Ultra-low-power Angle-of-Arrival Estimation Using a Single Antenna

Nakul Garg, Nirupam Roy
University of Maryland College Park

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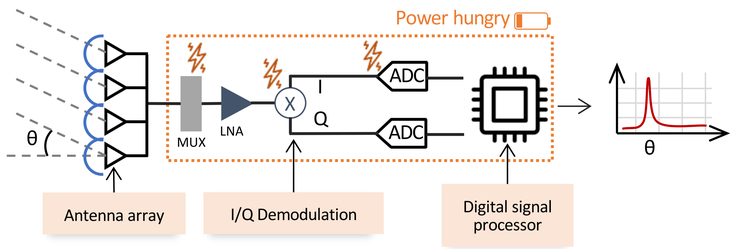
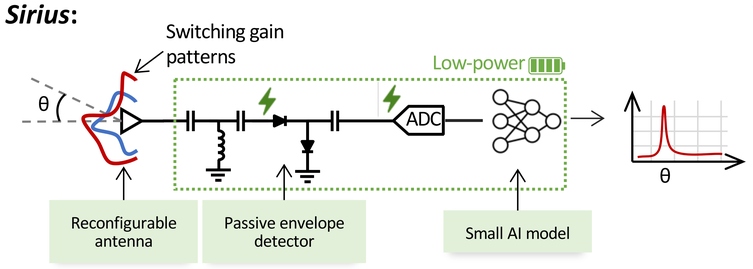
Overview

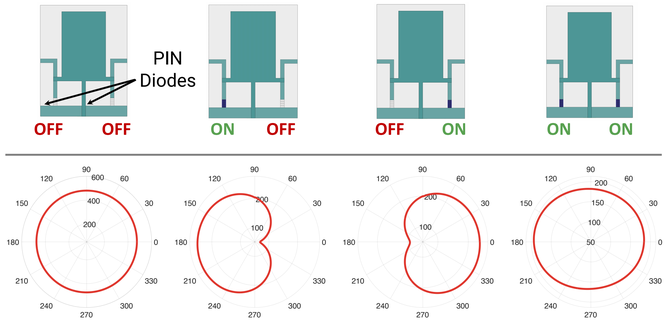
Traditional antenna array approach:

