P18571:
Sunspot Radio Telescope

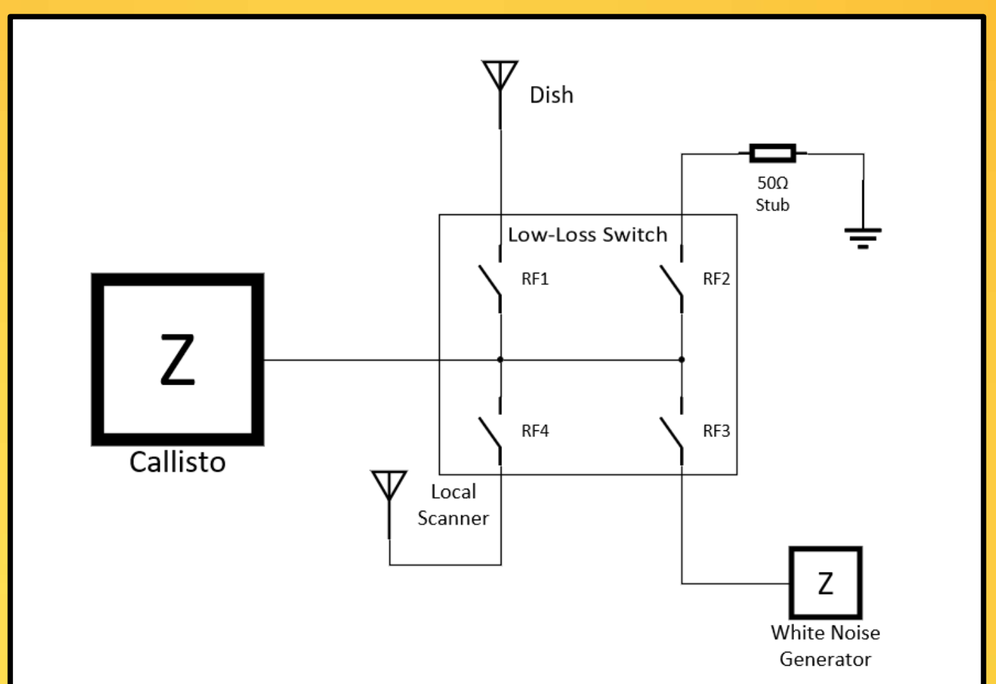
Introduction

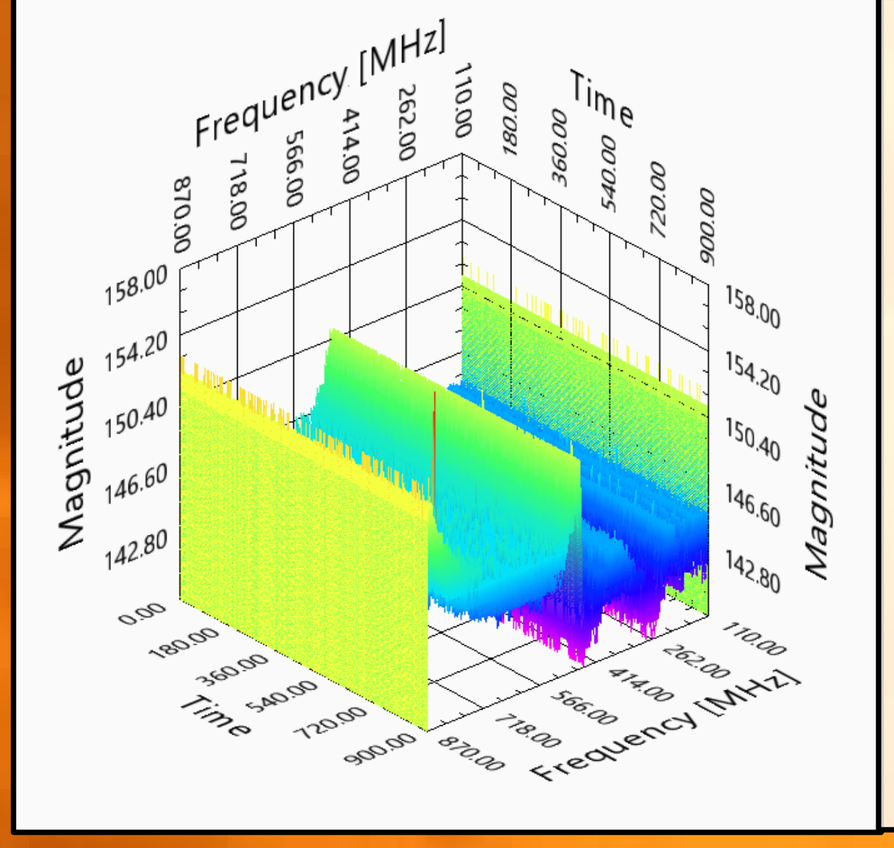
The sun emits the light and heat necessary for life on Earth. However, it also emits radiation outside the visible spectrum as well as energetic particles. These emissions can impact satellites and other man-made instruments, causing momentary failure or destruction, and even electrical blackouts. Some solar events are not typically viewable in the visible spectrum but do emit light in the radio spectrum. Because particle emissions take much longer to reach the Earth than RF, a radio telescope provides an early warning about incoming solar weather so that sensitive infrastructure including satellites and power grids can be protected. There is a lack of dedicated radio telescopes in the Northern Continental United States. This hole is to be filled by a new installation in Ionia, New York. A prototype was developed during previous projects but is not currently operational and requires additional features to be utilized.

