FAMU-FSU College of Engineering

Pole Health Detection Sensor

Florida Power and Light

Team 301

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Overview

- Project Scope & Goals
- Selected Design
- GPR Modeling & Simulation
- Initial Prototype
- Future Work
- Summary

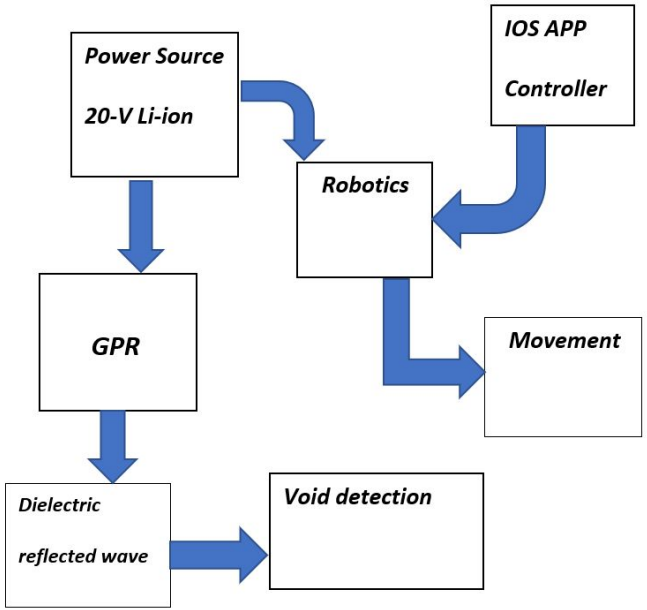
Project Scope

- Motivation:
  - Improve safety and reliability
  - Reduce resources needed to inspect poles
  - Increase inspection efficiency
- Goal:
  - Automate and simplify pole health inspection process

Project Goals

- Detect voids in southern pine wood utility pole
- Climb to the height of telecommunications line
- Keep tension while climbing
- Weigh less than 40 pounds
- Operated by a single person
- Rechargeable battery
- Display important information to user

Selected Design



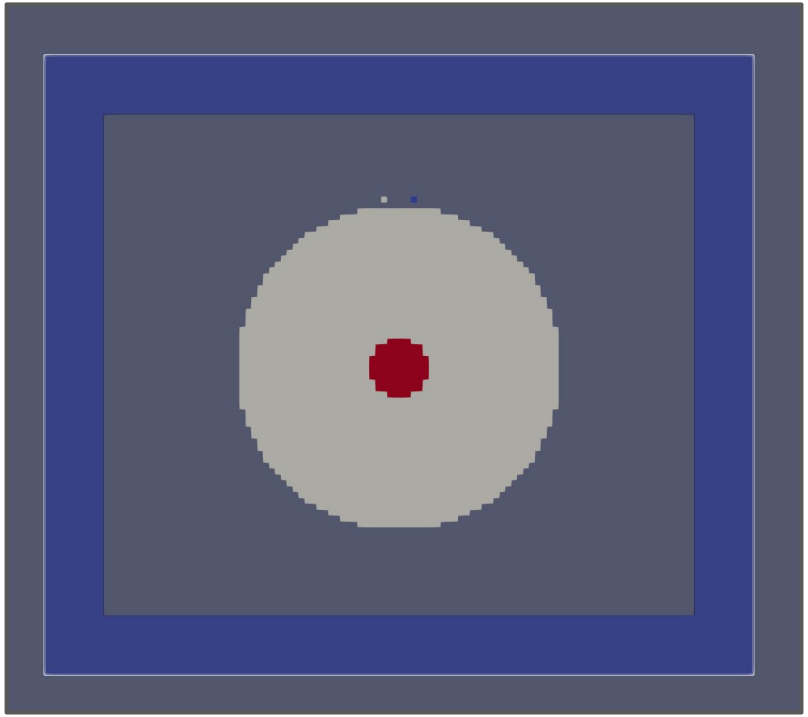
- Robot: Triangle Climber
- Sensor: Ground Penetrating Radar (GPR)
- Controller: IOS App
- Battery: Li-ion (Wireless Drill Battery)

