Staggered Pattern Charge Collector Design and Optimization

Blake R. Marshall

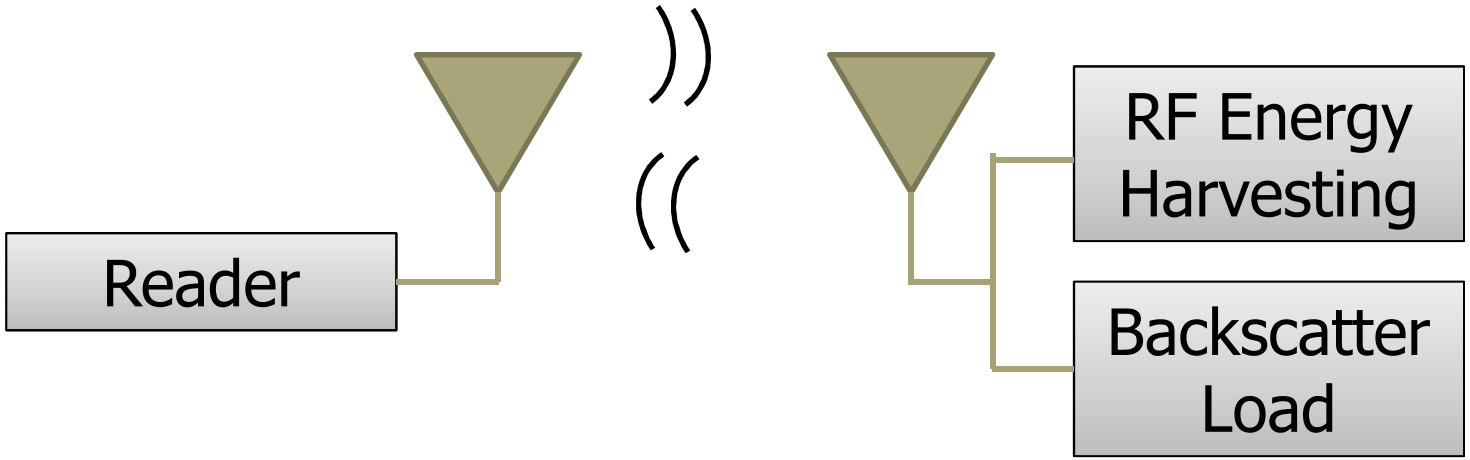
Prof. Gregory D. Durgin

Georgia Inst. Of Tech.

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



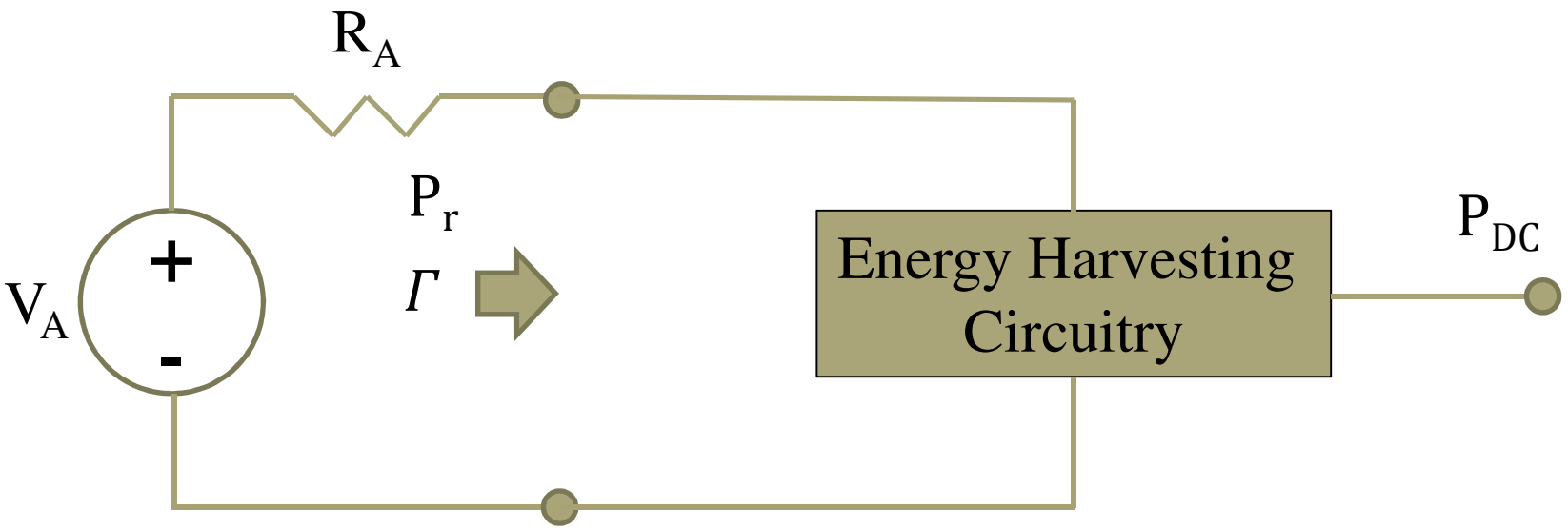
Limitations of Passive Backscatter Systems

