

Location and Temperature Passive Wireless Sensor Tags

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Overview

- * Adding location information to passive wireless sensors
- * Hybrid location estimation method
- * Fundamental limits of localization
- * Applications of location sensors



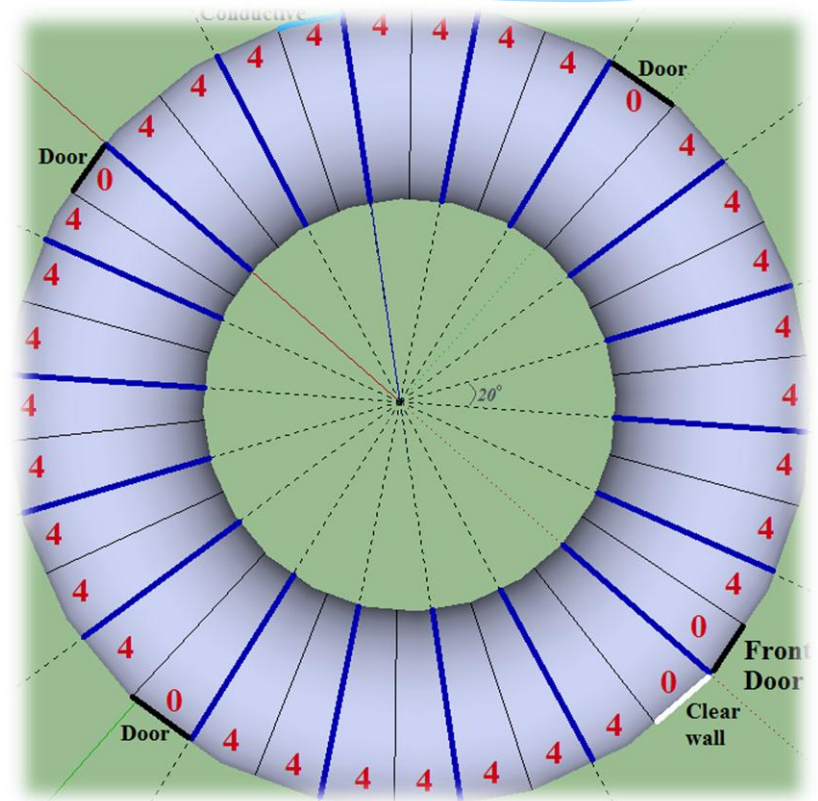
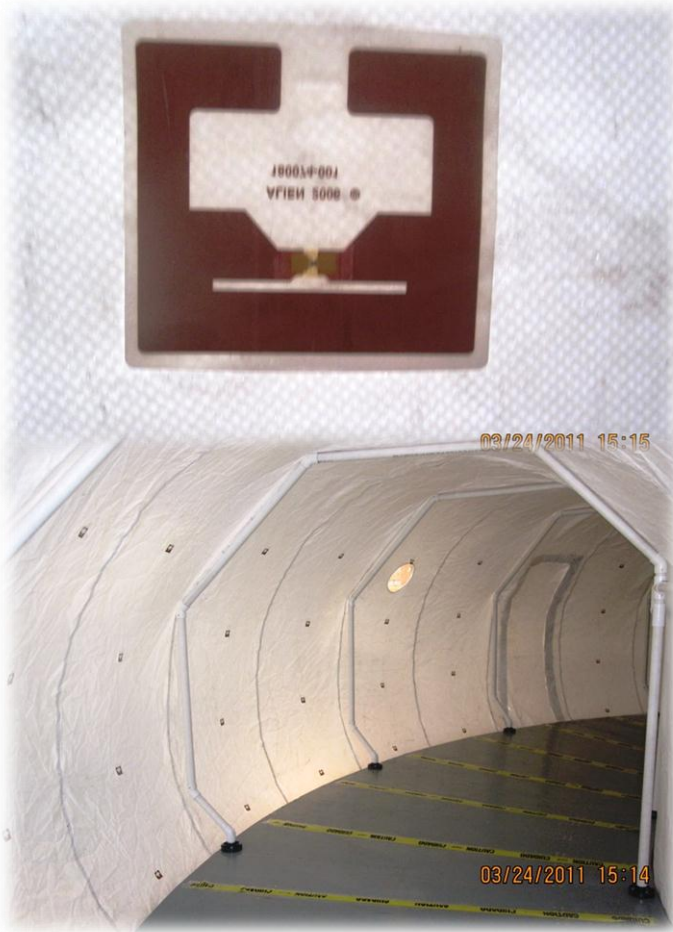
UMaine Wireless Sensing Lab



