



Technische  
Universität  
Braunschweig

Institute of Operating Systems  
and Computer Networks



## Investigation of Angle Dependent Errors in Phase-based Ranging with Different Antennas

EWSN 2020, Lyon, France

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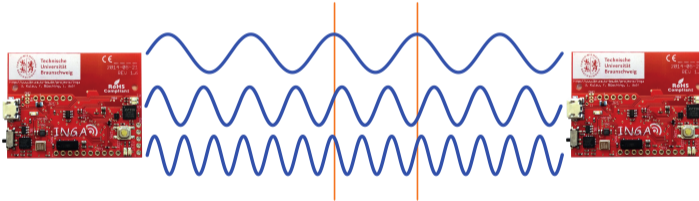


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- Most localization research ignores device orientation
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- Radiation patterns do not contain phase information

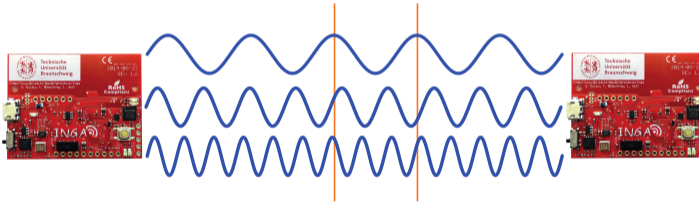
# Phase-based Ranging

- Obtain **distance in meters** between **two wireless sensor nodes**



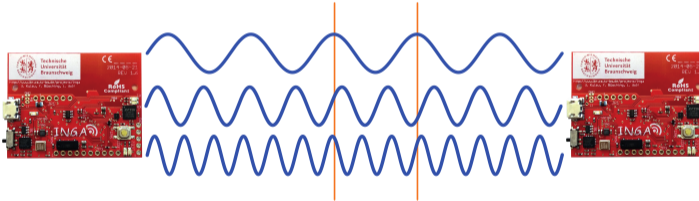
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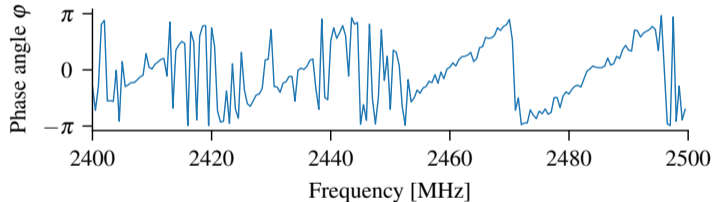
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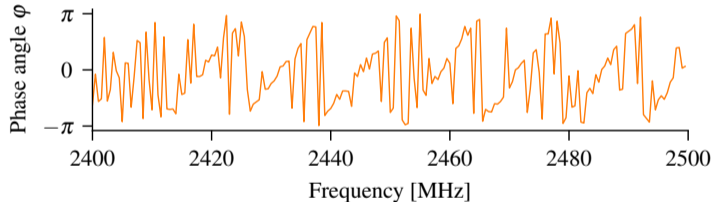
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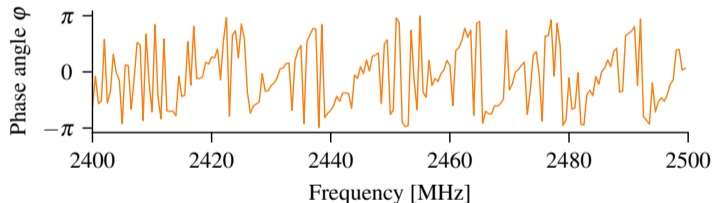
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- Distance is **proportional to slope/frequency** of phase response

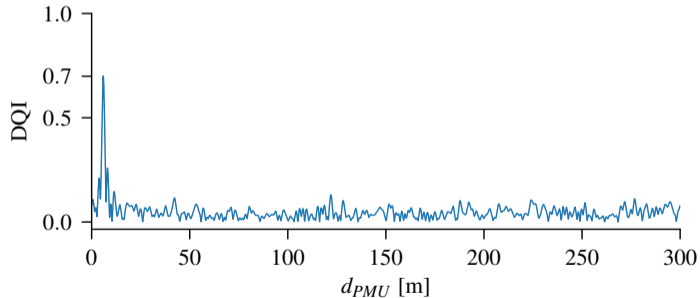
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- Compute **Fast Fourier Transform (FFT)** from complex signal