- 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



Only possible improvement on tag for link budget

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

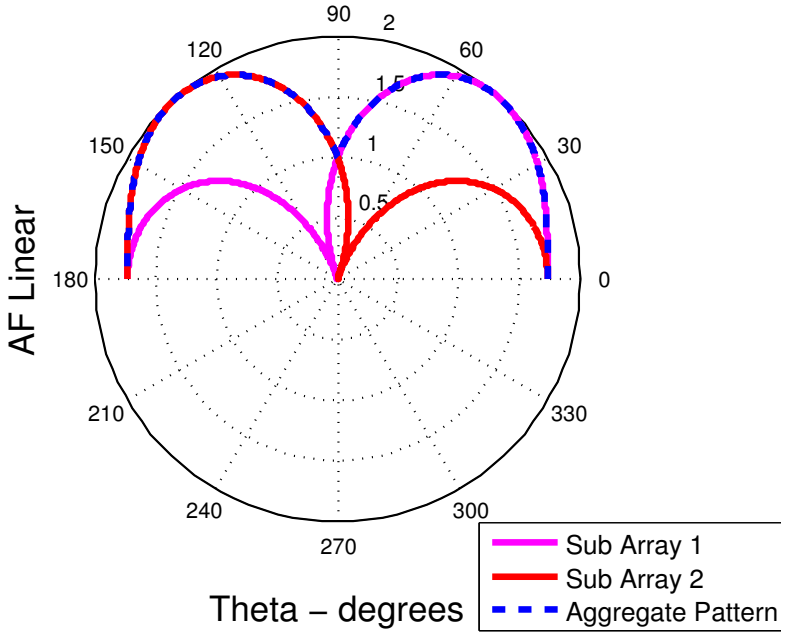
$$P_{DC} = \eta_{EH}(1 - \Gamma^2) P_r$$