3600 sqft Lab housing
Concentric Torus
developed by NASA-JSC,
on loan at UMaine

Fully assembled torus
42 ft diameter, 10 ft tall
124 sensors installed

Wireless Location Sensors

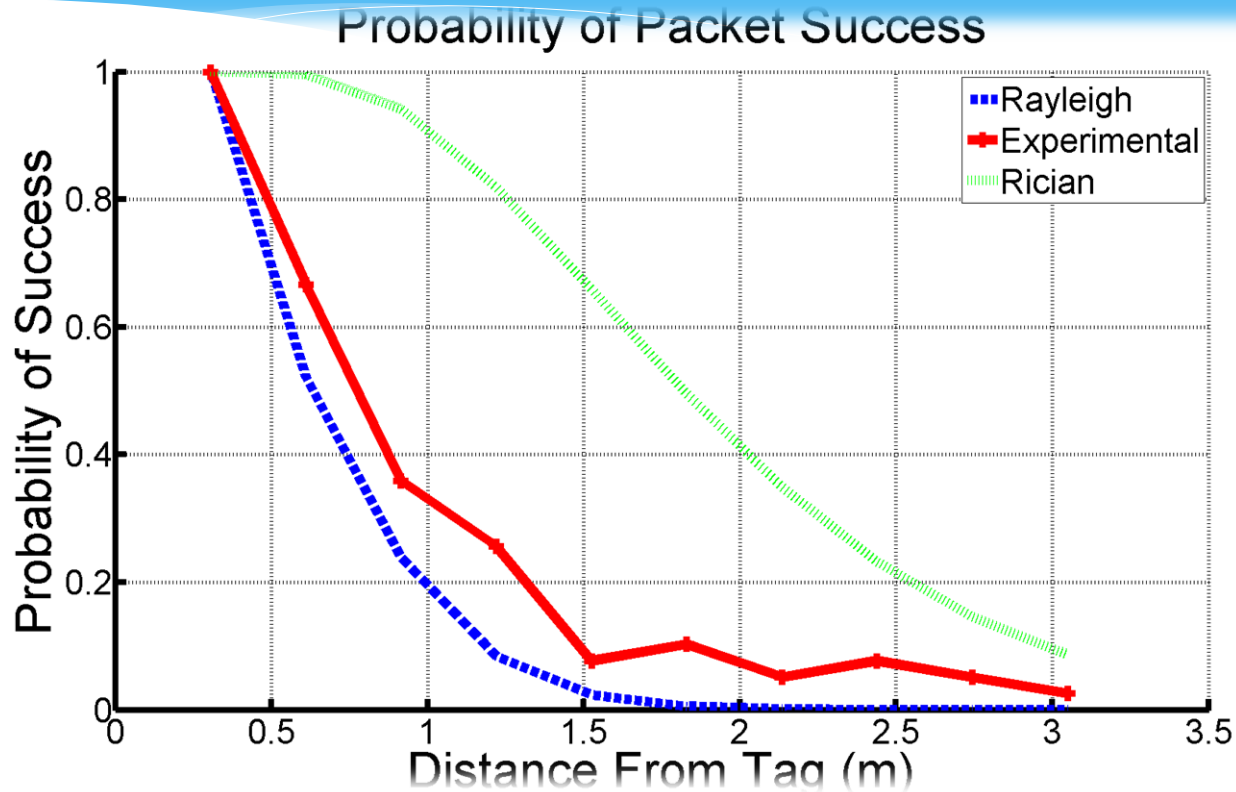


Sensor Spec

- * 860-960 MHz
- * 10 ft reading range
- * Passive – no battery
- * EPC Global Gen 2 / ISO 18000-6C Standard
- * Motorola Reader with 70 degree field of view



