Design and Implementation of Digital Synchronous Detector for Microwave Radiometer

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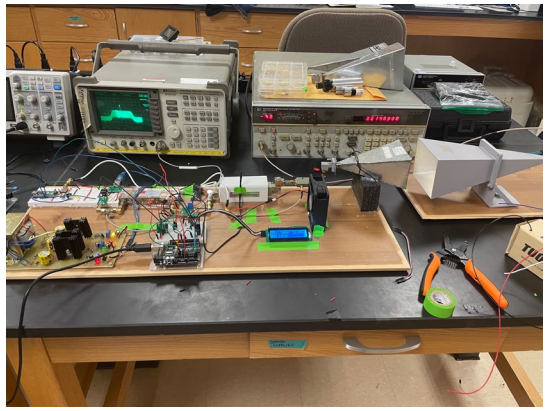
Objectives

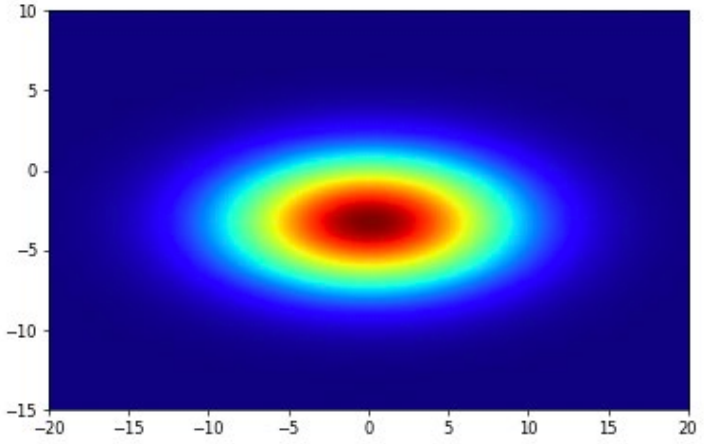
- Detect water vapor microwave signal in the atmosphere
- Implement firmware to perform digital demodulation on board
- Develop python interface to monitor and record data output from device



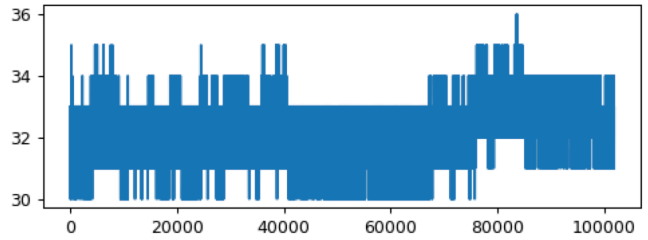
Results

- Sampling rate at 2.08kHz and analog read rate of 16.67kHz to produce output at 100Hz
- Observed difference in output signal. Signal collected during light rain has less variation compared to signal collected during heavy rain.

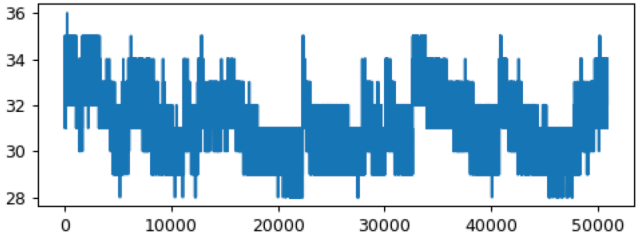
2D scan result of the simulated signal source



