

The Center for Advanced Satellite Manufacturing



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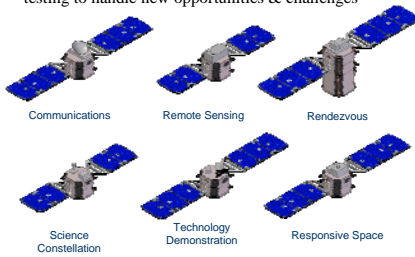
APPLYING ADVANCED DESIGN & MANUFACTURING TECHNIQUES TO SATELLITES



Additive Manufacturing Technologies and Modular Platform Designs

Platform Design

- Apply platform principles used in other industries (automobiles, consumer electronics, etc.) to satellites
- Requires some sacrifice in performance and first-unit development cost
 - Initial sacrifice offset by a reduction in non-recurring engineering costs, risks, and development time for follow-on units
- Enables rapid reconfiguration, manufacturing and testing to handle new opportunities & challenges



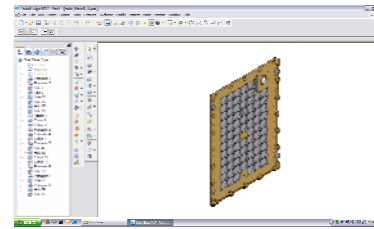
Design for Manufacturability

- Use Industry-Standard Design for Manufacturability & Assembly Techniques, Applied to Satellites
 - Adopt universal fasteners, mounting, connectors, etc.
 - Minimize assembly steps
 - Reduce number of manufacturing techniques used
 - Use pre-manufactured and commercial off-the-shelf (COTS) components.
- Modularize design and manufacturing
 - Individually separable modules
 - Assemble and test each module separately
 - Standard connections between modules enable reconfigurability and rapid assembly/disassembly



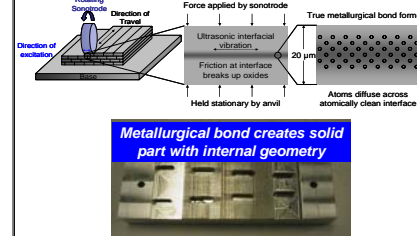
Rapid Reconfigurability

- Develop Software Tools which Enable "Bounded Customization"
 - Ability to rapidly change a design within certain bounds
 - Certify the quality of products manufactured within these bounds
 - Enables reconfigurable, responsive fabrication



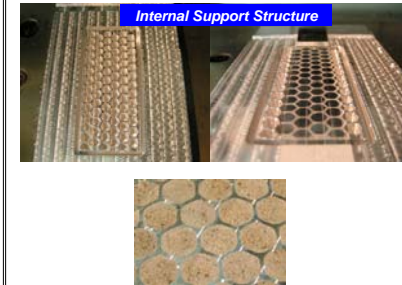
Ultrasonic Consolidation

- Ultrasonic Consolidation Enables the Fabrication of Advanced Satellite Panels and Modules
 - Embed electronics, wiring, sensors, fibers and other functional devices within a fully dense aluminum structure
 - Improve quality and reliability through increased automation
 - Shorter lead times due to the inherent digital reconfigurability



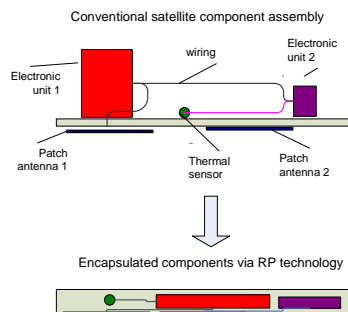
Advanced Structures using UC

- Utilize internal geometry and fiber-reinforced metal tapes to investigate novel structural design
 - Honeycomb-like sandwich panels with fiber-reinforced, stiffened skins



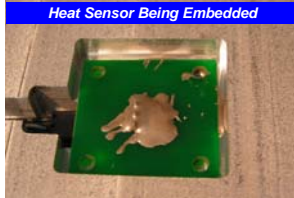
Direct-Write

- Direct-Write (DW) rapid prototyping (RP) enables deposition of conductors, insulators, capacitors, batteries, and more onto surfaces.
- Integration with UC enables
 - Embedded Circuitry, Wiring & Sensors
 - Printed Antennas



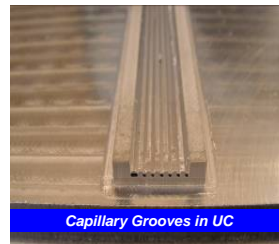
Embedded Electronics

- Used for:
 - Embedded Intelligence
 - Self-Monitoring Panels
 - Rapid Integration
 - Elimination of external wiring harnesses
- Encapsulated USB Devices
 - Internal Linux Processors
 - Connectors Distributed around Panels
- Sensors
 - Strain Gauges, Accelerometers, etc.



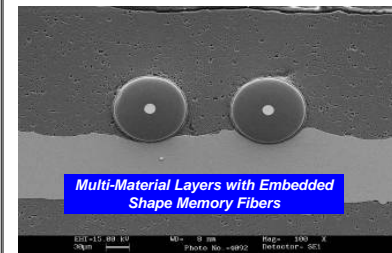
Thermal Capabilities

- Embedded Thermal Control
- Heat pipes
- Heaters
- Temperature Sensors
- Thermal Switches
- High Conductivity materials
- Phase Change Materials



Multi-Material Structures

- Structural properties can be improved by embedding materials
 - Piezoelectric stiffeners
 - Viscoelastic vibration dampers
 - Stiff or high strength materials



Embedded Fibers

- Ultrasonic plastic flow enables encapsulation of fibers
 - Structural fibers
 - Optical fibers
 - Shape memory fibers
 - Wire meshes
- Fibers can be used to:
 - Strengthen structures
 - Sense temperature & strain
 - Send signals
 - Actuate structures

