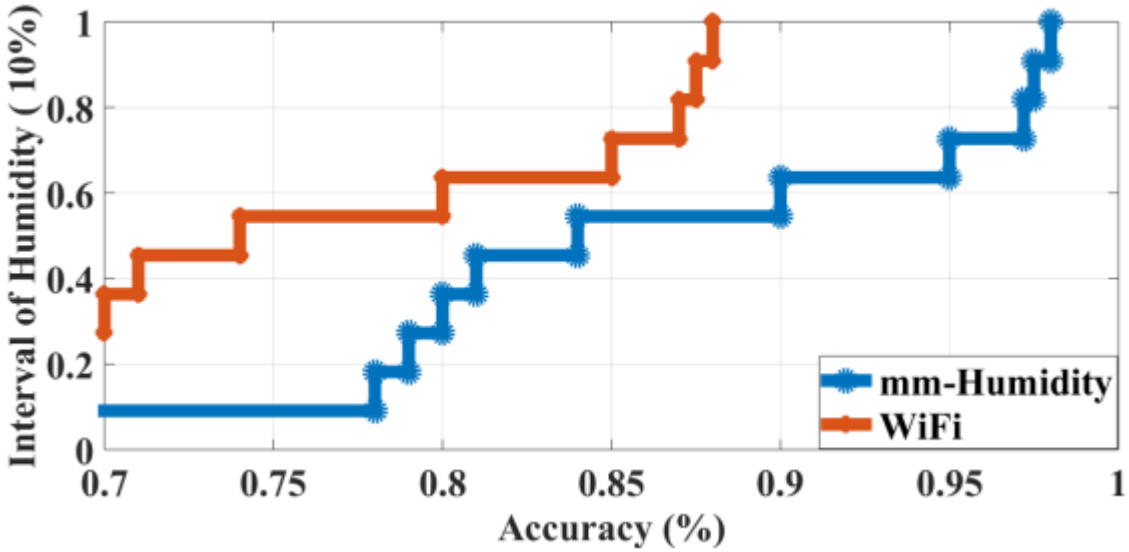
- Sensitivity Inspection



The Measurement Accuracy Comparison Between Mm-humidity And The Hygrometer.

Evaluation

- Comparison with 2:4 GHz WiFi Signal



Performance Comparison Between Mm-humidity System And That With 2.4 GHz WiFi Signal.

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Thank you!

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The IoT Research Center