

1. **Research Title:** "Signal Processing Techniques for Simultaneous Transmit and Receive (STAR)"
2. **Individual Sponsor:**
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3. **Academic Area/Field and Education Level:** Electrical/ Computer Engineering / Digital Signal Processing (MS/PhD level)
4. **Objectives:** Investigate signal processing algorithms realizable in digital hardware for providing 40 dB or more of cancellation of one or more narrowband and wideband (500 MHz or greater) transmitted waveforms present in a wideband digital receive chain. Implement algorithms in hardware and perform demonstrations with an AFRL-provided STAR testbed on the bench and in an antenna test range. Devise new and innovative techniques for STAR using various analog/digital components.
5. **Description:** The proposed project will investigate signal processing algorithms that can be used for STAR applications. AFRL is primarily interested in digital signal processing techniques that enable STAR, but analog techniques that support the digital processing are also encouraged. AFRL will provide a hardware testbed for experimentation which includes items such as an L-band multi-element antenna, circulator, A/D and D/A converters, FPGAs, and other components. STAR algorithms developed under this effort must be realizable in FPGA hardware and fit within the constraints (e.g. number of filter taps) of the provided hardware. In addition, the algorithm must be robust to performance variations in the RF components due to time and temperature, so calibration and characterization schemes must be developed. A sample concept is shown in figure 1 below.

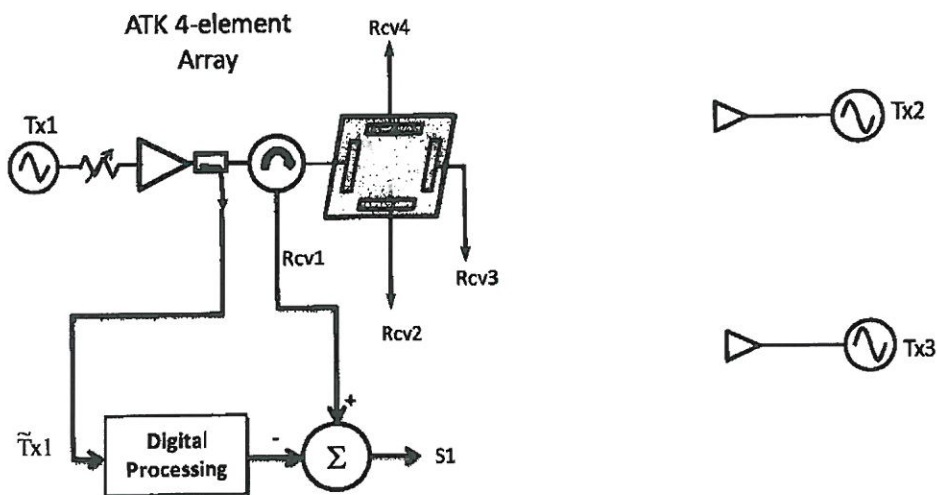


Figure 1: Sample Cancellation Concept

For this concept, a sample of the transmit signal $Tx1$ is coupled off and filtered so it can be subtracted from the receive port $Rcv1$. With the proper amount of cancellation (dependent on signal-to-noise ratio (SNR), the dynamic range of the ADC, bandwidth and other factors), the transmit signals $Tx2$ and $Tx3$ should be able to be received with a significant SNR improvement. The other receive channels, $Rcv2$, $Rcv3$, and $Rcv4$ should be able to cancel the coupled transmit signal from $Tx1$ in a similar manner. The application of such a concept could be the transmission and reception of multiple communications signals from a single antenna array. This research intends to advance knowledge in the signal processing portion of STAR.

6. **Research Classification/Restrictions:** This research has ITAR restrictions.

7. **Eligible Research Institutions:** Place an X in all that apply.

Universities (DAGSI) AFIT (only) USAFA

8. **Interest in Summer USAFA Cadet (Avg Cost for USAF Cadet for 33 days was \$5000):**

If you are submitting a topic for the USAFA, please indicate if you are also interested in sponsoring a USAF Cadet in summer of 2013