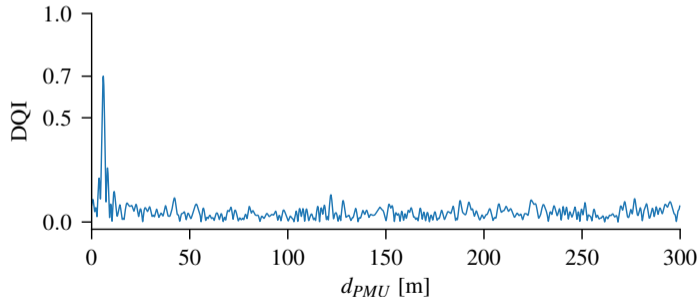
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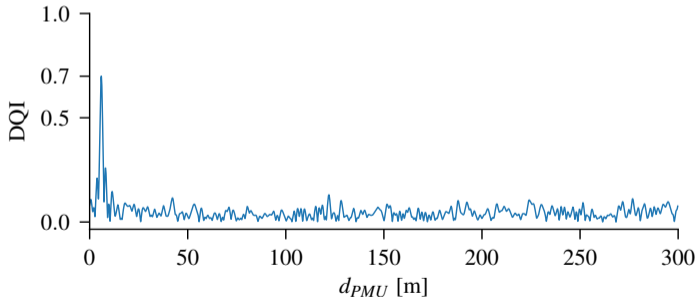
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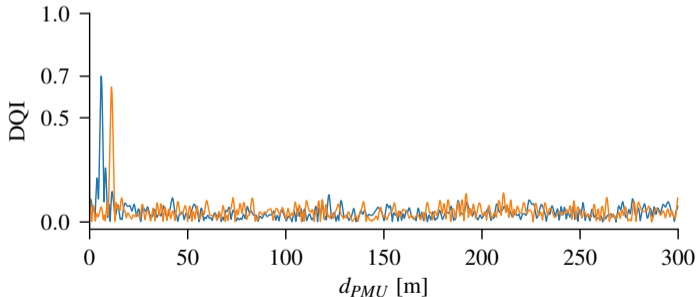
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# Research Questions

- How does antenna orientation influence phase-based ranging?



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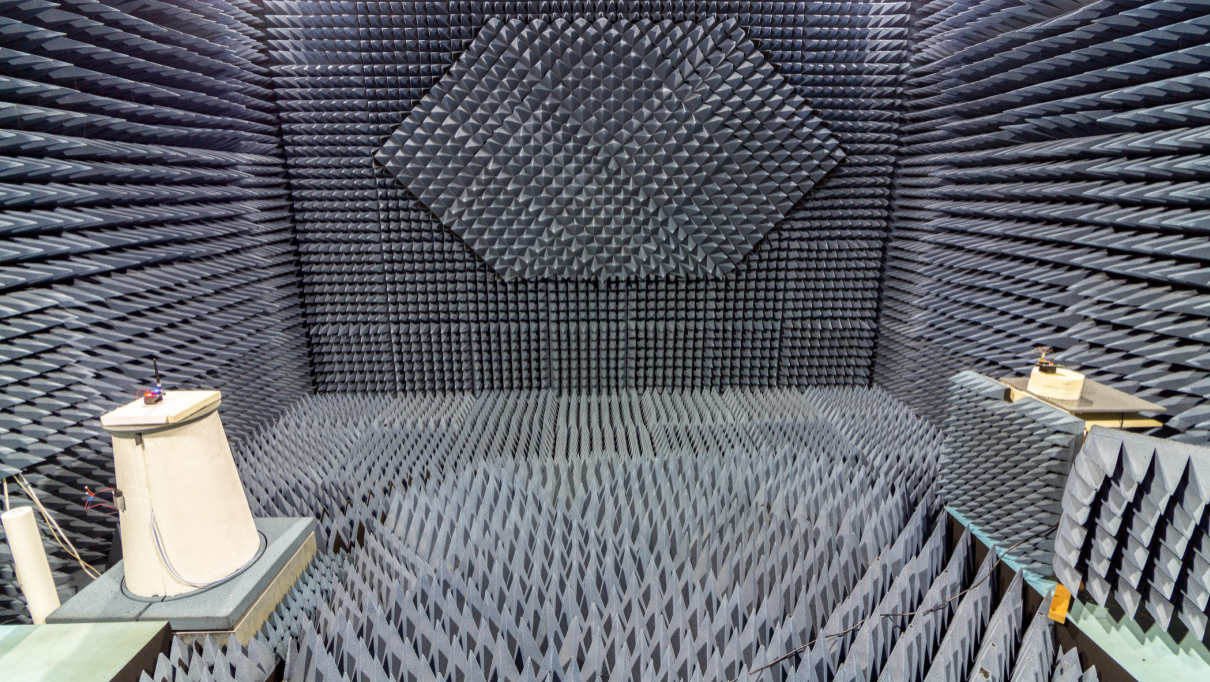
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- Which **angle dependent error** can be expected for different antenna designs?