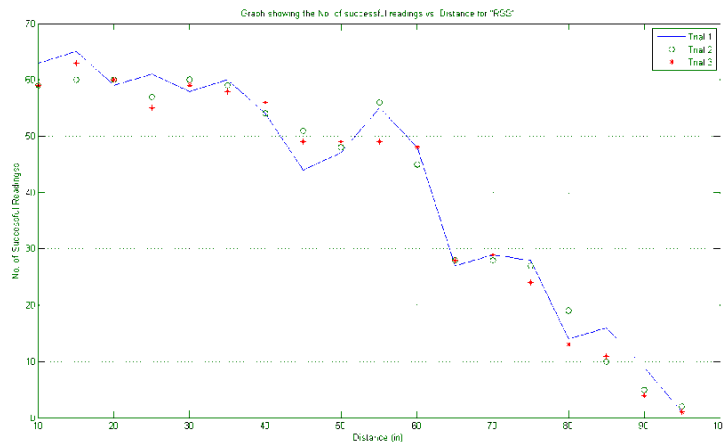
Theoretical Model



F. Schwaner, D. Blackmer, A. Abedi, "[Computing Performance Bounds for Analysis of Indoor Wireless Fading Channels for RFID-Based Localization](#)," ICWN'11, July 2011, Las Vegas, NV.

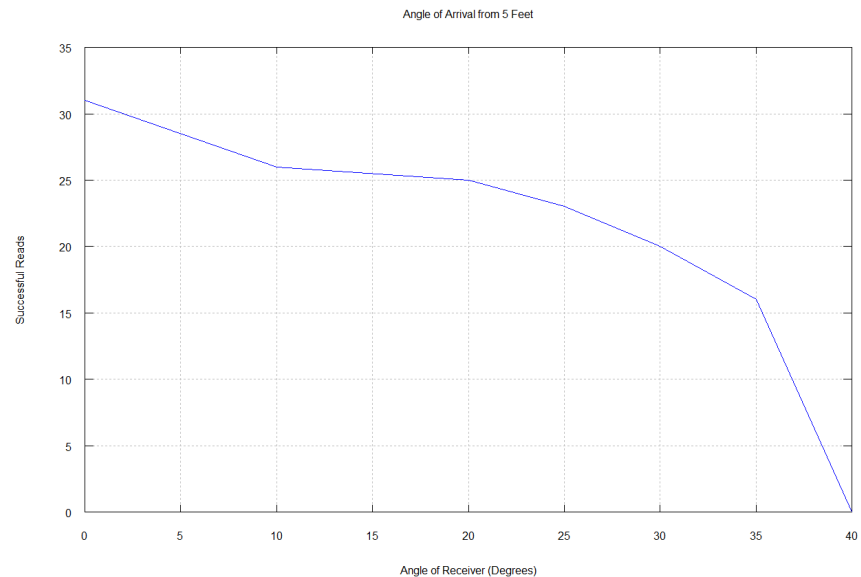
Experimental Data

Statistical modeling of
Received Signal Strength
(Left) and Angle of Arrival
(Down) for 1000 trials