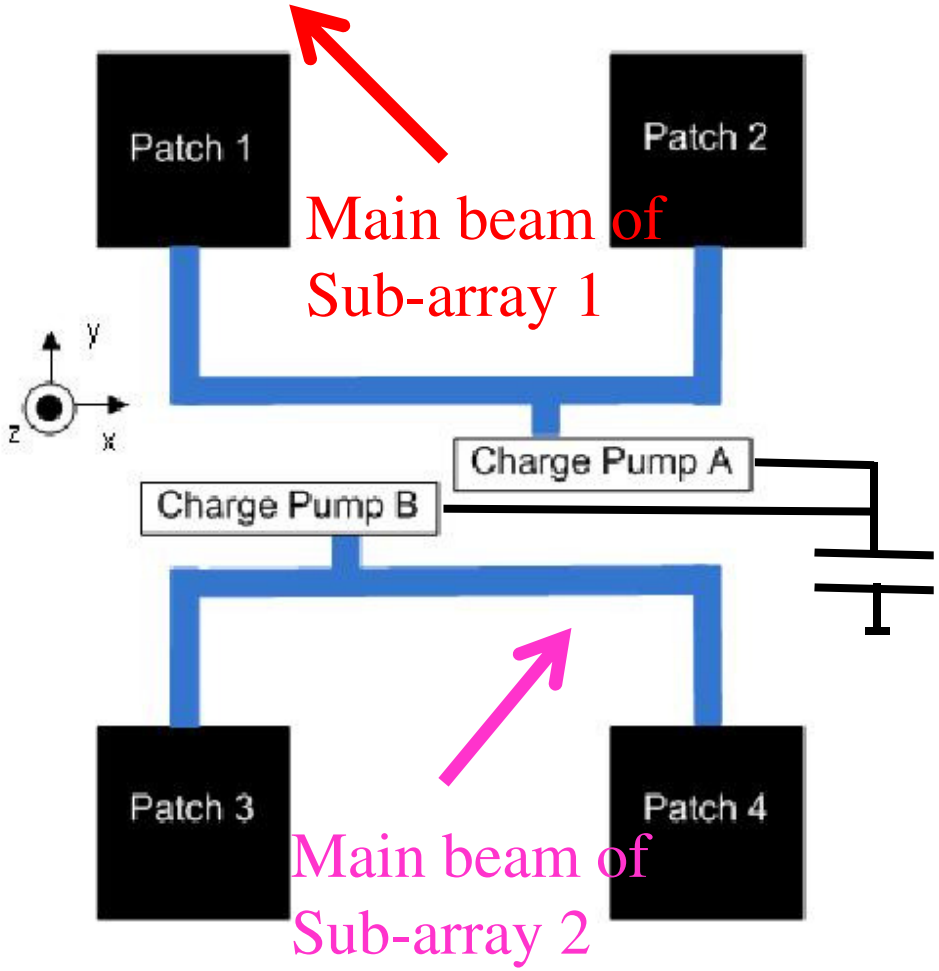
2x2 Staggered Pattern Layout

$$AG = \max(G_1, G_2)$$

