ELECTRONIC DESIGN LAB STAGE 1 EVALUATION REPORT
PROJECT: SINGLE CHANNEL FULL DUPLEX WIRELESS COMMUNICATION
Faculty in Charge: Prof. Nikhil Karamchandani, Prof. Kumar Appaiah

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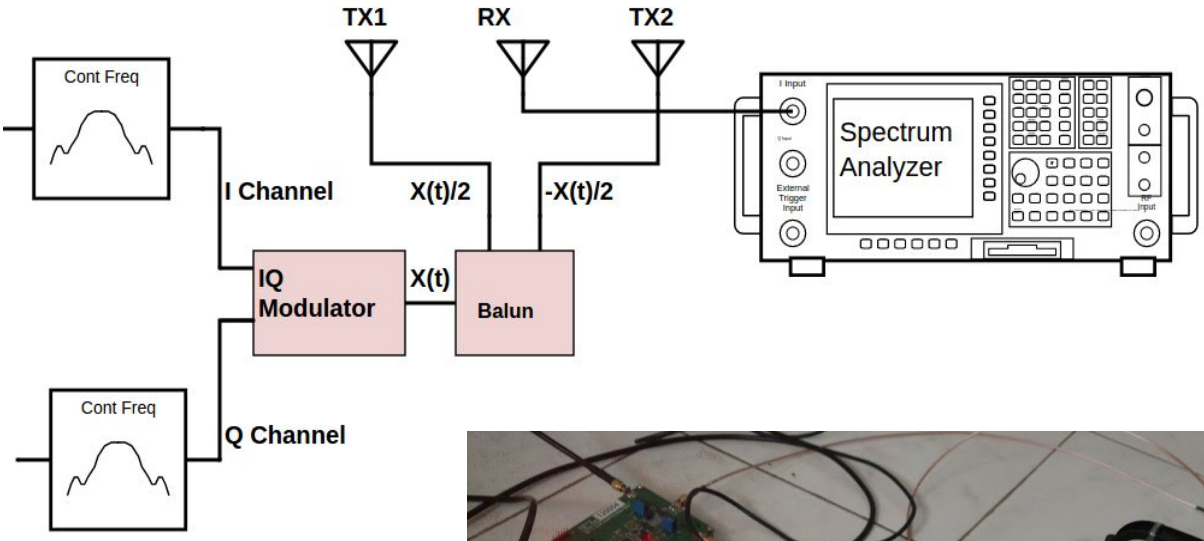
GROUP:DD 20

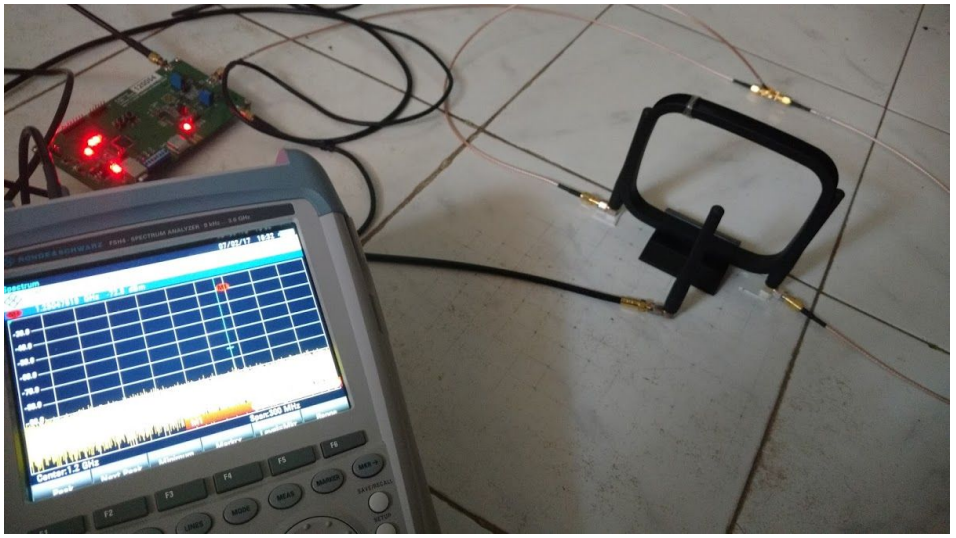
Project Aim:
Demonstrate single channel full duplex wireless communications using analog passive cancellation techniques and digital cancellation techniques and to achieve a cancellation in self interference signal of up to 40dBm.