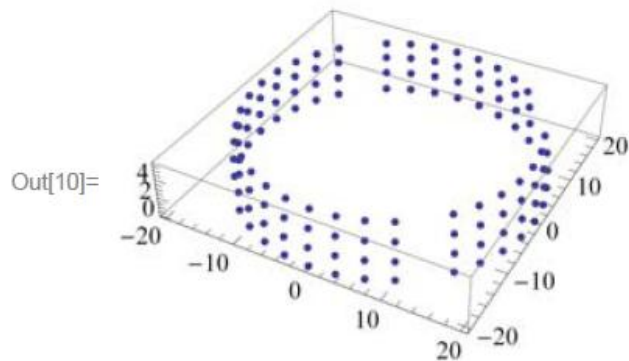


Produced by two
undergraduate student
research assistants

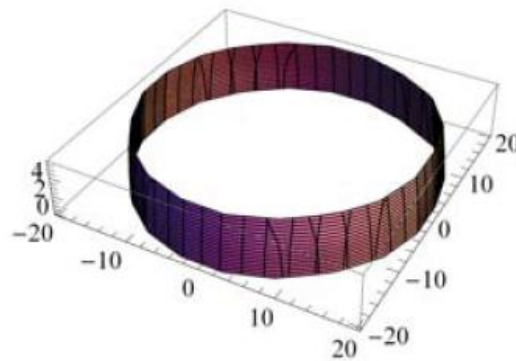
Jesse Rodgerson
Anin Maskay



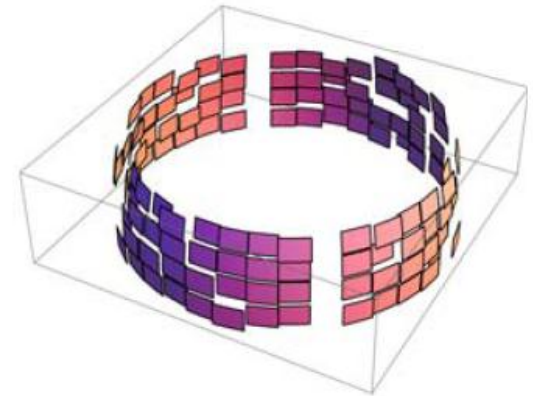
2D Shape Reconstruction



Actual locations



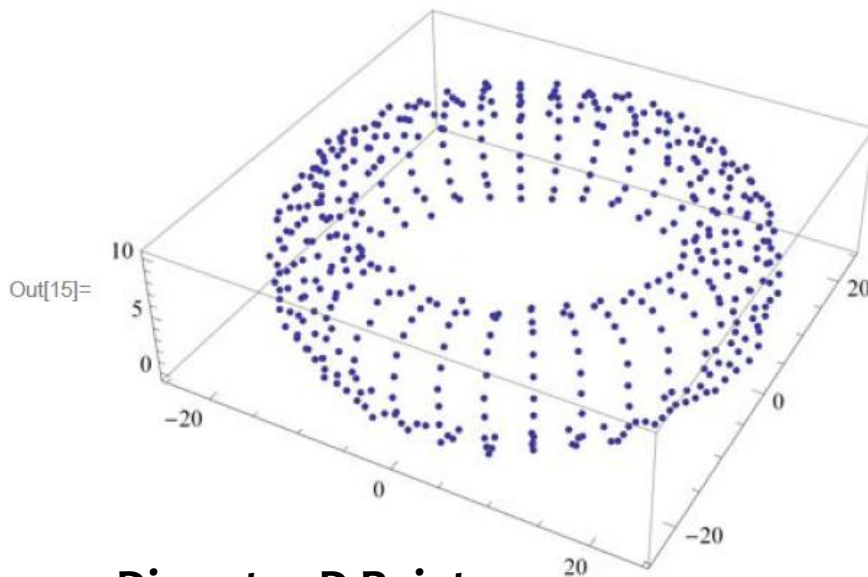
Theoretical



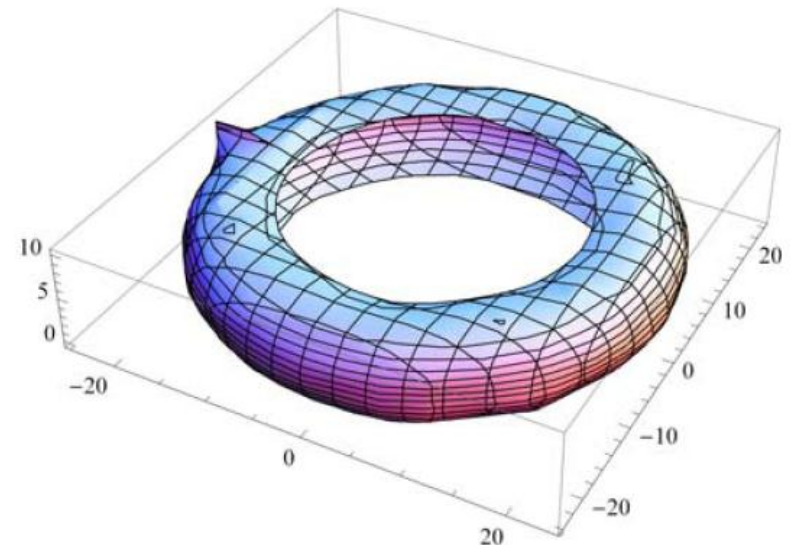