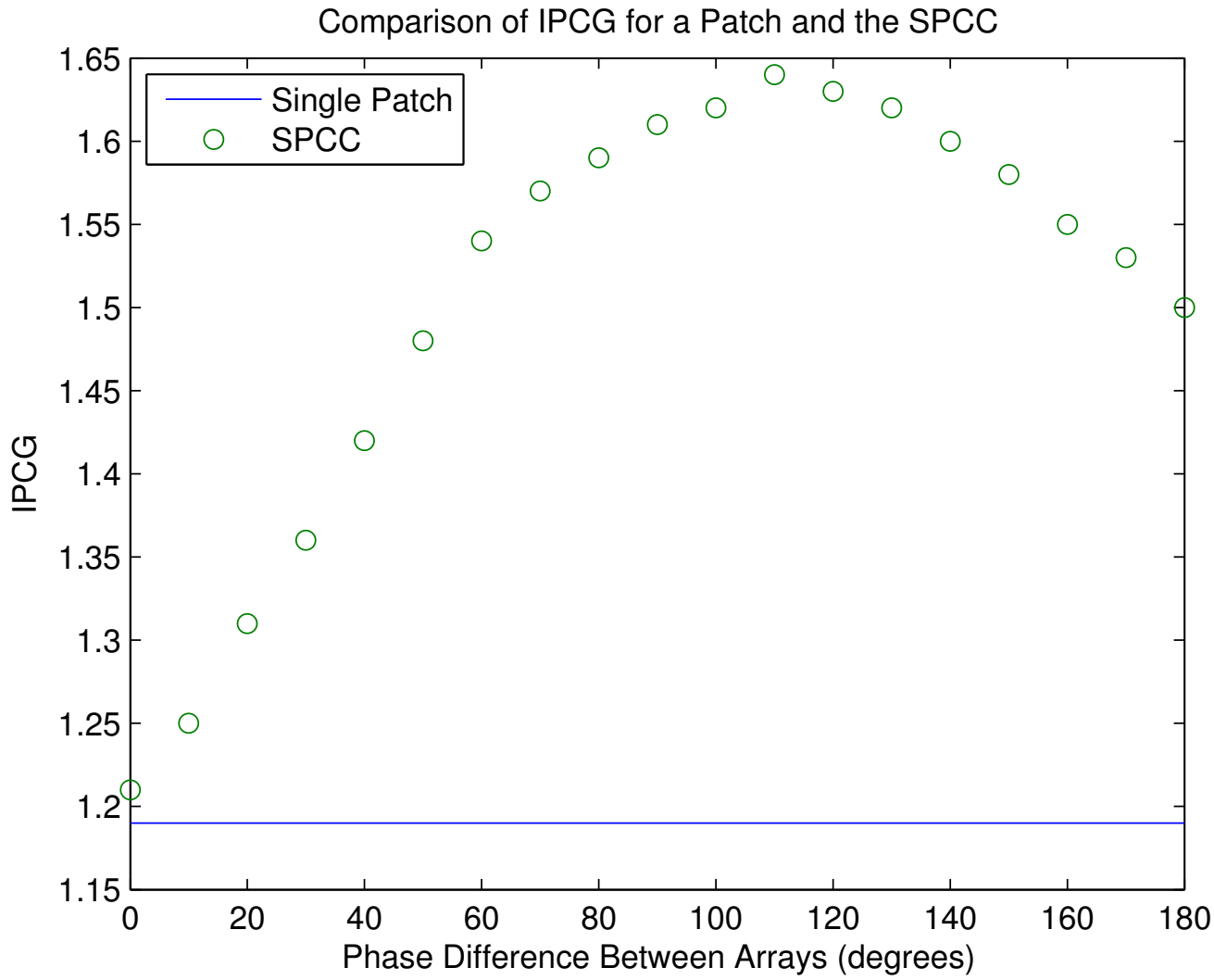
$$IPCG = \int_{RW} AG(\theta, \varphi)$$

