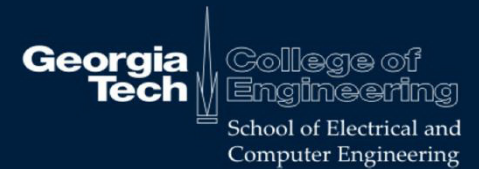


Staggered Pattern Charge Collector Design and Optimization



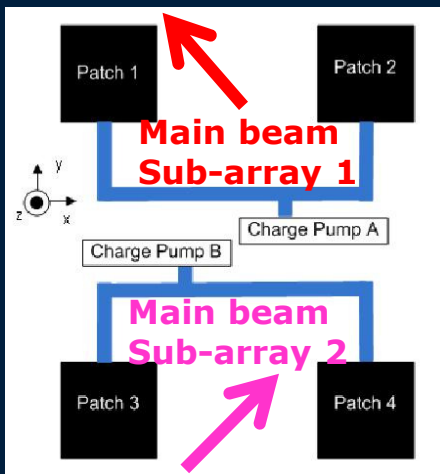
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1. Problem

- Long range RFIDs can not use inductive coupling to power passive tags
- RF energy harvesting is useful for longer range RFID but very inefficient

4. What is an SPCC?

- The SPCC is a group of sub-arrays that are steered in different directions for energy harvesting benefits
- For the 2-by-2, two sub-arrays are steered opposite from each other as shown below



2. Hypothesis / Goal

- The use of the staggered pattern charge collector can increase the power into energy harvesting circuitry without losing effective beamwidth

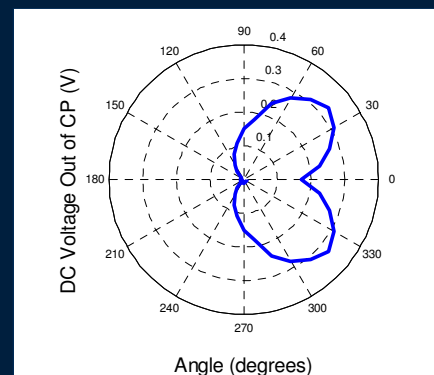
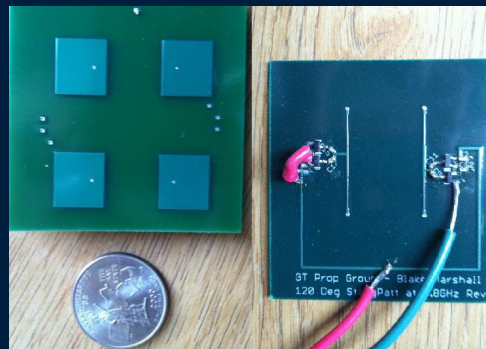
3. Energy Harvesting Model



Only possible improvement on tag for link budget

$$P_r = \frac{P_t G_t G_R(\varphi_i, \theta_i) \lambda^2}{(4\pi R)^2} \quad P_{DC} = \eta_{EH}(1 - \Gamma^2)P_r$$

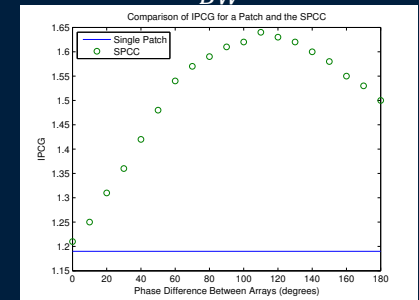
5. 2-by-2 SPCC Hardware/ DC Voltage Pattern



6. IPCG Optimization

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

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



7. Conclusions

- The SPCC is an effective technique to get more power to the energy harvesting circuitry
- Matching to the energy harvesting circuitry can be difficult and should be improved

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- [3] Stutzman W.L. and Thiele, G.A. "Antenna theory and Design." John Wiley and Sons, 1998.