Experimental

Produced by Dr. Jankowski (USM) using MATHEMATICA Software

3D Shape Reconstruction



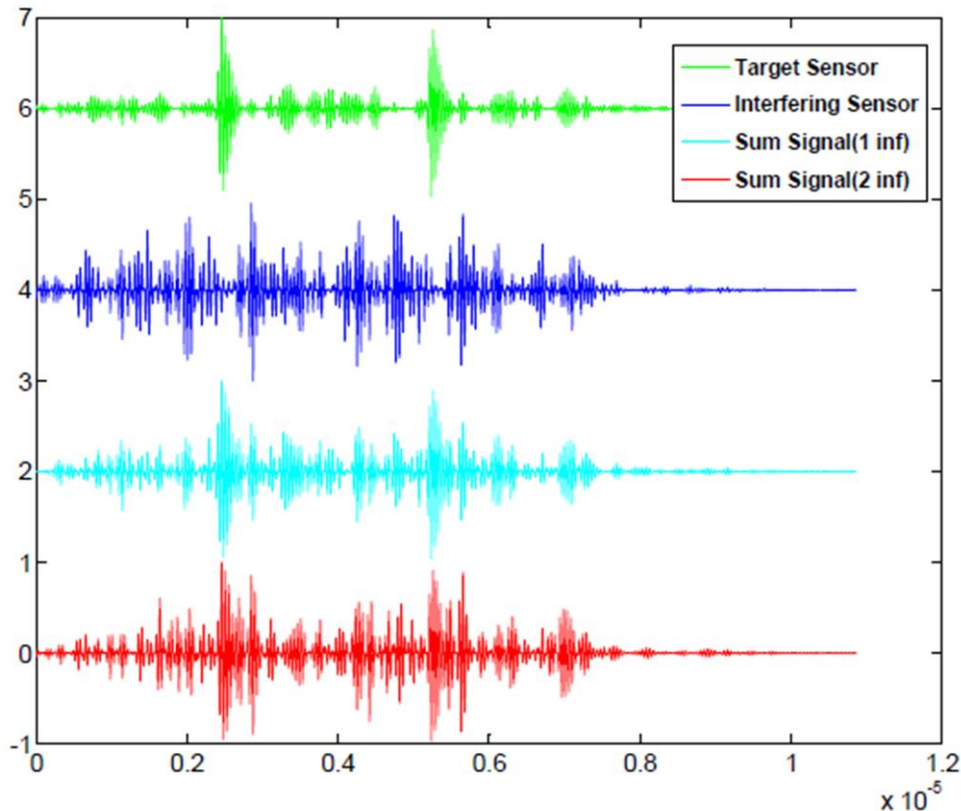
Discrete 3D Points



Continuous Surface Estimate

Produced by Dr. Jankowski (USM) using MATHEMATICA Software

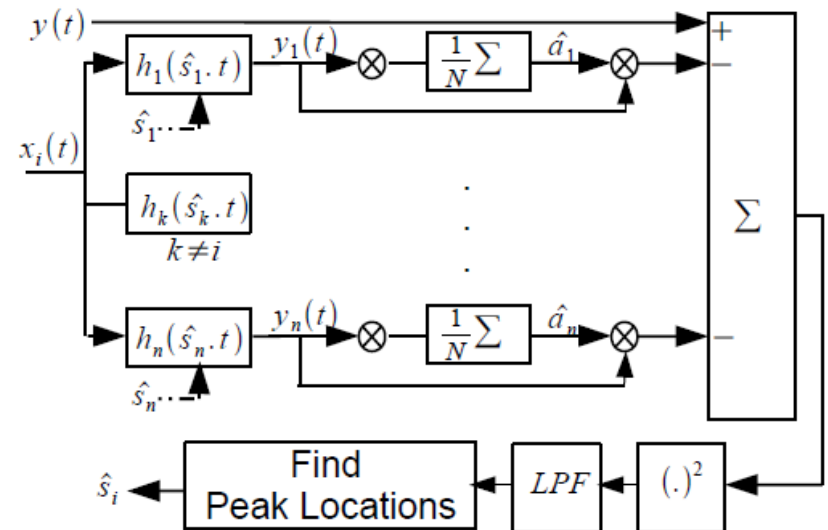
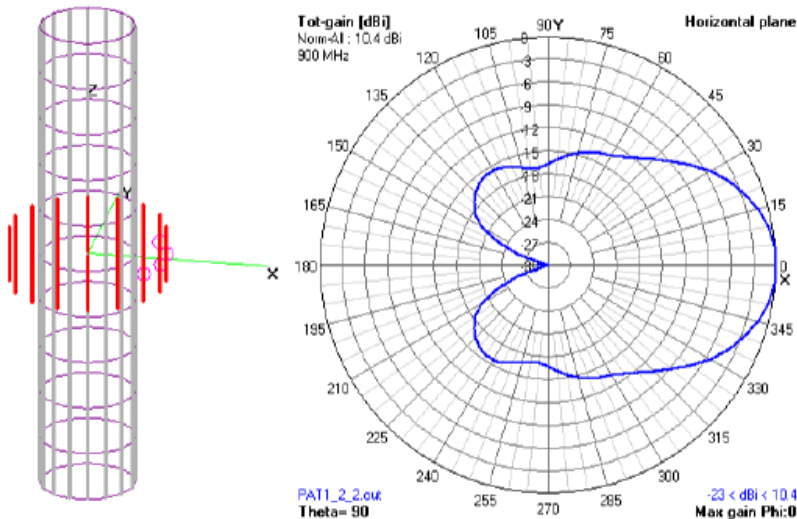
Interference Problem