Light Rain Observation Results



Heavy Rain Observation Results



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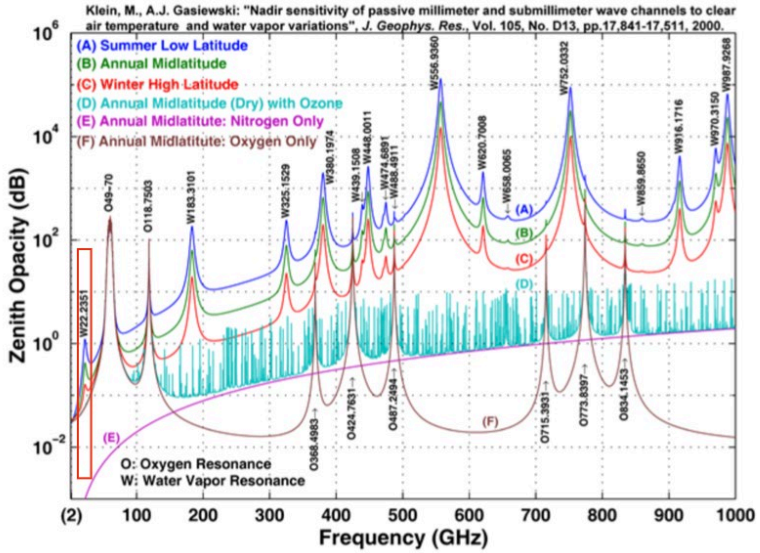
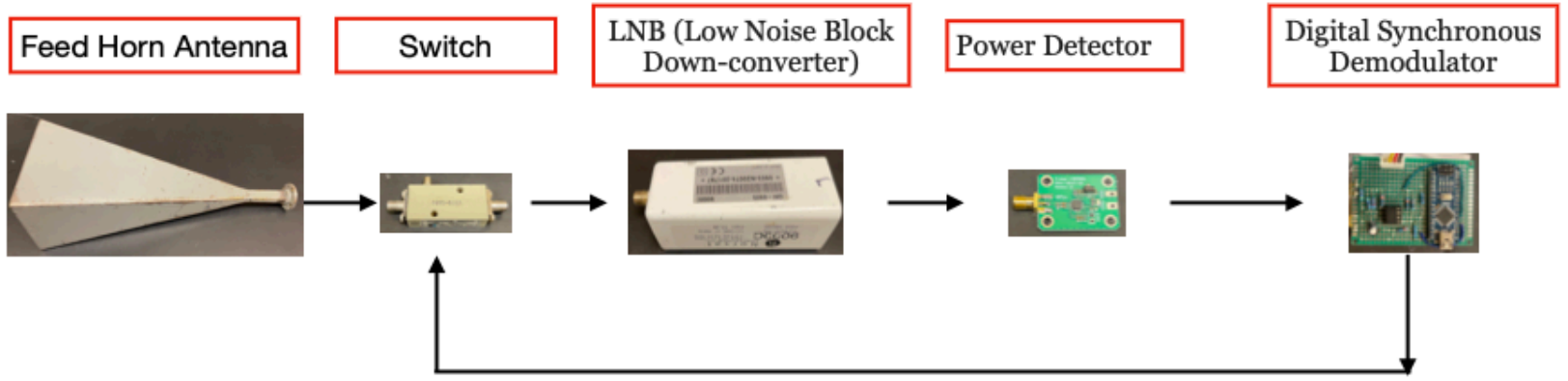
Introduction