Team - From left to right: Brandon McDonnell (CE), Martin Pepe (Guide), Kyle Tevis (EE), David Fediaczko (EE), Yaroslav Tochinski (ME)

Goals

The goals of this project are getting the radio telescope online and operational with a user friendly GUI, subsystems for self-calibration, RF filtering, a visible spectrum feed, and data upload for analysis. The data is to be uploaded to stakeholder's servers in Zurich. The end product must be remotely operable from RIT, provide accurate data, and be tolerant for environmental exposure, including tolerance of power failure without data loss.





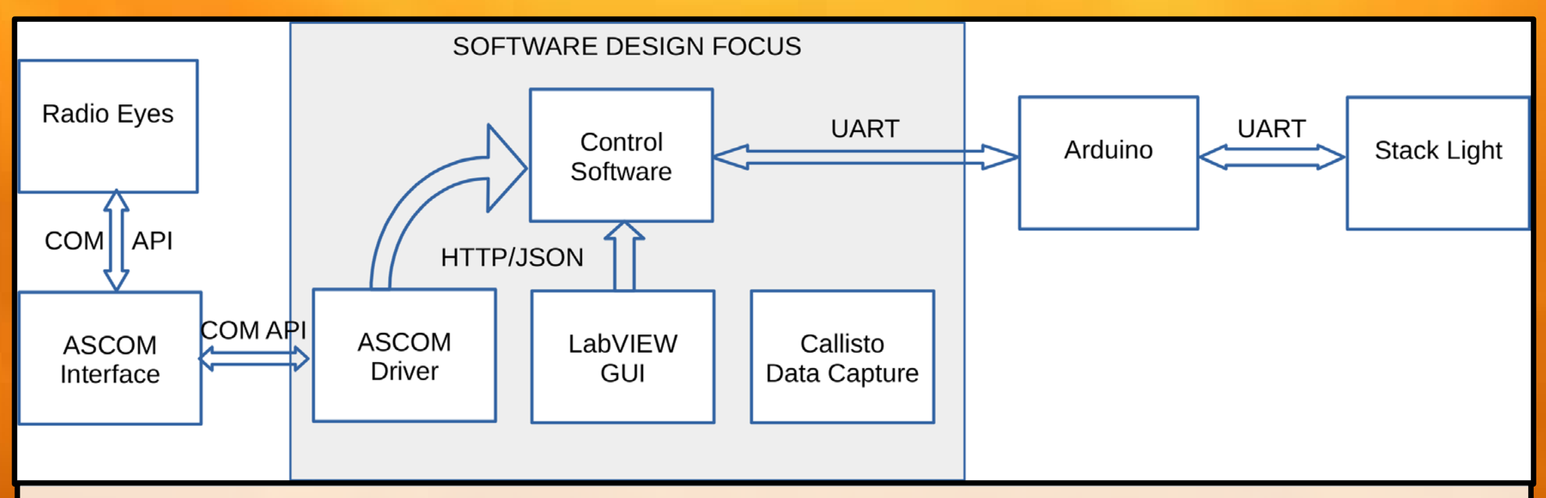
Waterfall Charts

Radio frequency data can be visualized using a waterfall chart. The eCallisto software produces these plots from data collected from radio telescopes. Clarity in these charts was increased by mathematically removing & isolating interfering emitters.

RF System Design and Flowchart

The system implements an auto-calibration function that allows the Callisto to look at a fixed load, a white noise source, and a second antenna that observes local radio emissions. This allows the system to filter out external noise such as thermal changes and nearby radio stations. This is done through a low-loss switch.

Dish Antenna Model



Software Design and Flowchart

The dish control software provides a WebSocket server that implements a standardized TCP protocol. LABVIEW, ASCOM, and Web Applications are able to easily implement the protocol to interact with the telescope. The server may be used for both local and remote control.

Special Thanks to:
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