

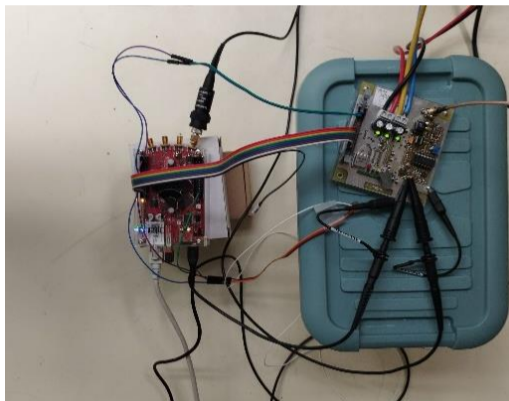
## DECEL Team Amboise

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# Ultrasound Underwater Imaging with Red Pitaya

### Abstract:

This project aimed to develop a method for imaging a metal object in a water tank using ultrasound. We utilized the Red Pitaya platform for signal processing and control of the ultrasound transducer. By measuring the Time of Flight (ToF) of ultrasound pulses, we accurately determined the tank's depth and created a visual representation of the object's position. Operating at 62.5 MHz provided a high-resolution image. Our results demonstrate successful underwater imaging with ultrasound.



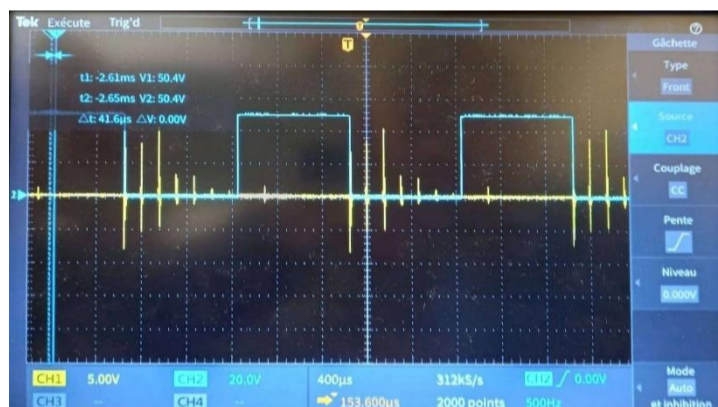
### Objectives:

- Develop ultrasound imaging for visualizing a metal object in a water tank.
- Utilize Red Pitaya for signal processing and transducer control.
- Measure tank depth using ultrasound ToF.
- Process signals in MATLAB to visualize tank depth and object position.
- Enhance resolution by operating at 62.5 MHz.

### Challenges:

- Low angle with accurate resolution.
- Communication with Red Pitaya.
- Signal processing and detection of echoes in MATLAB.
- Calculation of distance and geometric representation depending on probe angle.