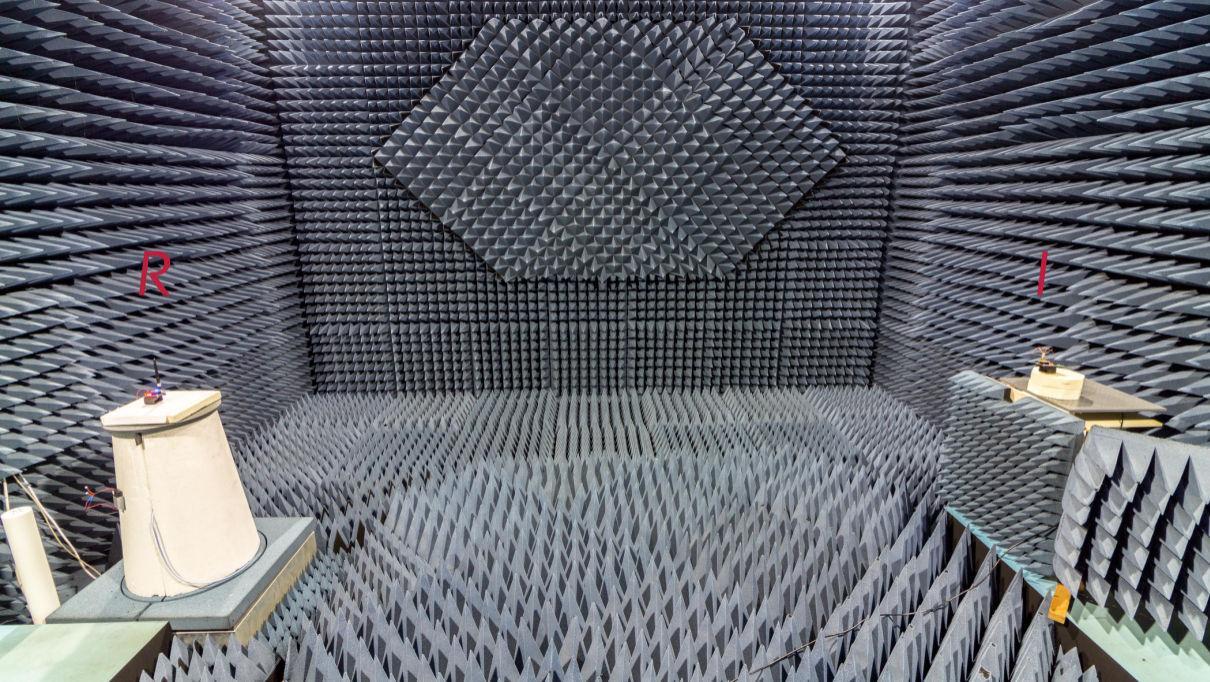
# Research Questions

- How does antenna orientation influence phase-based ranging?
- Which **angle dependent error** can be expected for different antenna designs?
- **How to measure** this error in a controlled environment?



