NASAfacts

3D Printing the Complete CubeSat

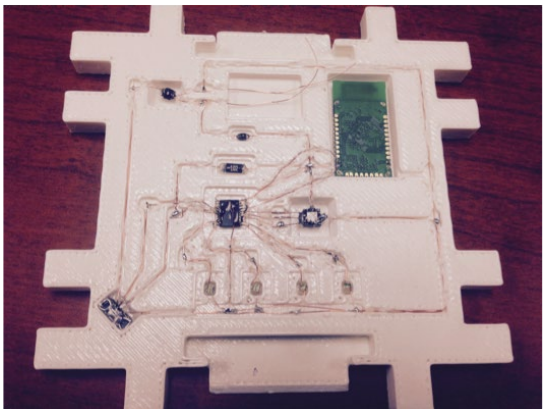
Advancing the Use of Additive Manufacturing in Space

The 3D Printing the Complete CubeSat project is designed to advance the state-of-the-art in 3D printing for CubeSat applications. Printing in 3D has the potential to increase reliability, reduce design iteration time and provide greater design flexibility in the areas of radiation mitigation, communications, propulsion, and wiring, among others.

This project is investigating the possibility of including propulsion systems into the design of printed CubeSat components. One such concept, an embedded micro pulsed plasma thruster (mPPT), could provide auxiliary reaction control propulsion for a spacecraft as a means to desaturate momentum wheels. The team is investigating mPPT concepts from Busek Co. Inc., for inclusion into the printed structure of the spacecraft. In order to fire these thrusters, high voltages must be supplied and this is enabled through the novel ultrasonic embedding of wires into the 3D printed structures – providing high routing densities (pitches in the order of hundreds of microns) and supplying high voltages (500 V to 15 kV) while maintaining low leakages.

This project involved total dose radiation testing in the X-Ray source on a wide variety of different materials (including doping with tungsten). Research included the printing of planer and non-planer antennas and then testing in anechoic chambers. Tests include the embedding of electronics into printed structures and then testing in vibrational and vacuum environments.

This technology is important for NASA and the small spacecraft community since it will greatly increase the ability for designers to rapidly create new designs for structures. The designs will have wiring embedded in the structure (with propulsion and communications systems) so as to reduce the risk associated with pinching wires during assembly and test. Other possible applications include the creation of assets on orbit where it is possible to print the electronics required for mission accomplishment.



SnapSat Version 3.0 Bluetooth

Additive manufacturing technology provides mission designers with the freedom to incorporate power, propulsion and communication systems into new structural concepts for mission specific needs. Essentially, this technology turns the design cycle into a capability cycle: new form factors can be explored which are directly focused on specific needs. For example, inspection spacecraft with large propellant requirements and low communication needs can be designed and printed to fit into standard dispensing units.

This project involves participants from NASA Glenn Research Center (GRC), the COSMIAC Center at the University of New Mexico, the Keck Center at the University of Texas at El Paso, and the Northrop Grumman Corporation.

This project is funded through the SmallSat Technology Partnerships, a program within the Small Spacecraft Technology Program (SSTP). The SSTP is chartered to develop and mature technologies to enhance and expand the capabilities of small spacecraft with a particular focus on communications, propulsion, pointing, power, and autonomous operations. The SSTP is one of nine programs within NASA's Space Technology Mission Directorate (STMD).

For more information about the SSTP, visit:

http://www.nasa.gov/smallsats

For more information about this project, please contact:

Craig Kief
Principle Investigator
Deputy Director, COSMIAC at University of New Mexico
craig.kief@cosmiac.org

Jim Stegeman
Manager, Architecture, Standards and Technology
Space Communications and Navigation (SCaN) Program
NASA Glenn Research Center
Stegeman@nasa.gov

Andres Martinez
Small Spacecraft Technology Program Manager
Space Technology Mission Directorate
NASA Ames Research Center
Andres.Martinez@nasa.gov

Andrew Petro
Small Spacecraft Technology Program Executive
Space Technology Mission Directorate
NASA Headquarters
Andrew.J.Petro@nasa.gov

Copper Mesh and Copper Foil Patch Antennas

CubeSat Printed with Thruster and with Embedded 28 Gauge Wire

National Aeronautics and Space Administration

Ames Research Center
Moffett Field, CA 94035

www.nasa.gov

NASA Facts

FS #2015-03-32-ARC