Staggered Pattern Charge Collector Design and Optimization

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Introduction

- RFID Backscatter Radio Overview
- RF Energy Harvesting Overview
- Staggered Pattern Charge Collection
  - Gain Patterns
  - IPCG Optimization
  - Design Equations
  - Experimental Results
- Conclusion and Future Plans
RFID Backscatter Radio

Limitations of Passive Backscatter Systems

• Wireless power to tag – RF energy harvesting
• Signal-to-noise ratio at reader – reflected wave back to reader

Frequencies

• 915 MHz
• 2.4 GHz
• 5.8 GHz
RF Energy Harvesting

\[ P_r = \frac{P_t G_t G_R(\varphi_i, \theta_i) \lambda^2}{(4\pi R)^2} \]

\[ P_{DC} = \eta_{EH} (1 - \Gamma^2) P_r \]
\[ AG = \max(G_1, G_2) \]

\[ IPCG = \int_{\text{RW}} AG(\theta, \varphi) \]

Phase Shift Between Sub–Arrays = 120 degrees

Main beam of Sub-array 1

Main beam of Sub-array 2
Optimized For IPCG

Comparison of IPCG for a Patch and the SPCC

Phase Difference Between Arrays (degrees)

IPCG

- Single Patch
- SPCC
Design Equations

\[ x_1 + x_2 = \frac{\lambda}{2} \]

\[ \Delta \phi = \frac{2\pi f}{\nu_p} (x_1 - x_2) \]
Experimental Results

DC Voltage Out of CP (V)

Angle (degrees)
Conclusions/Future Work

- SPCC improves gain without losing beamwidth but uses more footprint space
- N-by-N SPCC cases for higher gains
- Need improvement with matching to energy harvesting circuitry
Questions