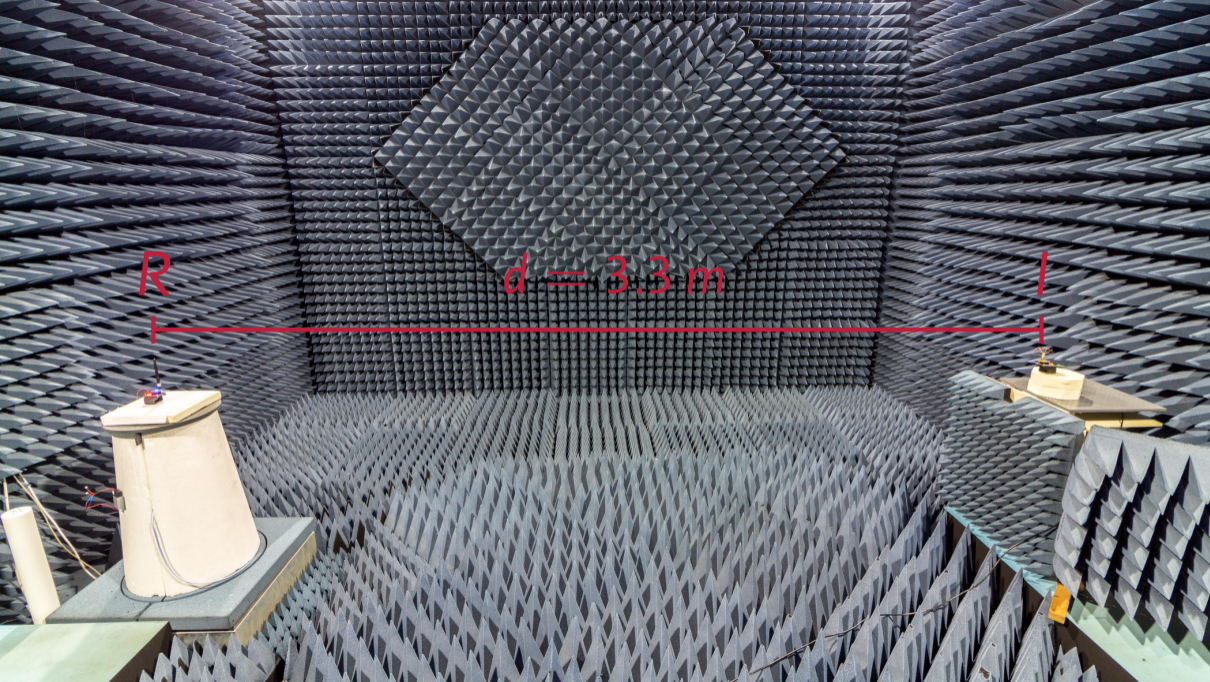






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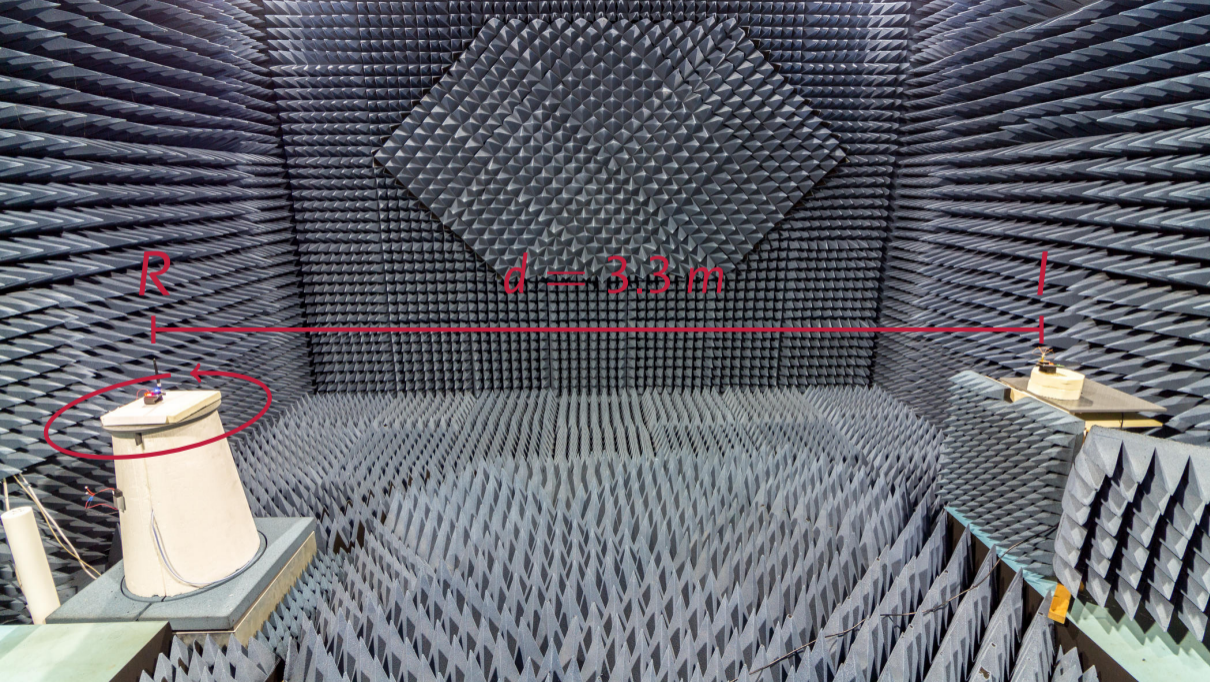