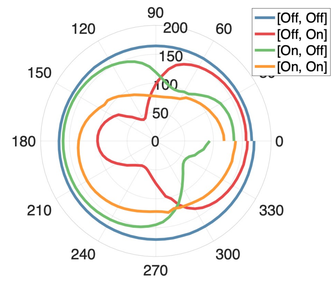


***Sirius*:**

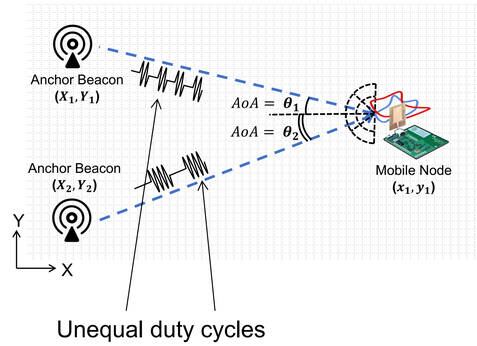


Low-power Reconfigurable Antenna

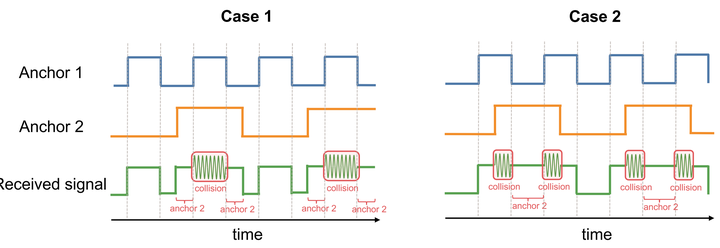


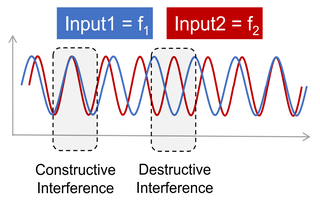


Collision Detection

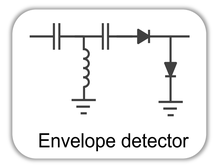


Beacon Identification Algorithm

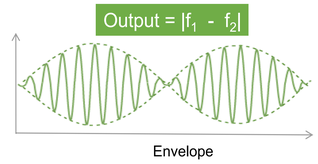




$$y(t) = A_1 e^{j2\pi f_1 t} + A_2 e^{j2\pi f_2 t}$$

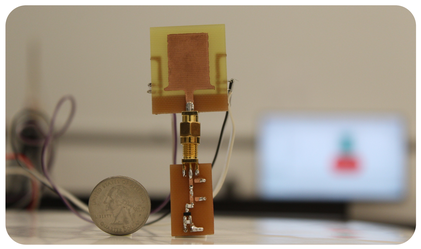


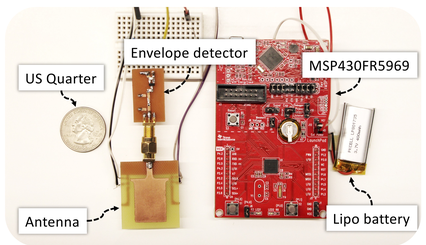
$$y_{env}(t) = |y(t)|$$

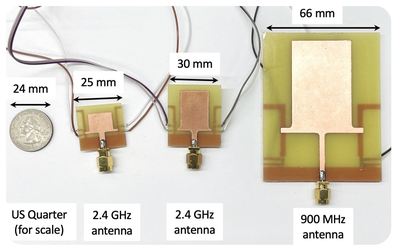


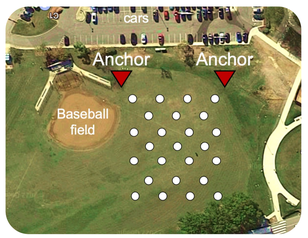
$$y_{env}(t) = A_1^2 + A_2^2 + 2A_1A_2cos(2\pi(f_1 - f_2)t)$$