GPR Simulation

- gprMax
- Miniconda3
- Python3 and Cython
- Yee's algorithm to solve Maxwell's equations in 3D using FDTD method

```
#title: test 1
#domain: 0.240 0.210 0.002
#dx_dy_dz: 0.002 0.002 0.002
#time_window: 3e-9

#material: 2 0 1 0 dry_wood

#waveform: ricker 1 1.5e9 wave
#hertzian_dipole: z 0.115 0.16 0 wave
#rx: 0.125 0.16 0

#cylinder: 0.120 0.105 0 0.120 0.105 0.002 0.055 dry_wood
#cylinder: 0.120 0.105 0 0.120 0.105 0.002 0.010 free_space

#geometry_view: 0 0 0 0.240 0.210 0.002 0.002 0.002 0.002 test1 n

```

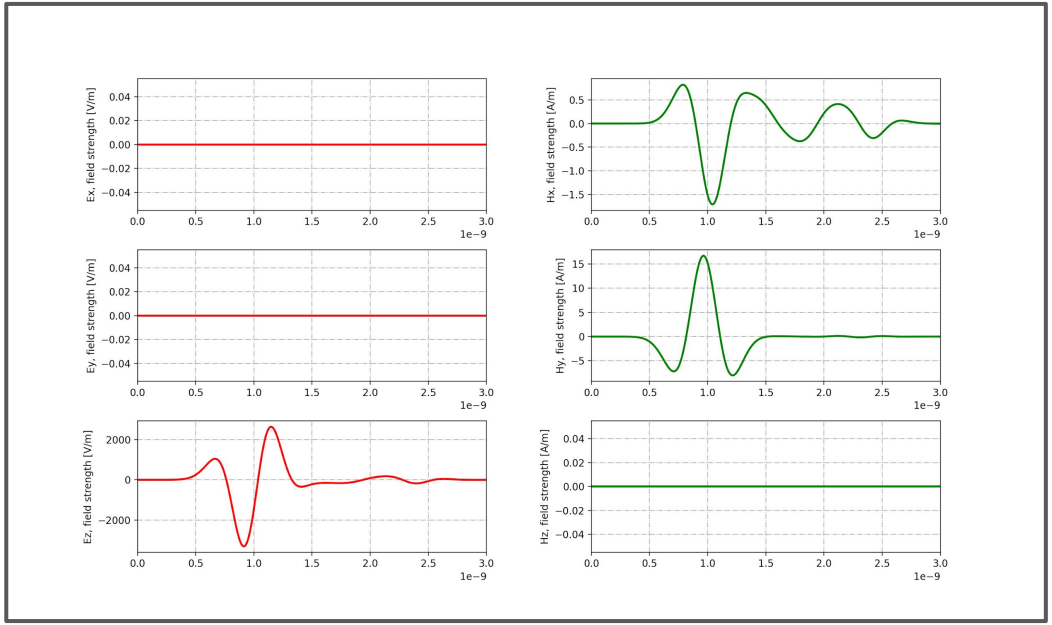
GPR 2D Model



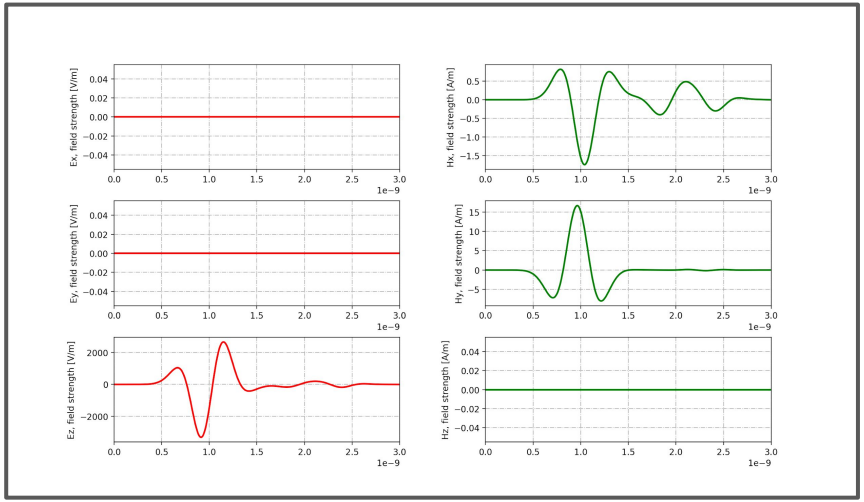
- ParaView-5.9.0
- Cross-section of utility pole with air pocket
- Scaled down by 2

GPR Simulation

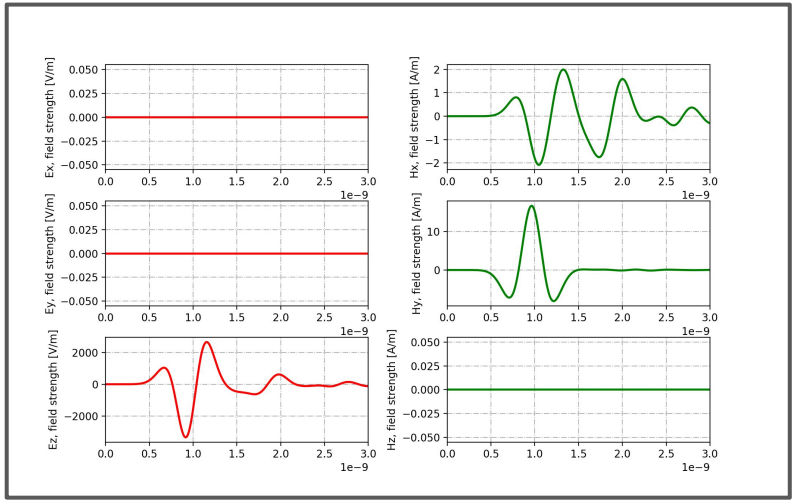
- Changing Variables:
  - Frequency
  - Waveform
  - Void Material
  - Void Location



Simulation Results



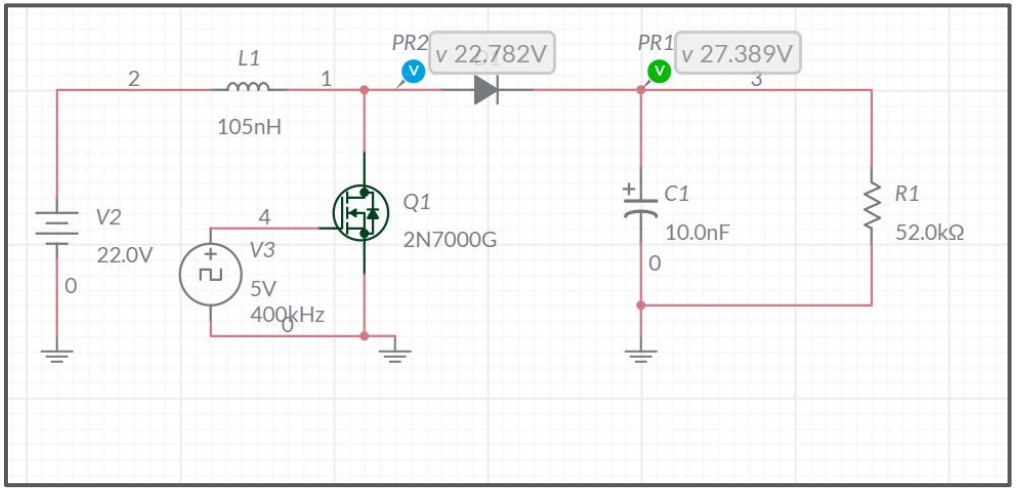
Control: Solid Pole ($\epsilon = 2$)