How to mitigate interference?

- Time domain
- Frequency domain
- Code domain
- Space domain

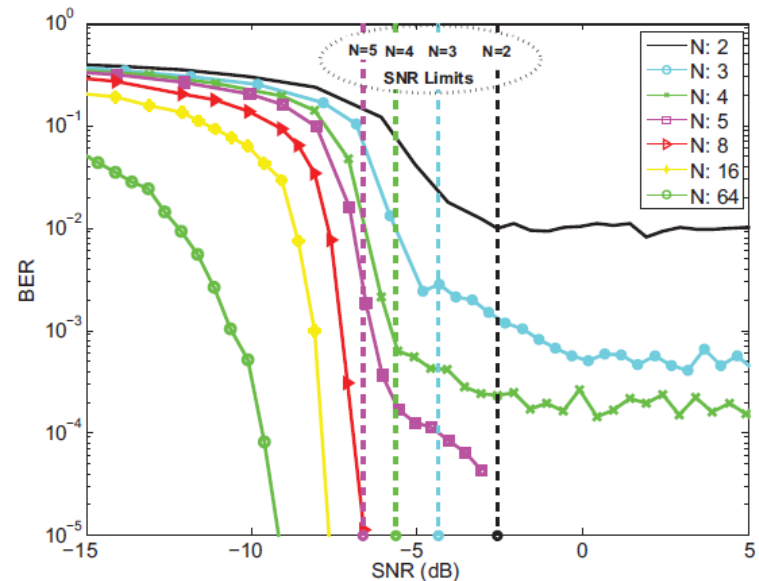
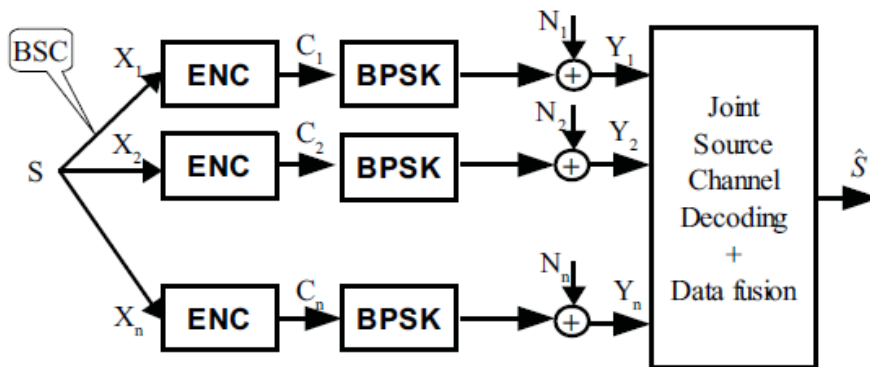
Interference Reduction



A. Razi, A. Abedi, "[Interference Reduction in Wireless Passive Sensor Networks Using Directional Antennas](#)," *IEEE/CANEUS Fly By Wireless Workshop*, June 2011, Montreal, QC, pp. 83-86. **(Best Paper Award)**