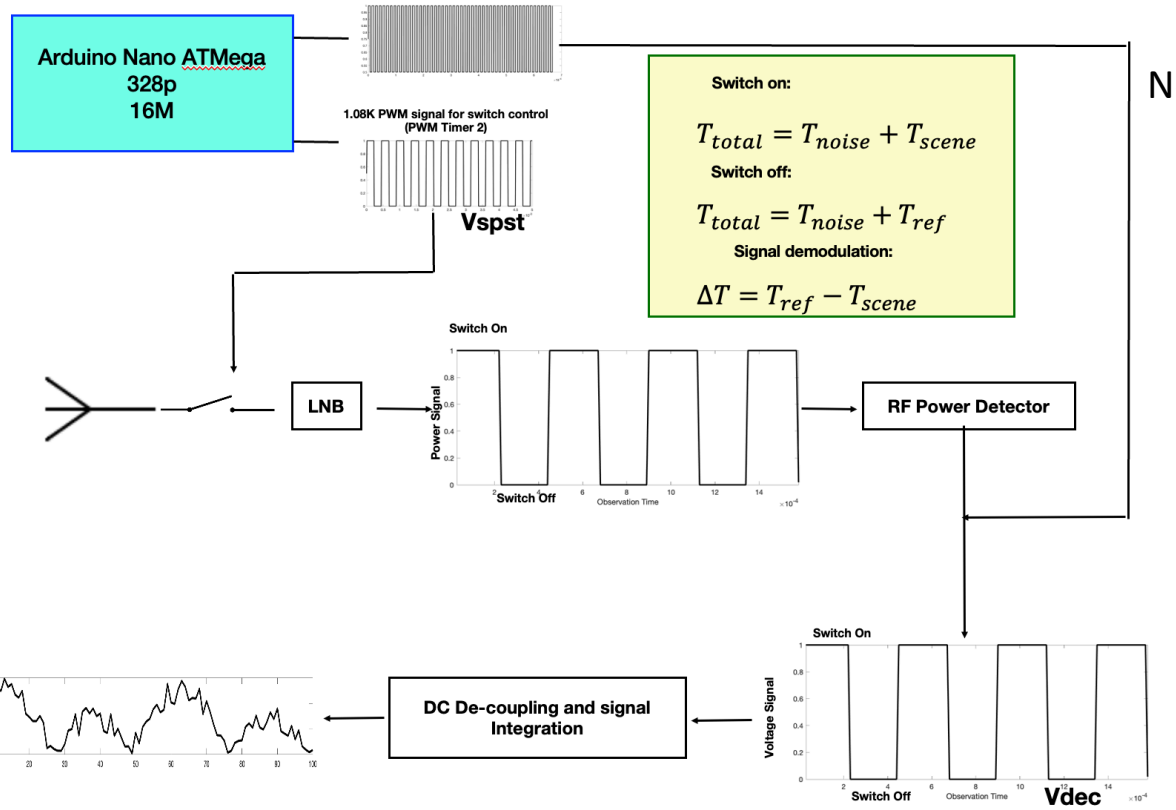
- Microwave can penetrate most of the cloud, and being widely used to measure atmosphere parameters in all weather conditions
- In this project, we built a microware radiometer with central frequency of 22GHz which is sensitive to water vapor absorption