Phase Shift Between Sub–Arrays = 120 degrees





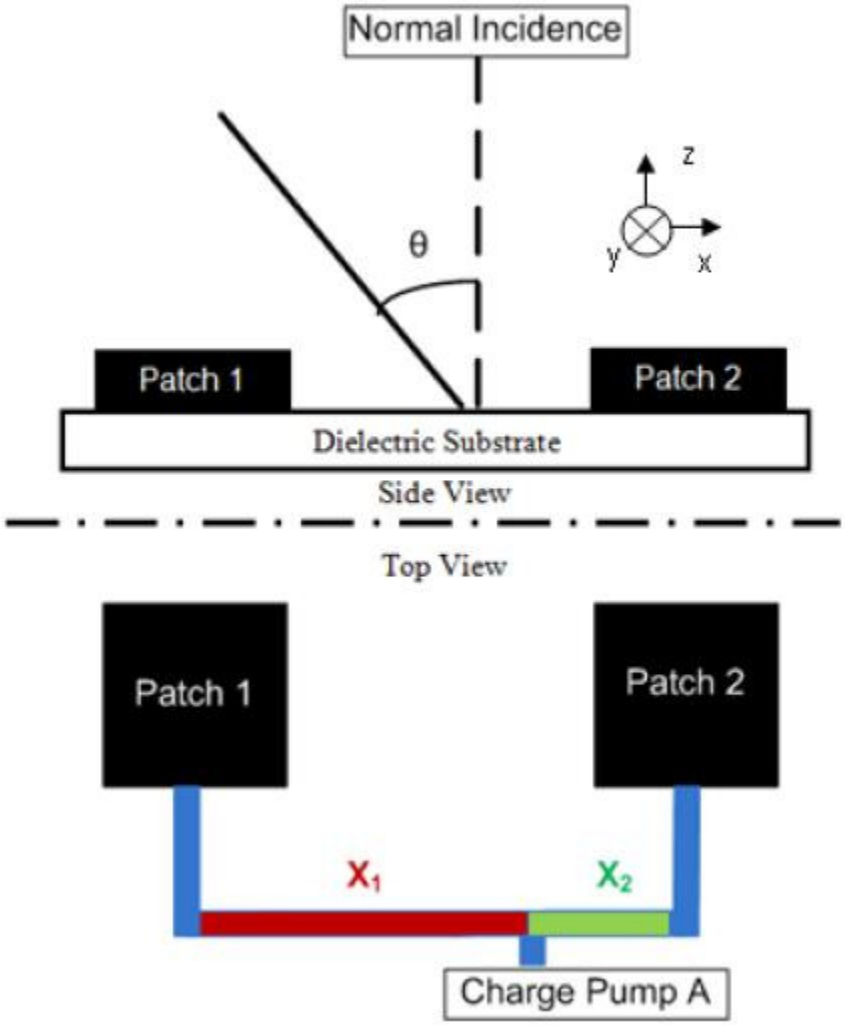
Optimized For IPCG



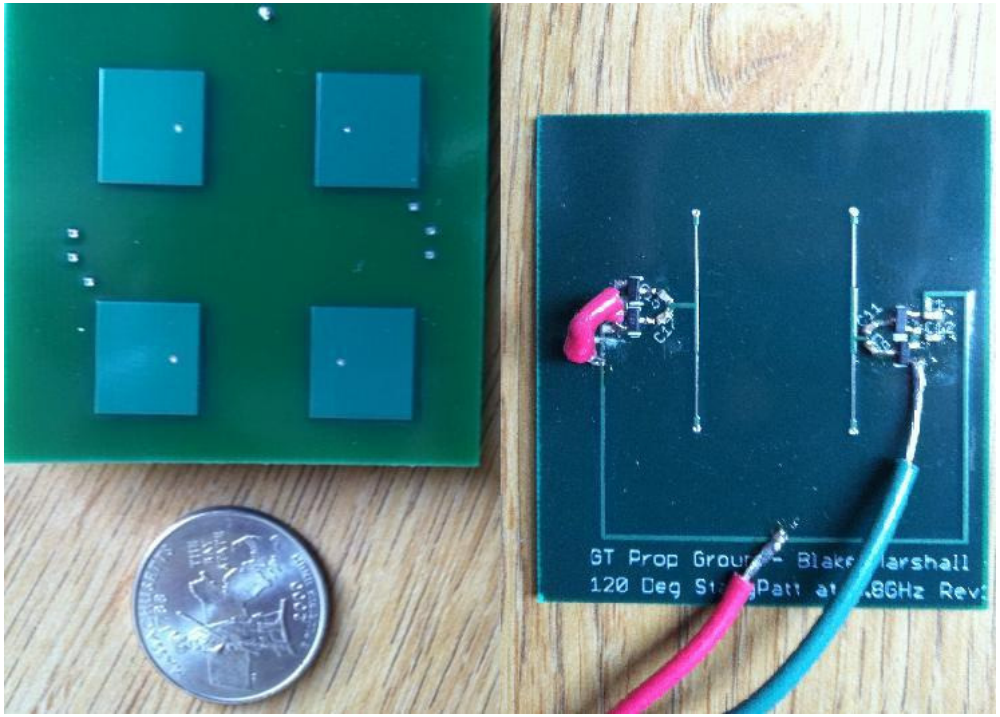
Design Equations

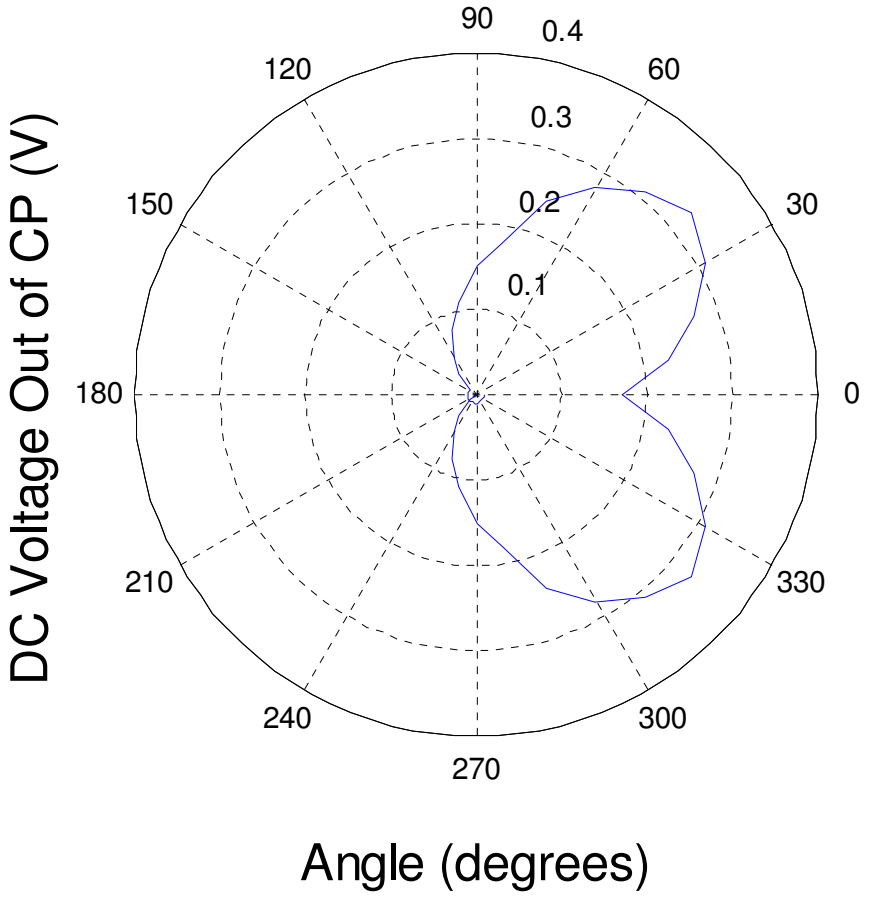
$$x_1 + x_2 = \frac{\lambda}{2}$$

