

# **Lightning Talk 1**

## **Millimeter-Wave Imaging Radar**

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# Problem Statement

Researchers and students at Iowa State University need a method to analyze materials, beyond the surface of those materials. The researchers and students are working in the CNDE at Iowa State University, but this is not a problem specific to people at Iowa State University, there are likely people working around the world on similar projects. The problem may occur at any point in an items lifecycle, requiring regular analysis of the material. The importance of this is crucial to ensure safe operation, where a material analysis of the inside of a material is required. Finally, we will design a product that will analyze a material to check for defects and communicate that to the analyzer.

# Requirements & Constraints

- Must interface with existing hardware/software that includes Up counters and Down counters, this will require a signal input and output.
- Our design will ideally output a 10 MHz signal, which will be “sped up” by the existing hardware.
- With the input signal that is returned from the output signal, we must convert that into its real and imaginary components.
- This converted data must be organized clearly into a file on the PC, so that Labview or Matlab may graph it.
- FPGA clock is 100 MHz.
- Communicating with PC to FPGA via a USB-C port.

# Engineering Standards

- IEEE 287.1-2021, IEEE 287.2-2021, IEEE 287.3-2021: All three of these standards relate to Precision Coaxial Connectors at RF, Microwave, and Millimeter-Wave Frequencies. Our project is designed to operate at millimeter-wave frequencies, so we can save time by adhering to the standards relating to Coaxial connectors.
- IEEE 1696-2013: IEEE Standard for Terminology and Test Methods for Circuit Probes. Our result will be very dependent on the connection made between probes and our circuitry, and this standard discusses probe performance, we can assume that using this standard will allow us to make a competent decision relating to what we use for our project. As signal quality will make or break us.
- IEEE 1658-2011, IEEE 1241-2010: IEEE Standard for Terminology and Test Methods of Digital-to-Analog Converter Devices, and Analog-to-Digital. Our project will contain both DAC's and ADC's so having the standards for testing them is crucial to us, because it can be difficult to find a starting point when testing.

# Intended Users and Uses

Unfortunately, this is a very niche DAQ product and its users are very specific.

Users: Iowa State Researchers, and students.

Uses: Evaluating the integrity of a material without having to disassemble the product, in our case the most likely material would be wood. Although some Imaging radars can be used to analyze metals, ours wouldn't likely have those capabilities.