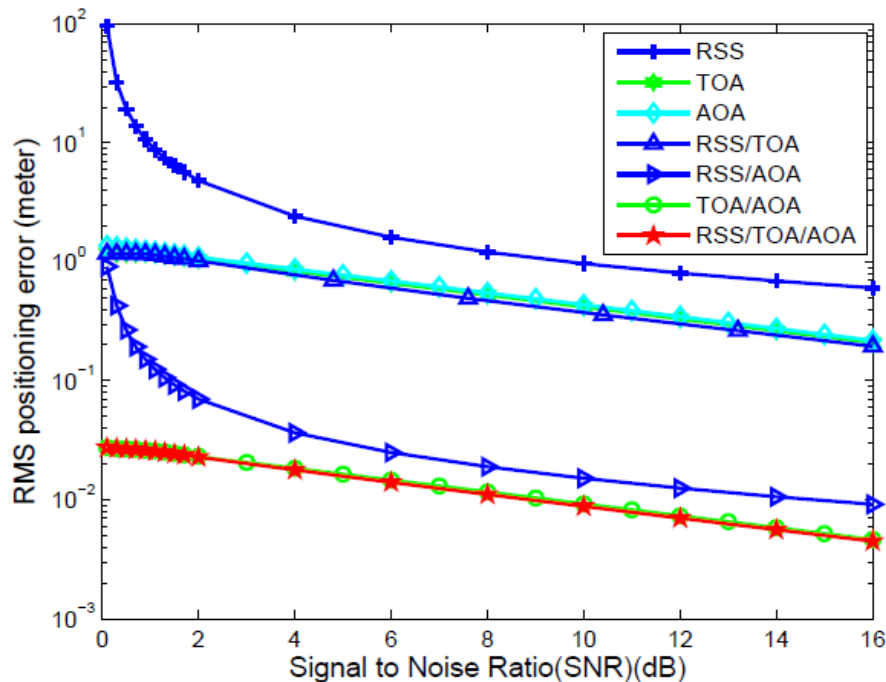
Reliable Estimation

- * How many sensors are required for reliable estimation?



A. Razi, K. Yasami, A. Abedi, "[On Minimum Number of Wireless Sensors Required for Reliable Binary Source Estimation](#)," IEEE WCNC'11, March 2011, Cancun, Mexico.