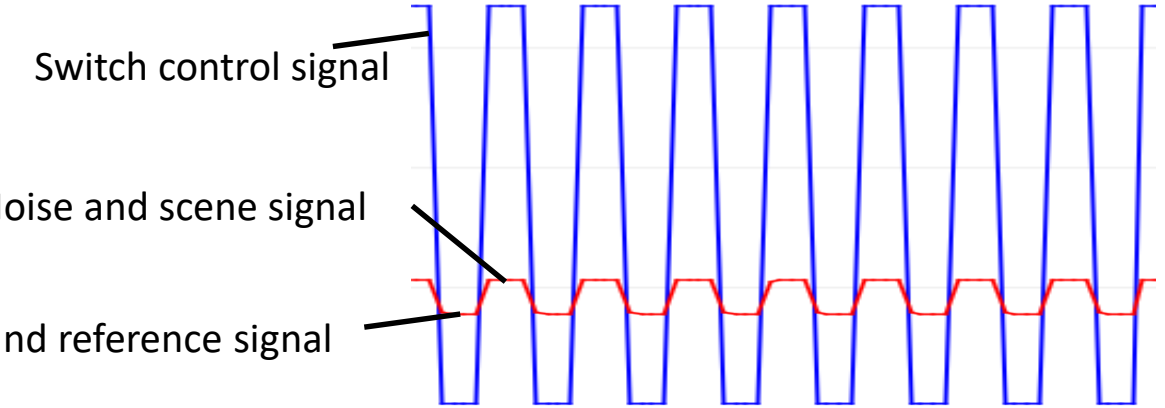


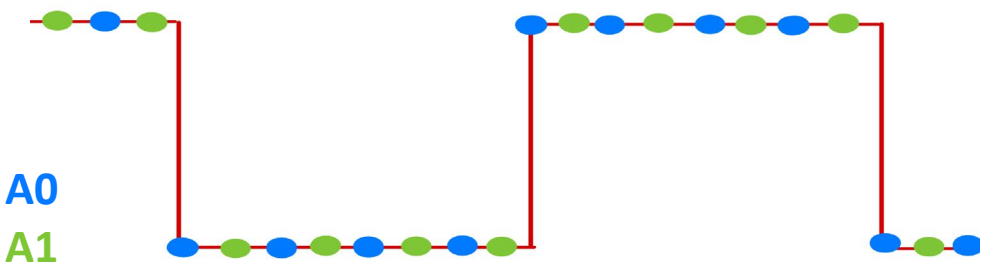


Implementation of Digital Synchronous Detector

- Use microcontroller to implement ad converter and generate pwm pulse signal to control switch
- Using 2 analog pin for demodulation, 1 pin for detecting signal, other pin for receiving switch control pwm