Implementation

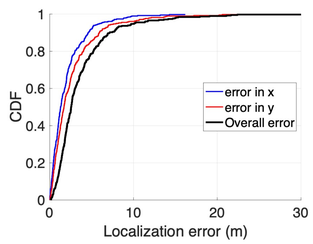


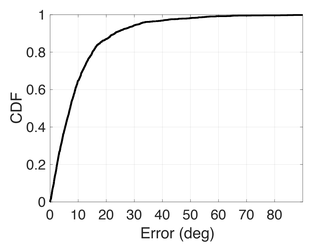


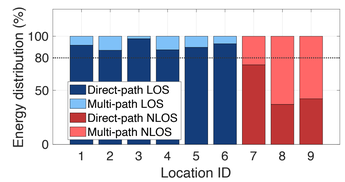


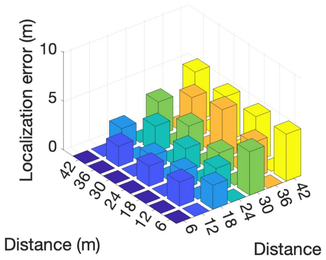


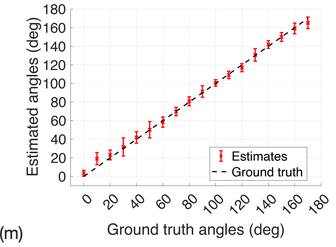
Evaluation

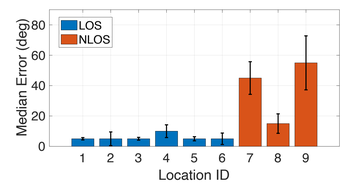












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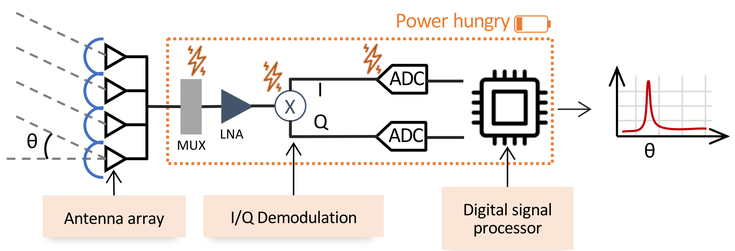
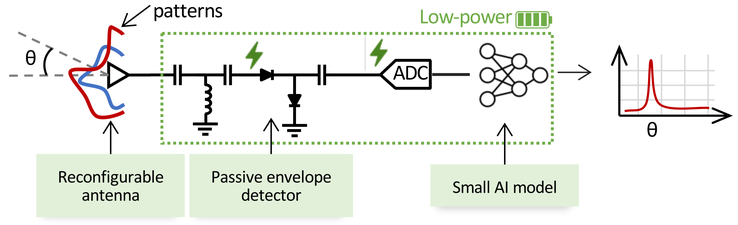
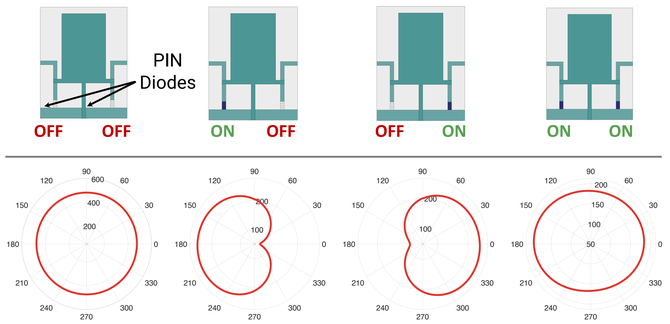


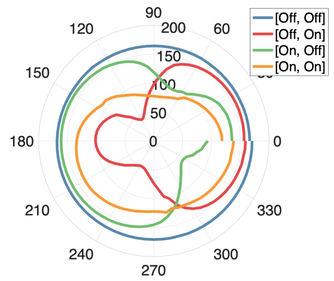
Sirius:

Switching gain

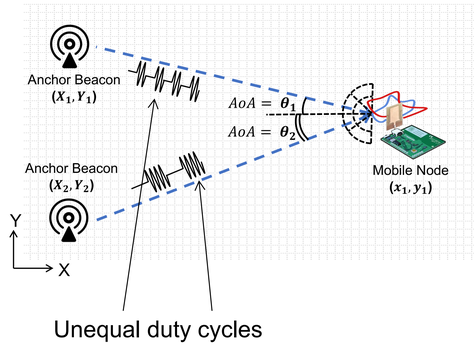


Low-power Reconfigurable Antenna





Collision Detection



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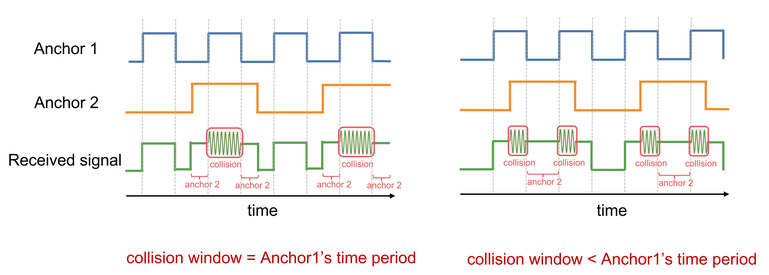
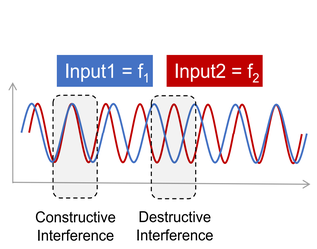
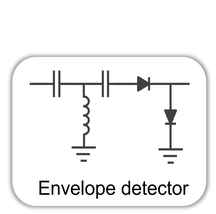
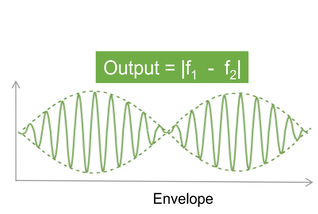
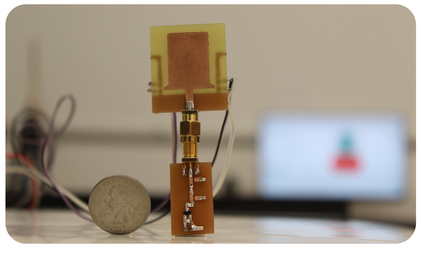