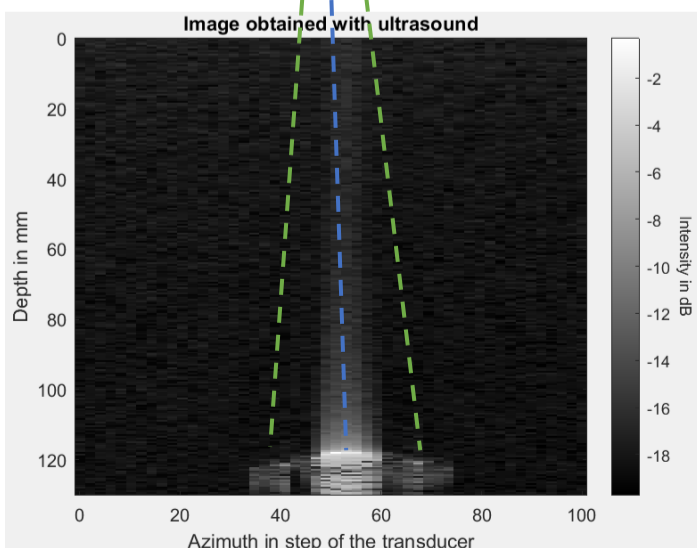
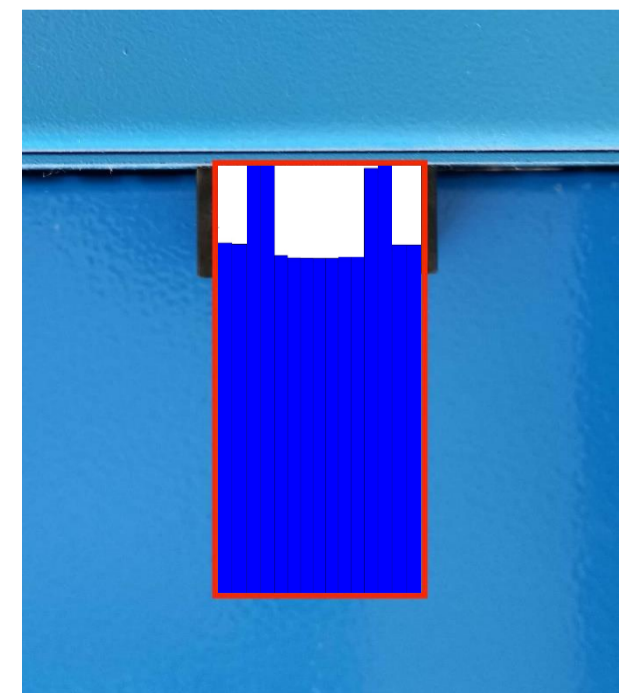
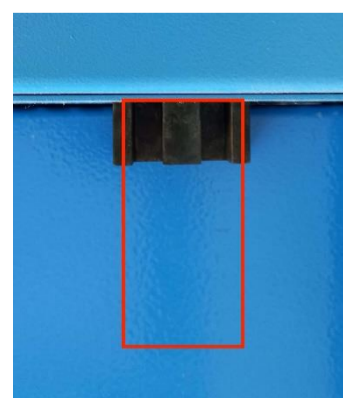
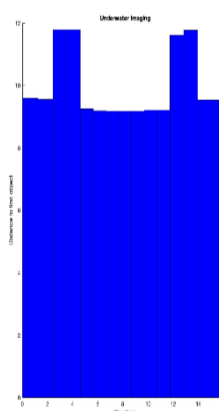
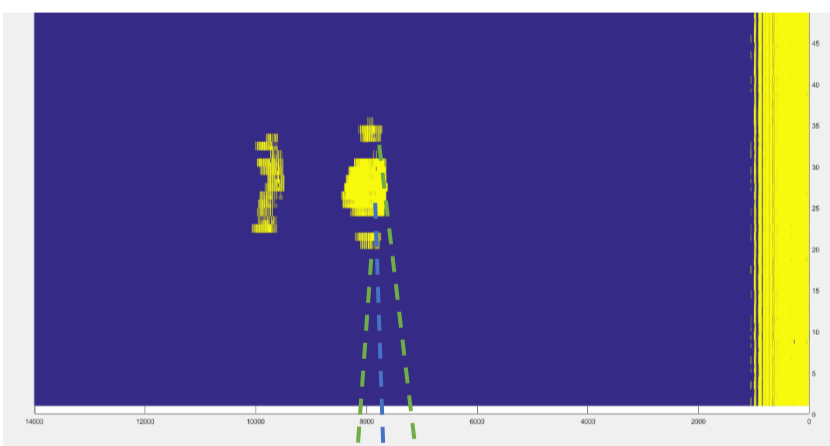
Oscilloscope capture of the ultrasound signals and echoes



### Results:

Our project successfully achieved underwater imaging of a metal object using ultrasound. Red Pitaya enabled signal processing and transducer control. Accurate depth measurement was achieved through ToF analysis. Signal processing techniques improved echo detection. MATLAB generated visual representations of tank depth and object position. Operating at 62.5 MHz yielded a high-resolution image. Our findings provide valuable insights into underwater object detection with ultrasound.

Ultrasound results for different angles with threshold binarization



Ultrasound results for different angles

Visual comparison of image reconstruction to real object.