Distributed FM Radio System
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Goal

- Successfully establish a radio system where receivers connect to a centralized server.
  - Server will relay data from clients (radios) receiving a strong signal to those clients receiving a severely degraded one.
- Minimize the time a client is not obtaining any useful data.

Methodology

- Using a series of TCP communications between server and clients, we can configure a network of mutually beneficial radios. The communication protocol is shown in Fig. 1.1.
  
  ![Server Client Communication Protocol](image1)

  **Figure 1.1.**

- Server processes the SNRs calculated by the clients to determine whether a client is receiving sufficient signals. The state diagram of the server is shown in Fig. 1.2.

  ![Client Structure](image2)

  **Figure 1.2**

- Successfully establish a radio system where receivers connect to a centralized server.
- Minimize the time a client is not obtaining any useful data.

Objectives

- Design a Universal Software Radio Peripheral (USRP) network of receivers where each USRP is a client.
- Calculate signal-to-noise ratio (SNR) from received data and transfer these values from client to server.
- Create a multi-threaded TCP server to relay data from USRPs with strong SNR to those with weak SNR.

Research Challenges

- Learn to use LabVIEW and interface it with USRP.
- Format data to be sent over TCP in a manner that is suitable for USRP.
- Determine an effective way to calculate SNR from captured data.

References

[1] https://decibel.ni.com/content/docs/DOC-23110
[2] https://decibel.ni.com/content/docs/DOC-25893

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Results

- Observed the linear relationship between the received signal power with noise and the transmitted power as shown above.
- Set up the streaming network to accept multiple received signals from USRPs and send higher quality signal to all receivers.

Future Work

- Make the system more autonomous so when SNR returns to a good value the server will cease to send data.
- Improve streaming process by switching to UDP protocol so the transition between the server and the client is seamless.