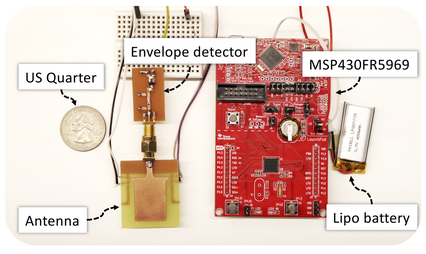


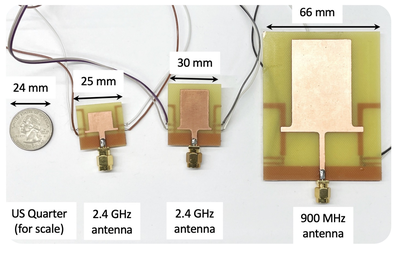


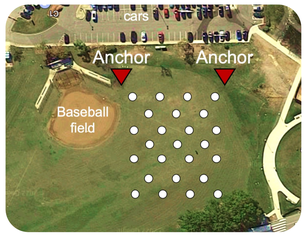


Implementation









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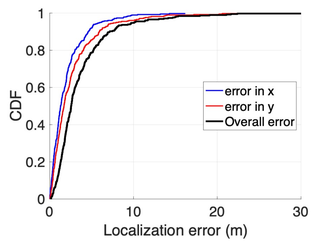

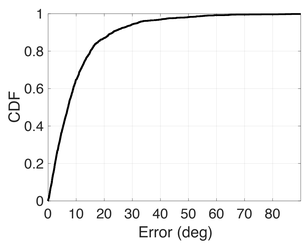

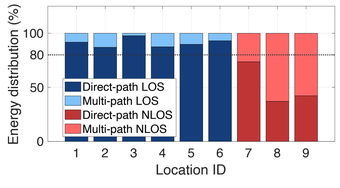

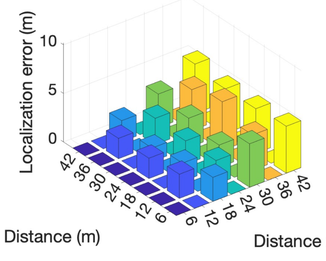

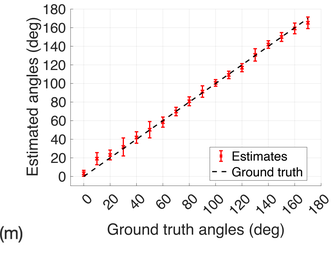

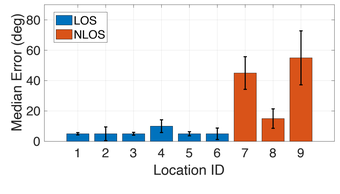

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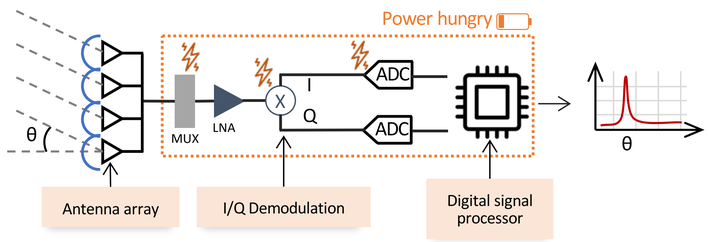

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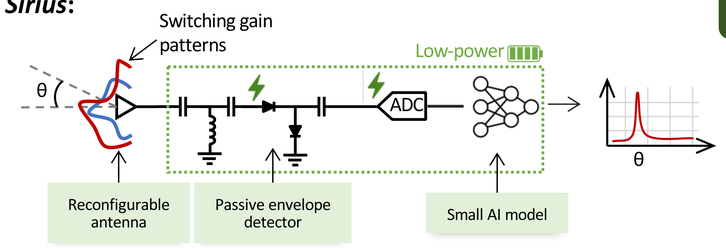
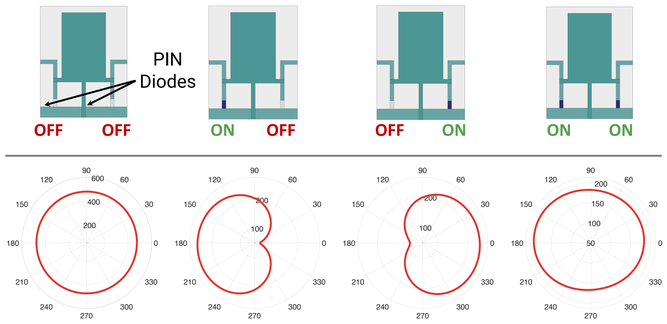
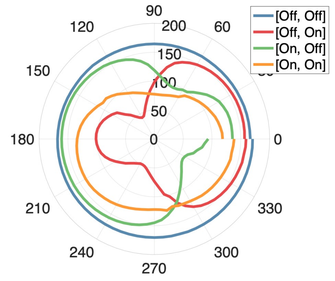
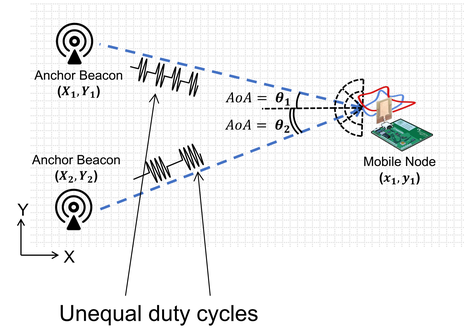