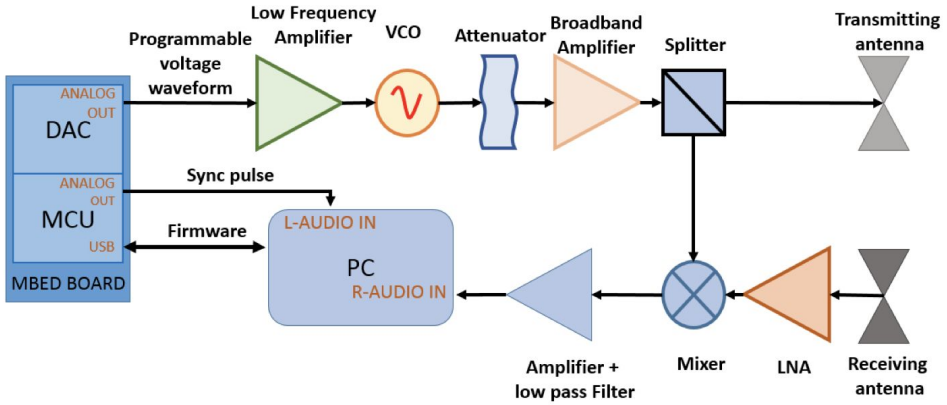
Pole ($\epsilon = 2$) with Void ($\epsilon = 20$)

Initial Prototype

- RF power supply
- Boost converter (22V-27V)
- ME team Buck converter (22V-5V)
- HILTI B22-5.2 battery pack



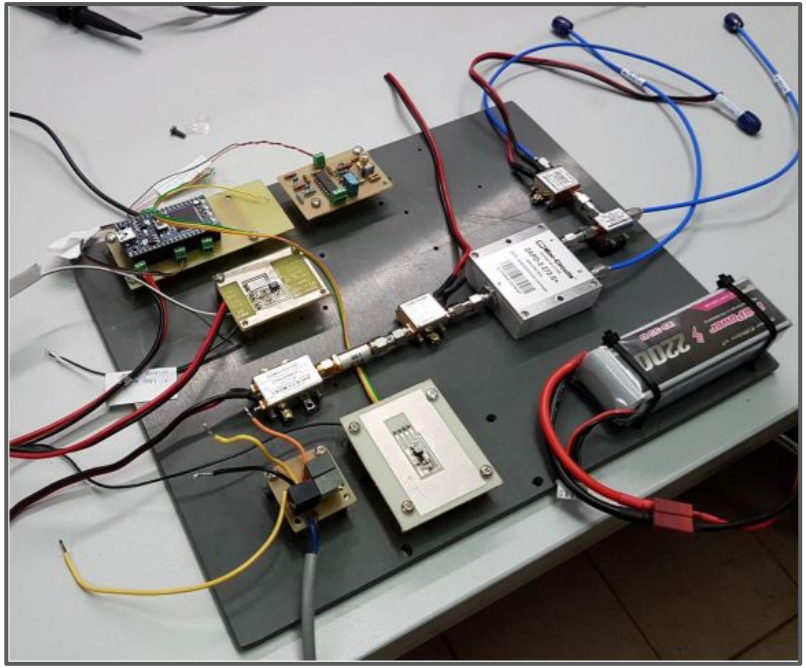
Initial Prototype



- Waiting on components
  - Low Noise Amplifier
  - Power Splitter
  - Frequency Mixer
  - Adapter
  - Coaxial Cables
- Determining signal processing needs

Future Work

- Construct initial prototype
- Begin programming IOS app
- Continue working on simulation



Summary

- Automating and simplifying the pole inspection process
- Built working simulation
- Start building initial prototype
- Continue testing and revising

Questions?