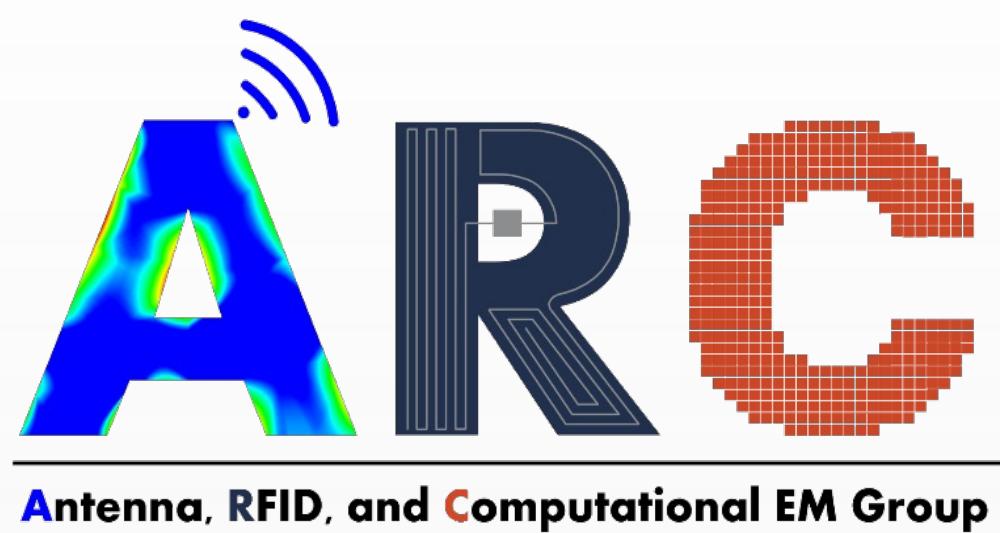


Hardware and Software Development of Antenna Characteristics Demonstration Module



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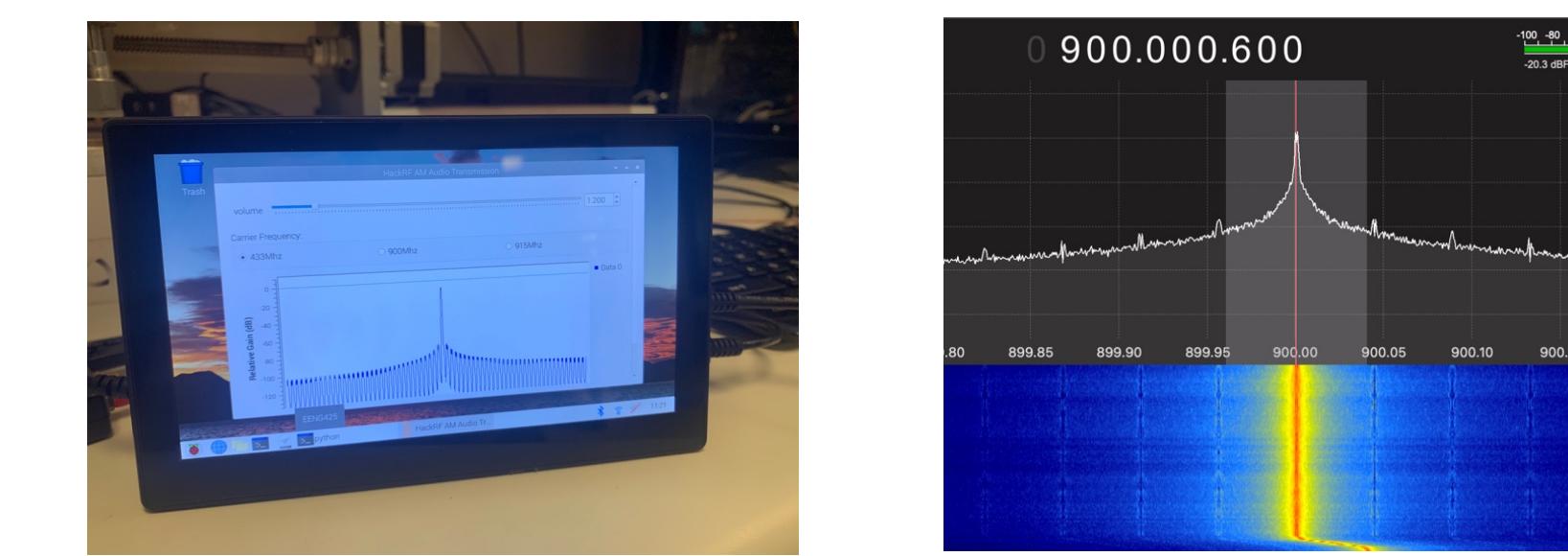


Introduction

- The relative positioning of a pair of transmitting and receiving antennas has a significant effect on the received signal strength.
- Antenna position, orientation, and polarization affect the strength of the received signal.
- There is a reduction in power density of an electromagnetic wave as it propagates through space.
- The way these factors change the signal strength can be challenging for students to understand and to visualize from mathematical equations and static illustrations alone.
- This project aims to create an interactive demonstration that shows these effects in real time with easily manipulatable antennas and intuitive graphical interface.

