

Application of Digital Beamforming Techniques for Secure Non-Coherent Software Defined Radio (SDR) Communication Links

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An adaptive digital phased array beamforming system operating at 2.4 GHz is presented using a Direct Sequence Spread Spectrum Offset Quadrature Phase Shift Key (DSSS-OQPSK) with Low Probability of Intercept (LPI) of non-coherent signals. The setup consists of two N210 USRP equipped software radios with a total of four receiver channels and one X310 USRP software radio to transmit the DSSS-OQPSK LPI signal using a 2.4 GHz antenna array. The beamforming receiver steers in the direction of the target signal to increase the signal-to-interference-plus-noise ratio (SINR). This SINR increase is due to eliminating sources of interference from other directions. To determine the direction of the incoming signals, a direction of arrival (DoA) algorithm, such as MUSIC (**M**Ultiple **S**ignal **C**lassification), is employed for the beamforming operation. Notably, the transmitter is considered to operate dynamically and perform continuous DoA scanning with the goal to isolate and demodulate the signal of interest.

To execute the beamforming operation, a beam is crafted using weights (coefficients) applied digitally to each of the antenna array elements to create the desired beam(s). The beam serves as a spatial filter by finding the maximum return when sweeping through all possible angles of interest. The combination of angle of arrival determination algorithm, MUSIC and beam steering serve to optimize signal reception to achieve optimal SINR for the received in presence of interference sources. Figure 1 illustrates the communication link. Once the non-coherent signal arrives at the twin receiver daughter cards of the N210 USRP software radios, it is possible to achieve accurate phase synchronization across the four synchronized receiver channels streams. This synchronization is due to the sharing of the local oscillator channels across the two USRP daughter cards. Doing so, an accurate DoA algorithm is implemented. This algorithm was developed using GNU Radio blocks and custom hierarchal blocks coded in Python. At the meeting the details of the algorithm along with experimental data will be presented.

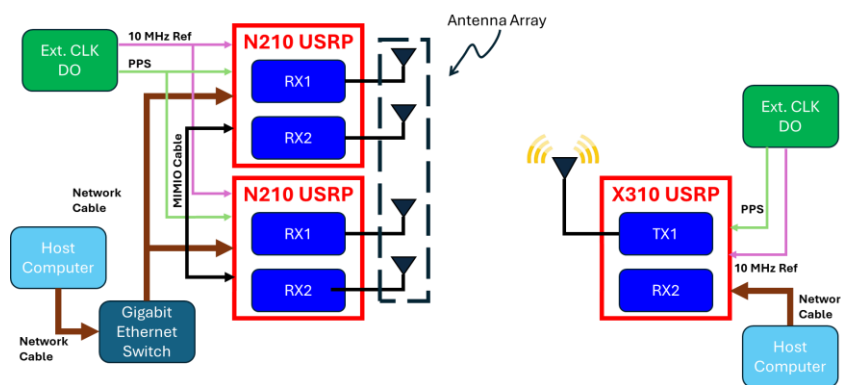


Figure 1. Communication Link

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