Progress:
Completed: Hardware implementation of passive analog cancellation
Ongoing: Simulation of Digital Cancellation method on GnuRadio
Left: Hardware Implementation of Digital Cancellation

Experiment Setup:
Passive analog cancellation: Send Π phase reversed signal from another antenna using Balun and achieving cancellation at the receiver by placing it at a location of minimum self interference (along perpendicular bisector) in this case.



[Working Demo Video]



Results:

Data : Receiver moved in the X-Y plane and plotted vs received power (in dBm) (z axis)
Transmitters located at (0 cm,0 cm) and (12 cm,0 cm)

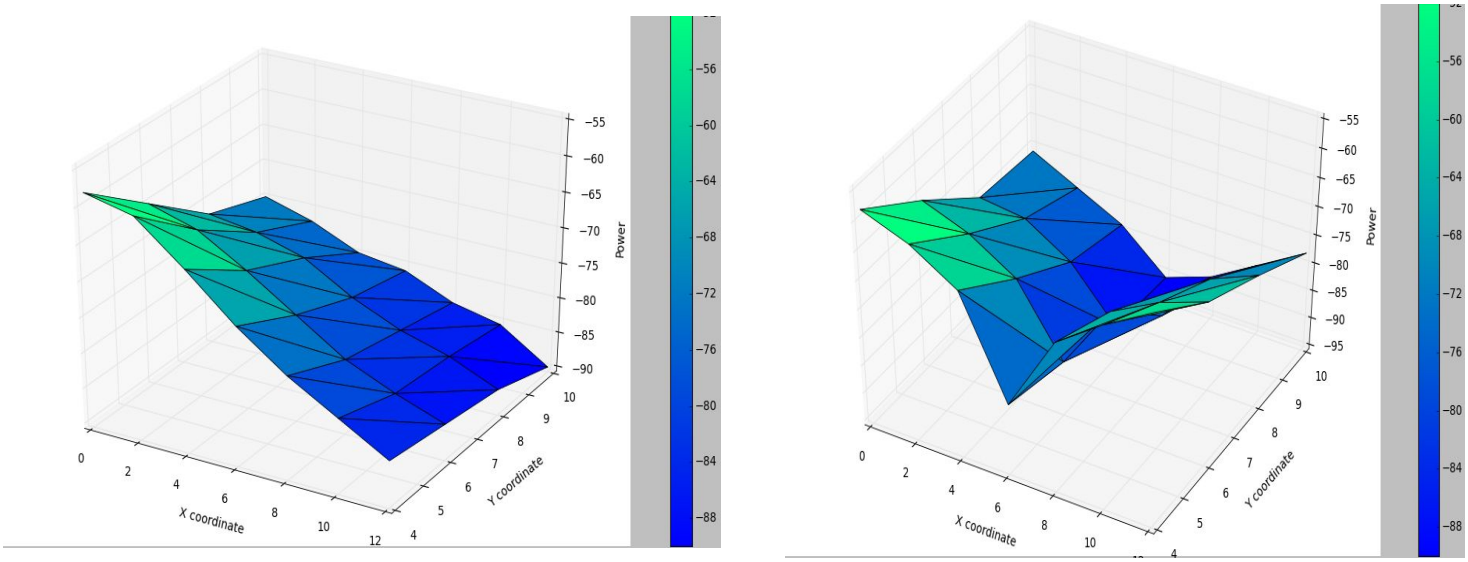


Fig 1: *a) Power received due to one transmitting antenna [1]*
b) Power due to 2 transmitting antennas with 2nd antenna transmitting phase reversed signal [2]

Two phenomena can be observed here: i) Attenuation of transmitted signal with distance
ii) self interference cancellation due to Π phase shifted signals
We can clearly see that there is maximum cancellation of self interference signal close to the **line perpendicularly bisecting** the 2 antennas. Hence we place the receiver here. We observe **~ 12 dBm** cancellation using passive analog cancellation technique

Challenges faced:

- Directivity of monopole antennas were centered at 1.25GHz and these also had low bandwidth, work best when transmitted at 1.25GHz. But, the IQ modulators were centered at 1.12 GHz. This was found by testing antennas via impedance matching upon suggestions of Prof. Shevgaonkar and Antenna Lab RA's, and was a **critical factor** which improved the design.
- Familiarization with the spectrum analyzer to measure received signal power and test Balun
- Using equal length connecting cables to both antennas to avoid relative phase changes

Future Work:

As indicated in proposal, we plan on demonstrating cancellation using RTL+GNURadio & DSP+Rx antenna (Rough) in second evaluation, and final collaboration of both the techniques in third evaluation. If time pertains, we will try our hands on analog active cancellation.
To ramp up for our next task, we've already started coding in gnuradio for simulation purposes and have fixed upon the ICs we will be using for our downconverting and interfacing with PCBs.