R

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l





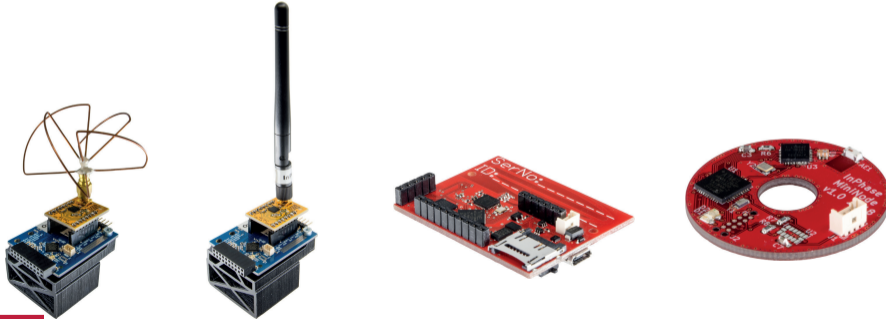
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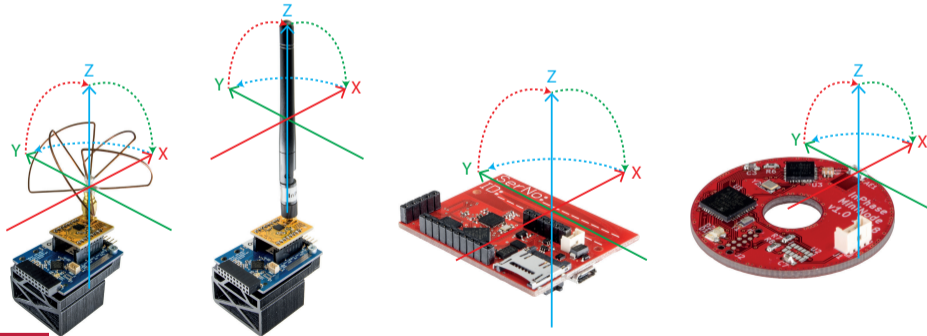
# Experiment in Anechoic Chamber

