A Thin and Conformal Rocket Antenna for LoRa Communication

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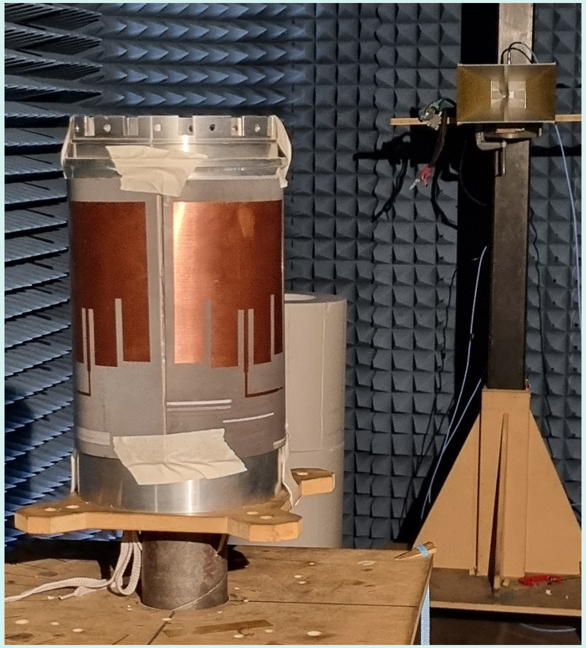


A final-year Capstone project in Antenna Design

The Basics

The Problem

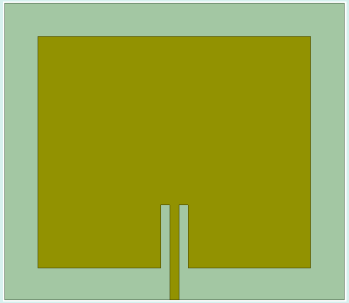
The RMIT High Velocity (HIVE) rocket team is a student club dedicated to constructing sounding rockets for participation in university competitions both domestically and overseas. The team has had great success with their *Aurora V* and *Legacy III* rockets, winning awards for technical excellence.

However, with the move to a fully carbon-fibre rocket shell, radio signals will no longer be able to pass through the shell to an internal wire antenna, so a new range of antennas for embedding in the shell was requested.

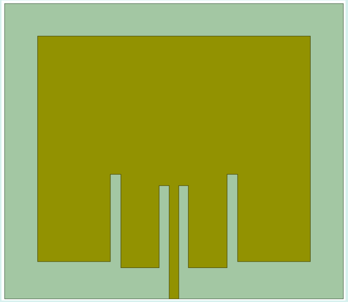
This capstone project fulfils the need for a thin antenna that can be embedded into the rocket shell to deliver vital telemetry such as velocity, fuel levels and GPS location to the HIVE team during flights. A key challenge in the development of thin antennas is the limited bandwidth (they only operate well on a narrow range of frequencies. To satisfactorily complete the project, a design beyond the basic patch was required.

The Solution

To address this, additional slots were cut in the patch to generate two sub-patch antennas within a single structure. This allowed it to be tuned to two frequencies simultaneously. A doubling of the bandwidth was seen using the technique allowing the full LoRa band to be used for communications.



Standard Patch



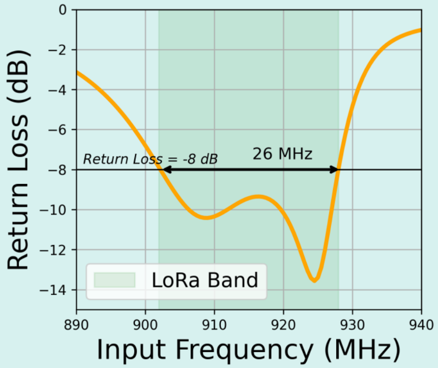
Dual-Resonant Patch

The Technical Bits

Project Results

A physical prototype of the patch array was manufactured, conformed to a metallic cylinder and tested in the RMIT anechoic chamber. Due to shifts in the resonant (tuned) frequencies of the sub-patches, the antenna exhibited 70% coverage of the LoRa band and transmitted in all directions.

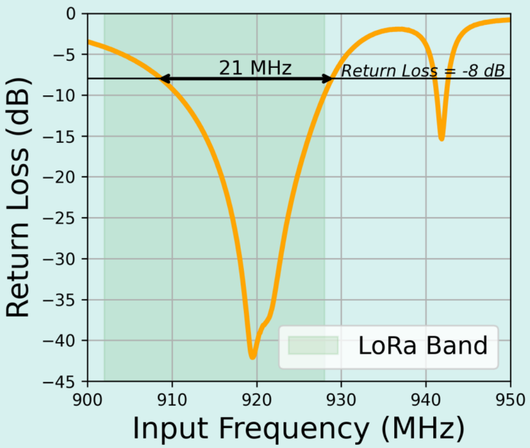
The capstone delivered an physical antenna suitable for use on the full Australian LoRa band and a simulated design with full coverage of the United States band. A second iteration will allow the resonant (tuned) frequencies to be adjusted to allow full coverage as seen in the simulation results (see below). It will then be tested embedded in a carbon-fibre shell and under flight conditions.



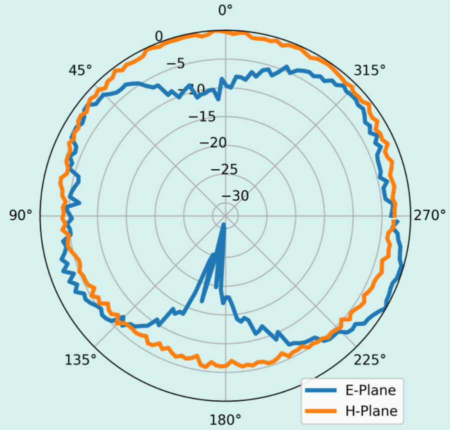
Target Specifications

Characteristic	Target Value
Centre Frequency	915 MHz
Minimum Bandwidth	26 MHz (902-928 MHz)
Maximum Return Loss	-8 dB
Target Thickness	1.6 mm
Target Radiation Pattern	Near-isotropic

Return Loss



Radiation Pattern



Robert Bell is a graduating engineer with a Bachelor of Engineering (Electronics and Computer Systems). He has a specific interest in RF and antenna engineering, alongside skills in embedded systems, programming and data visualisation.

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