Reconfigurable Antenna

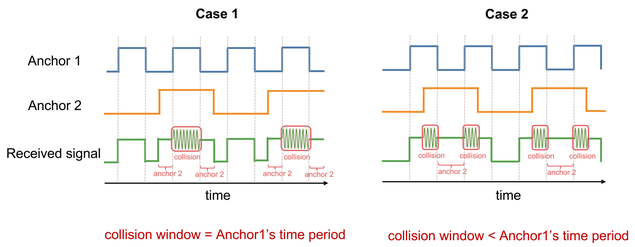




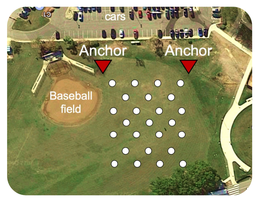
Collision Detection

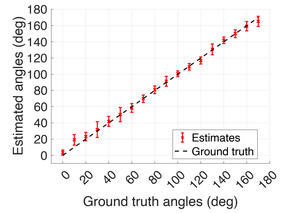


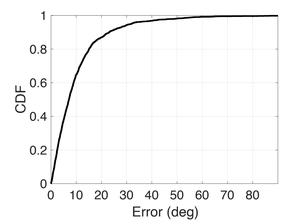
Anchor Identification

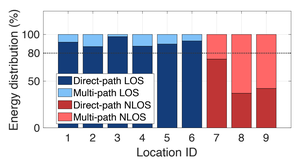


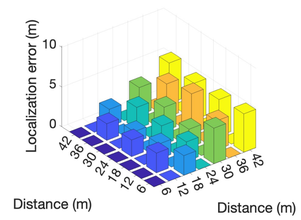
Evaluation

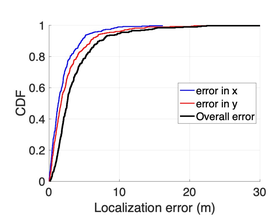


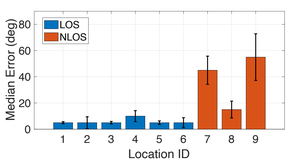




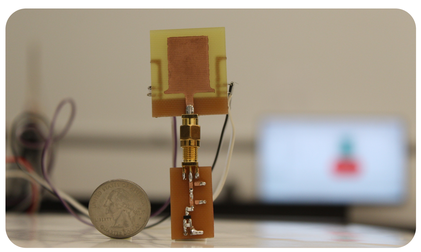


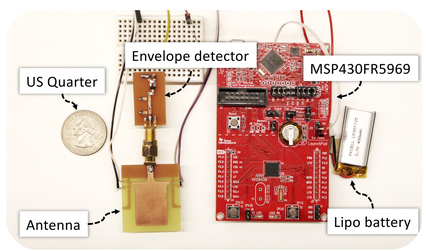


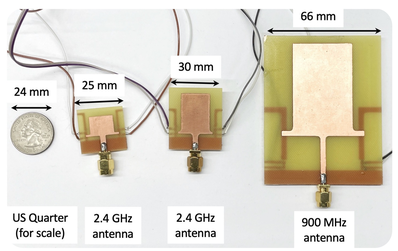




Prototype







Applications

Precision Farming

Wildlife Monitoring

Asset Tracking

Climate Sensing

Space Localization