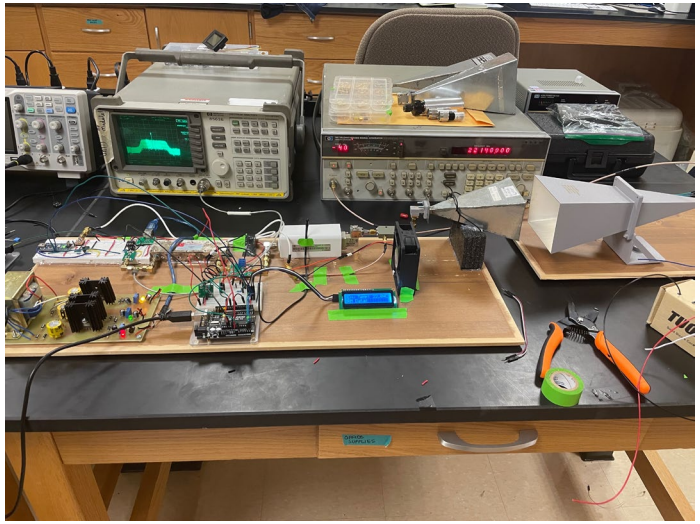


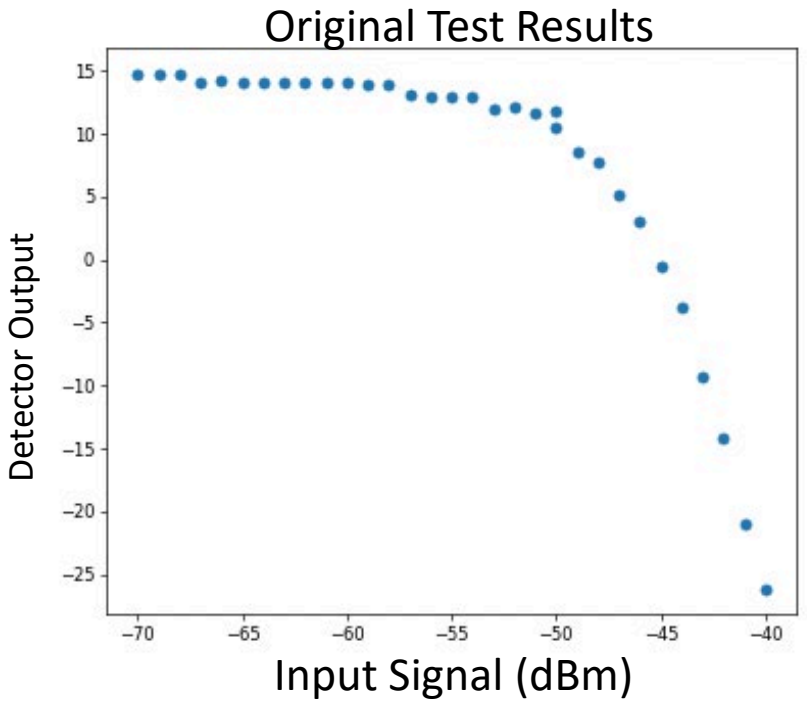


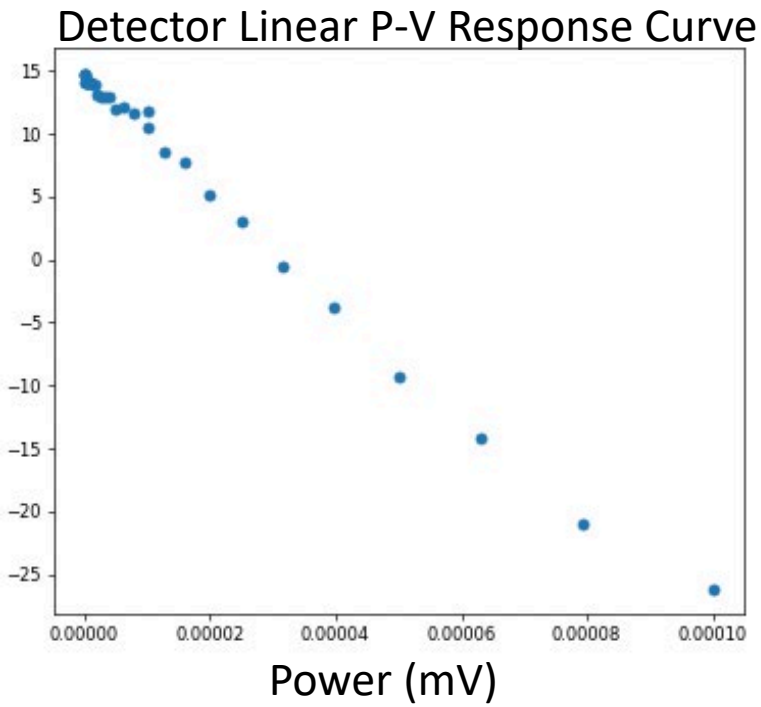


Device Calibration

- Use signal generator to calibrate the microwave radiometer detector
- Power-voltage response curve was derived from test data
- Linear response found from the detector







