



Designing Wideband Antenna System for NASA Mars Drone

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Extended Abstract

Currently, NASA has initiated a project to determine whether Mars ever supported life [1]. In this project, the goal is to understand the process and history of the climate on Mars, understand the origin and evolution of Mars as a geological system, and prepare for human exploration. Therefore finding the water on the Mars surface is a key part of this project. One of the idea is to use the NASA drone and fly it over the Mars surface, and map the potential ice sheets or water bodies in the Martian subsurface.

In this paper, we are proposing to design two electrically small antenna and integrate them into the drone landing gear. One of the antennae will illuminate an electromagnetic signal to the surface of Mars. This signal will penetrate in different layers of the Mars surface, and another antenna will measure the reflection signal from the surface of Mars in order to find the location of the water or ice sheets. The differences between the transmitter and the reflected signal will be used to map the dielectric properties of the water. For better penetration depth, we have designed the antenna at the HF frequency range and used the frequency tuning technique to create a wide-band antenna structure.

In this design, we used wire around the drone landing gear to create inductance coil components and used a combination of varactor diodes for continuous frequency control as well as RF switch for discrete switching. Series capacitance needed to resonate the loop at specific frequencies. We used off-the-self varactors (Skyworks SMV1801-079LF hyperabrupt junction tuning varactor, which capable of creating capacitor range from 3pf -87pf. Varactors are placed parallel with inductance and offer continuous frequency tunability. The RF switches short circuit different sections of the discrete LC circuits. The microcontroller is used to control the DC bias voltage for varactors and RF switches and create an ultrawideband antenna.

In the presentation, the simulation and measurement results for the proposed HF ultrawideband antenna with a drone for detecting the water will be presented, and the characteristics of this antenna will be discussed.

References

- [1] D. Hernandez, "NASA Science Mars Exploration," Mars Communications Team at NASA's Jet Propulsion Laboratory, <https://mars.nasa.gov/> (accessed: 2022)