

## **Construction and Testing of a Solar Panel with an X-band Optically Transparent Reflectarray Antenna Integrated on Top of It**

Taha Yekan<sup>(1)</sup>, Muhammadeziz Tursunniyaz<sup>(1)</sup>, Reyhan Baktur\*<sup>(1)</sup>, Charles Swenson<sup>(1)</sup>, Serhat Altunc<sup>(2)</sup>, Eleanya Onuma<sup>(2)</sup>, and Harry Shaw<sup>(2)</sup>

(1) Utah State University, Logan, UT 84322

(2) NASA Goddard Space Flight Center, Greenbelt, MD 20771

This paper presents a collaborative work between NASA and Utah State University to demonstrate a fully integrated X-band solar panel reflectarray with a size of 30 cm by 20 cm. The panel can fit a 6U or larger CubeSats. The antenna is see-through to light with a transparency as high as 95% and is printed using an inkjet printer on the cover glass of the solar panel. The gain of the antenna is expected to be higher than 21 dB when integrated on the solar panel.

The reflectarray design is optimized and utilizes subwavelength spacing for improved gain. The proposed antenna design is conformal and does not require mechanical deployment. Compared to antennas integrated on the bottom side of solar panels, integrating antennas on the top side of CubeSat panels is to solve problems for several situations where the CubeSat either only has surface-mount solar panel, or when the communication end and the sun is along the same direction. An example vehicle for the latter application can be Mars Rover.

Previously the collaborative group has shown the antenna design that can be integrated on solar panel. The focus of this work is to assemble the solar panel and antenna in modular fashion and perform rigorous tests on both the solar panel and the antenna. Further tests such as mechanical properties of the multi-functional panel will also be performed. Because the antenna design supports dual polarization, the reflectarray can provide circular polarization (CP) as long as the feed is CP, however, we will research effective designs where the panel provides CP under an illumination of a linear polarized source.

The main design challenge of this project is to fit an X band antenna on a relative small panel. In another word, this design can be easily extended to larger panels or higher frequencies such as Ka band without compromising antenna's properties.