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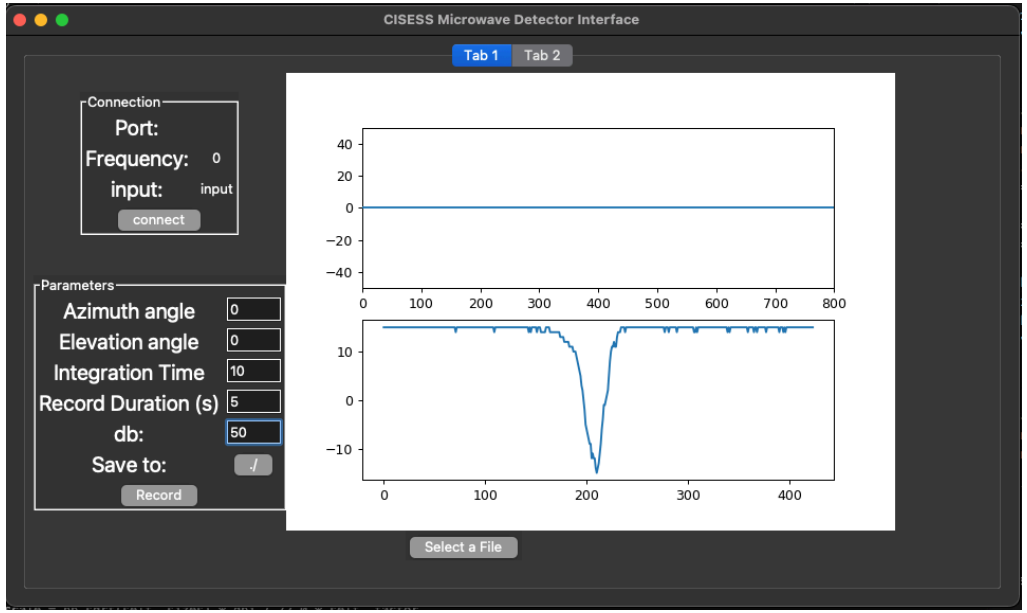
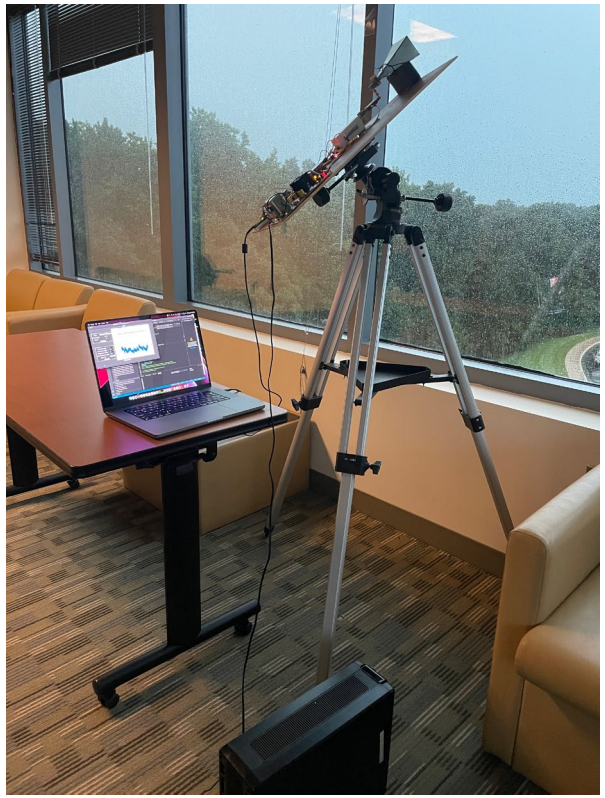
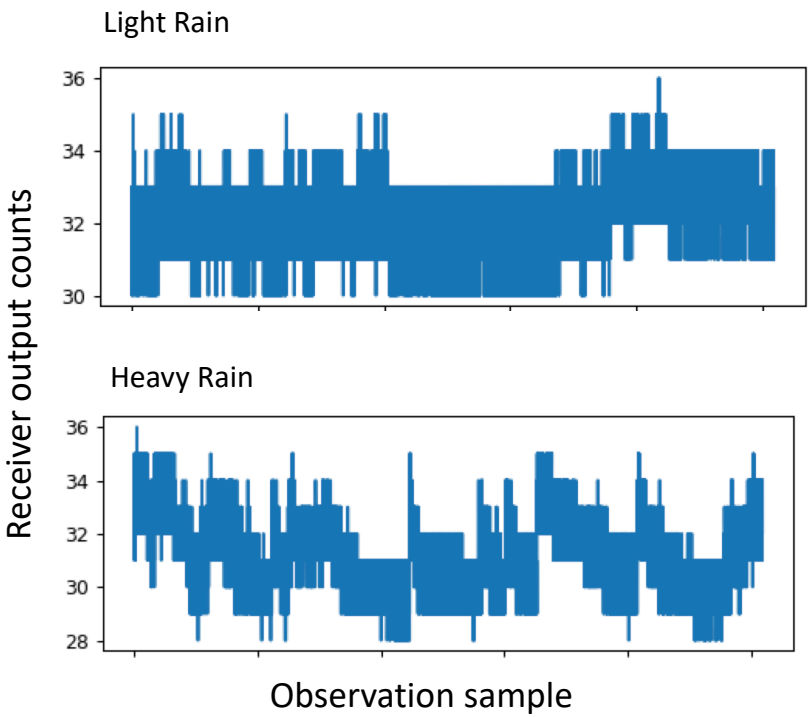
CISESS Microwave Radiometer Data Acquisition System



In-situ observation





Conclusion

- Designed and implemented digital synchronous detector
- Calibrated and tested the performance of prototype instrument
- Put device to test and see that the output varies with weather condition

Future Work

- Add more feature to interface
- Automate observation process
- Output data to external machine for further analysis