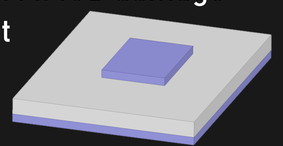
2-in-1 Smart Panels:
Embedding Microstrip Patch Antennas within Satellite Structures

Valorie Platero, Philip Ferguson
University of Manitoba Space Technology and Advanced Research (UMSTAR) Laboratory
Valorie.Platero@umsats.ca, Philip.Ferguson@umanitoba.ca

Background & Objective

- Patch antenna embedded within a sandwich structure of carbon fiber and polyethylene fiber composites
- Multifunctional structures can reduce the subsystem's volume by 80%, mass by 90%, and assembly labor by 50%
- Low-profile antennas reduce risk of MMOD damage
- Composite materials reduce weight
- Case studies for a single antenna designed and simulated in HFSS



CASE 1: Radar Mapping Spacecraft

- S-band (2.25 GHz) space-to-ground communications for tracking, telemetry and command
- Simulations show bandwidth of 15 MHz, gain of 7.25 dB, half-power beamwidth of 76°, return loss of –33.8 dB
- Traditionally larger spacecraft can support bigger aperture sizes for higher volumes of imaging data

CASE 2: CubeSats

- S-band (2.45 GHz) amateur radio space-to-ground communications for tracking, telemetry and command
- Simulations show bandwidth of 15 MHz, gain of 7.6 dB, half-power beamwidth of 80°, return loss of –40 dB
- Embedded antennas are beneficial to miniaturized spacecraft that have limited available space

CASE 3: Nanosatellite Constellation

- Ka-band (23 GHz) space-to-space communications for tracking, telemetry and command
- Simulations show bandwidth of 390 MHz, gain of 7.5 dB, half-power beamwidth of 60°, return loss of –35 dB
- Higher frequencies allow for smaller antennas, more elements in a limited space and higher data throughput

CONCLUSION

The objective of this project is to develop a versatile component for spacecraft that performs multiple functions while reducing overhead costs for integrating components. This project presented a preliminary single-element patch design for potential use cases in different levels of spacecraft complexity and size. Simulation results show promise that this cost-saving and versatile technology could be feasible for future satellite programs.

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