

United States Naval Research Laboratory

Inexpensive Radar for Through-Object Viewing

Progress Report 2

Team 4

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Summary

Now three-quarters through the semester, Team 4 has made remarkable progress towards the realization of a through-object radar system. At this point, the major components of the hardware have been assembled and can be connected to the signal processing unit to display distance information on the software front panel. As a result of this, our goal of being online by Week 11 has been met and we have moved into the calibration and cancellation implementation stage. As we enter this stage, we have remained within budget.

Task Progress

Software

The software architecture has experienced important changes since the last progress report and has improved in terms of efficiency and robustness. Major changes took place to both the sampling software and the processing software.

The sampling software underwent a fundamental change in terms of buffer usage and port usage. Because the cancellation hardware needs to have IQ (in-phase and quadrature) inputs and outputs, the sampling software now needs to handle two inputs and three outputs. However, the FPGA we are using has only three DMA buffers. Under the old synchronization system, all of these buffers would have been exhausted on only three ports, thus leaving two ports unimplemented. A solution to this was found by implementing a memory-based architecture and splitting the resources available in each buffer—in effect, multiplexing the DMA buffers. As a result of this solution, all five ports can be serviced with the use of only two DMA buffers.

The processing software also underwent considerable changes. A new front panel was implemented giving the user much more control over radar parameters. The graphs displaying the radar response we also updated to show accurate X-Y mappings so that amplitude is mapped directly to distance. Additionally, new features have been added that allow the operator to threshold radar input and to detect movement of objects. The results of these features can be seen in new waveforms added to the software front panel.

Hardware

Hardware development has likewise been moving along quickly. The power supply chassis is now assembled and distributes power through a single multi-conductor cable. Each component in the radar has access to its desirable voltage level from a single power supply unit.

The FPGA has now been enclosed a special chassis to expose only the power connection, the I/O ports, and the data transfer port. The FPGA is securely

mounted to this chassis to protect the FPGA and its I/O ports from physical damage. The chassis also serves an aesthetic purpose in that it shields wiring from the eyes of the radar operator.

The core radar hardware has been assembled, allowing for basic radar operation and the ability to view an image on the software front panel. The cancellation hardware has not yet been installed, as we are awaiting delivery of canceller hardware from NRL.

Budget

As of this progress report, all major purchases needed for the completion of this radar have been made. All cancellation hardware has also been purchased. This leaves the team \$92.90 remaining in the budget, which is a sufficient window for small purchases (connectors, cables, etc.)

Forward Plan

Software

In terms of the software, all work related to mapping distance versus amplitude is essentially complete, though some tweaking is necessary. All further software work pertains to interfacing with the cancelling hardware and passing the cancellation hardware the necessary IQ data.

Hardware

Hardware work that remains includes troubleshooting of connections, improvement of the sensitivity of the core radar hardware, and development of the cancellation hardware. The cancellation hardware has been ordered by the sponsor and should be available in Week 13. One of our existing antennas is not performing to specifications, so a new one will be assembled. Minor hardware work includes mounting of connectors and completion of all chassis work.

Outlook

The team hopes to have hardware troubleshooting completed by the beginning of Week 13. As a result, the team hopes to have the core radar hardware and software features to be fully functional at the end of Week 13. The team intends on having cancellation functionality integrated by Week 14.