Hybrid Wireless Localization

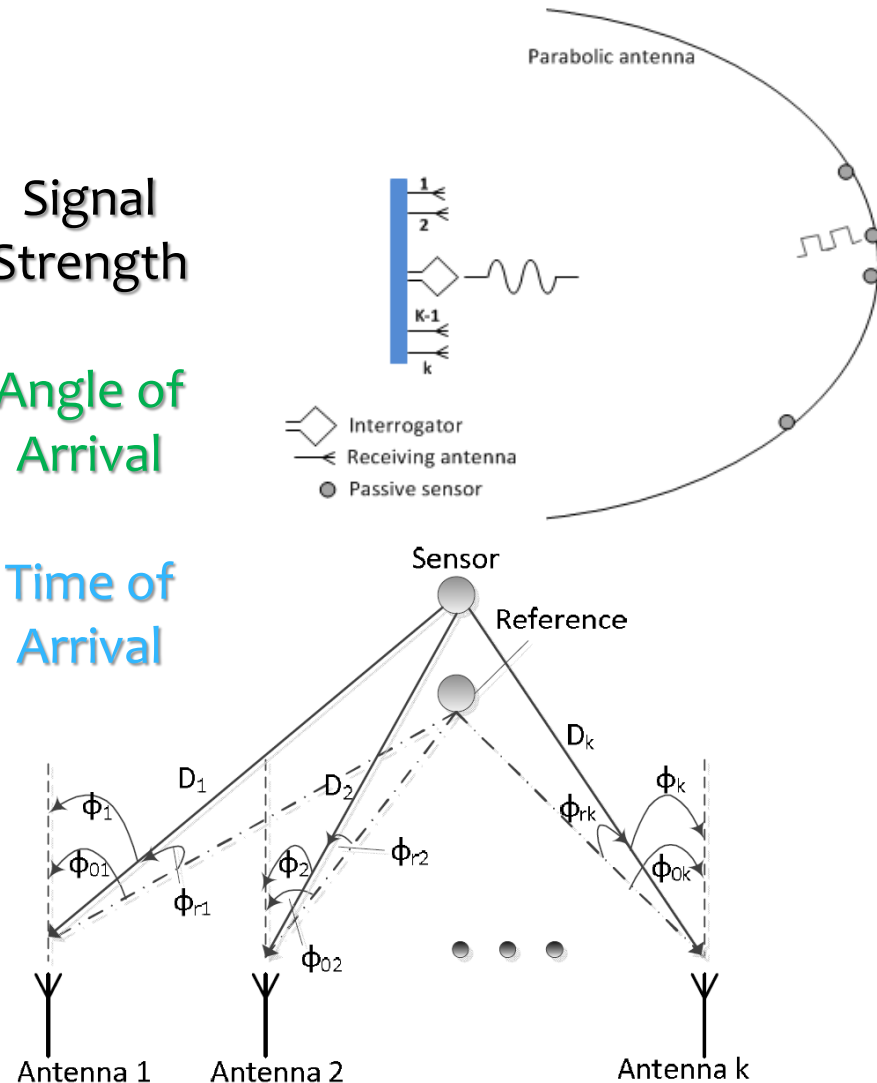


Joint work with Dr. R. Romanofsky
NASA GRC

Signal
Strength

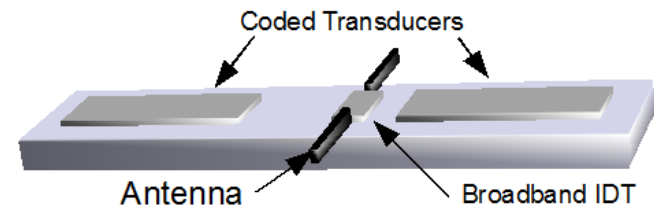
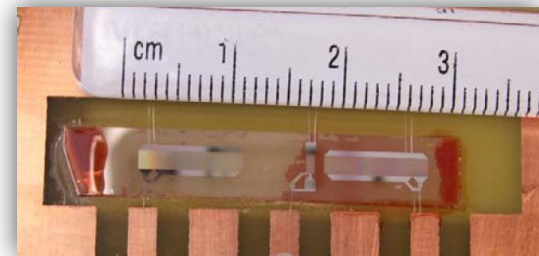
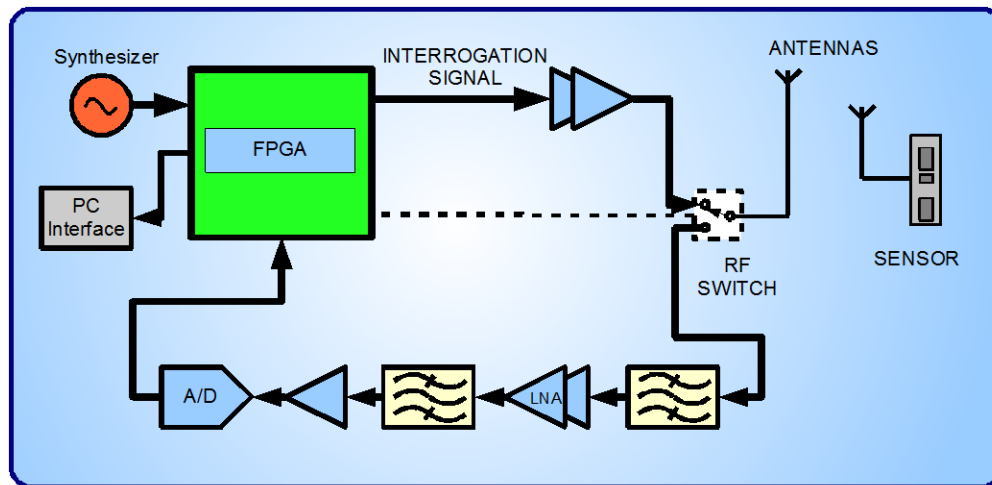
Angle of
Arrival

Time of
Arrival



Location and Temperature Sensors

- * Joint work with Dr. M. P. da Cunha, UMaine
- * Designed and built at UMaine
- * 107 MHz, 18 ft range



Acknowledgements

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- * Collaborators:
 - * JSC: Dr. P. Fink, Dr. R. Barton
 - * GRC: Dr. R. Romanofsky
 - * JPL: Dr. D. Divsalar
 - * LaRC: W. Cy Wilson
 - * SPX: K. Cozad

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