- 4 types of antennas evaluated in 6 combinations



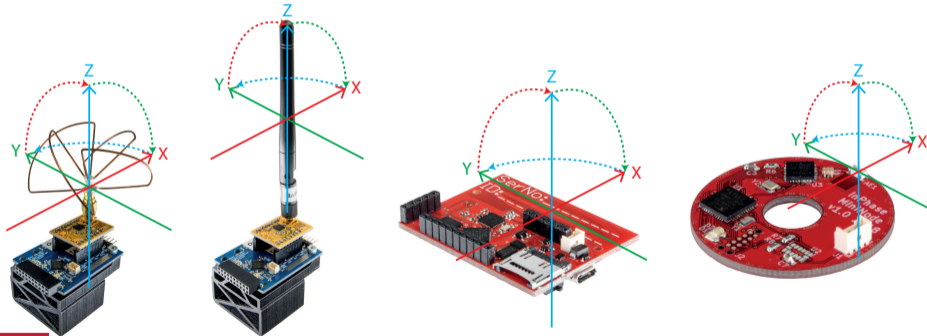
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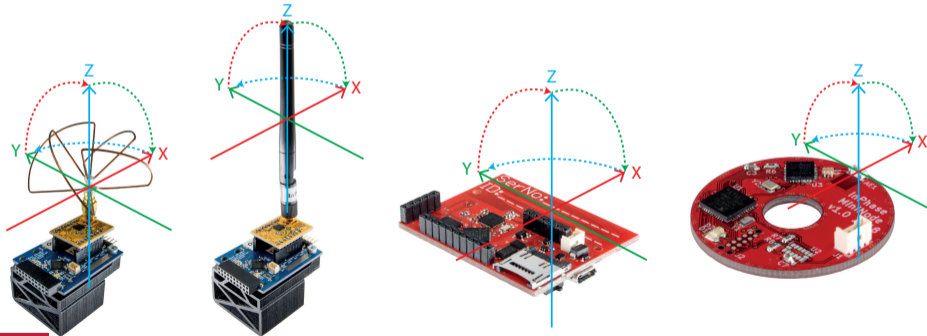
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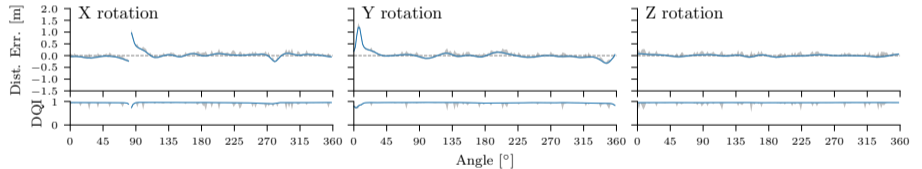
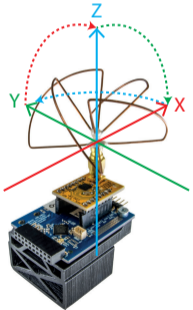
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- **324000 distance measurements**



# Two Skew-Planar Wheel Antennas

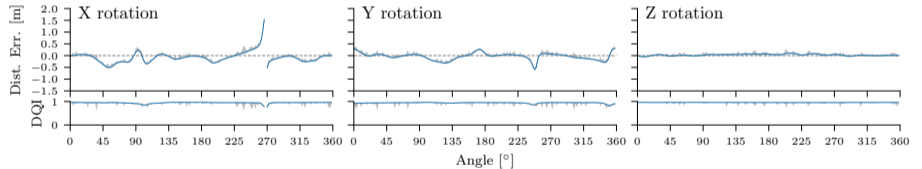
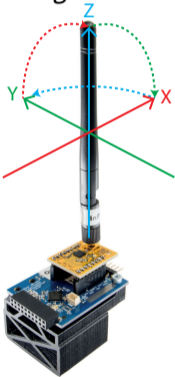
- Lowest maximum error
- Lowest angle dependent error





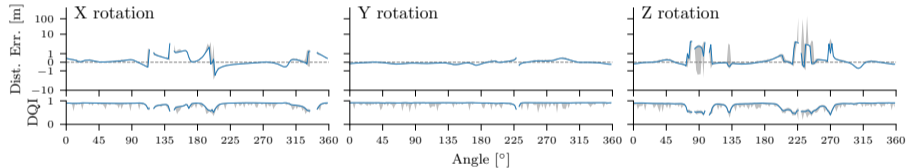
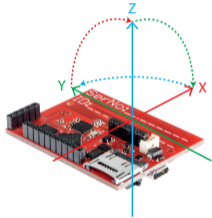
# Two Monopole Antennas

- Low error when rotated around Z-axis
- Higher errors in other directions



# PCB Antenna with Skew-Planar Wheel Antenna

- Low error when rotated around Y-axis
- High errors in other directions



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# Thank you for your attention!

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