$$\Delta\phi = \frac{2\pi f}{v_p}(x_1 - x_2)$$



Experimental Results

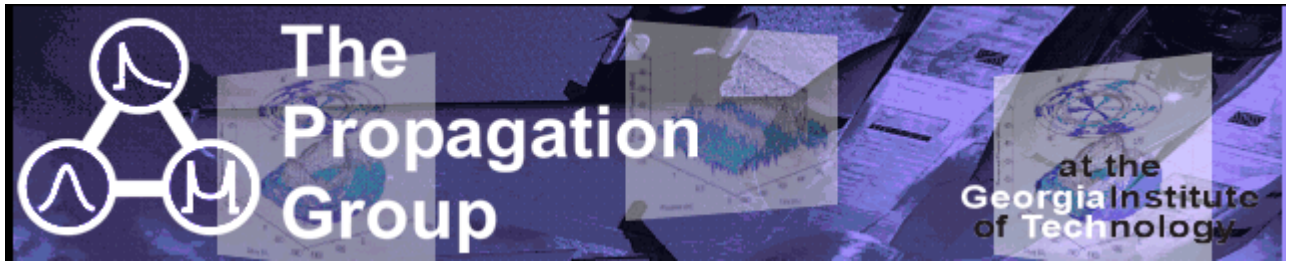




Conclusions/Future Work

- 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?



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