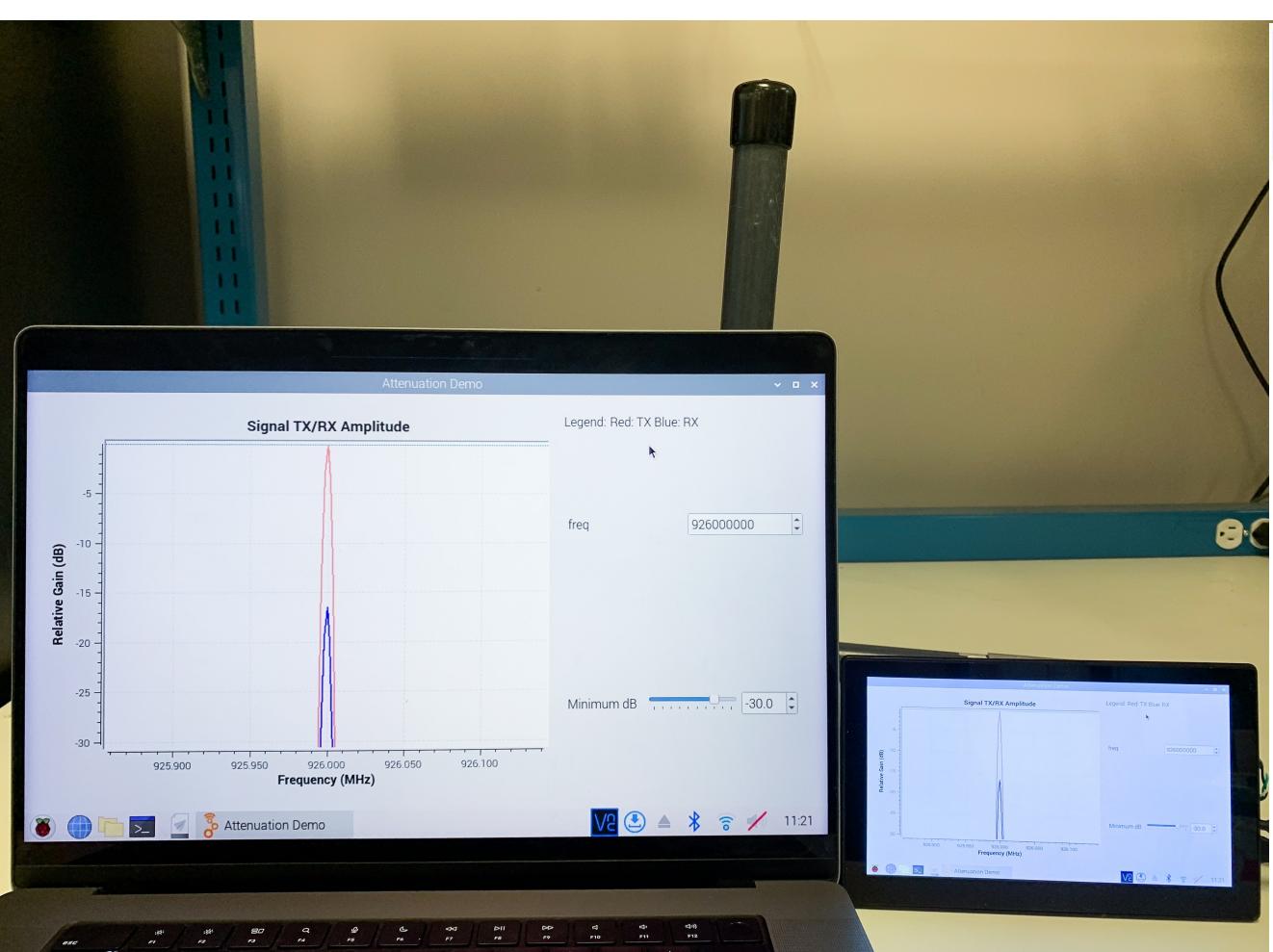
Hardware Development

- The final developed module consists of:
 - ADALM-Pluto SDR (Transmits and receives signal)
 - Raspberry pi 4
 - All in one touch screen display
 - 20,000 mAh battery pack
 - 3D printed stand
- First Iteration:
 - A HackRF SDR transmits AM audio and an RTL-SDR receives the signal
 - During the first demonstration it was difficult to identify the received signal gain because the amplitude of the transmitted audio signals varied with time



Software Development

- A virtual network computer (VNC) connection is used to allow for larger display for class demonstrations [4]. (pictured left)
- The Software driving the ADALM-Pluto SDR is GNU Radio (flowgraph pictured right)
 - The program transmits a tone at a user-defined frequency.
 - That signal is then received by the receiving antenna and the relative signal strength can be seen based on polarization, position, orientation, and frequency.



Conclusion and Future Work

- This second iteration is a proof-of-concept hardware unit, minimizing software setup
- Immediate next steps for this project are to attempt to adapt the software setup to make it compatible with Windows and Mac operating systems.
- Future version would not need remote desktop software to access the Raspberry Pi and would run on the teaching laptop directly.
- This would eliminate the need for the Pi and battery, slimming the unit down to just the SDR and the pair of antennas.

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References

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