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DEPARTMENT OF AEROSPACE ENGINEERING

19ASZ401-3D Printing for Space Components

UNIT-IV Extrusion Based and Sheet Lamination Process

TOPIC: Manufacturing for Rocket Process

NAME: Mr.N.Venkatesh., M.Tech
Assistant Professor
Aerospace Engineering
SNS College of Technology

INTRODUCTION

- A spacecraft incorporating additively manufactured components through 3D-printing technology is constructed with 3D-printed rocket parts and small satellites.
- In comparison to traditional rockets, the 3D-printed variety is more fuel-efficient, lighter in weight, and can be built in a fraction of the time.“

Manufacturing of 3D Printed Rocket Parts

- The engines and airframes of 3D-printed rockets can be built in one piece without any joints, seams or welds.
- Its additive manufacturing process also streamlines production pipelines, requiring little to no tooling and fewer parts, while enabling aerospace startups to partake in rapid prototyping.
- 3D-printed rockets and their components are made using powder bed fusion method and directed energy deposition.

Powder Bed Fusion

- Using computer-aided design (CAD) software, the blueprint is uploaded, then split into thin cross sections.
- That data is then transferred to the manufacturing equipment — a large, boxy machine with a built-in window and leveling roller.
- At each step, the roller passes from side to side, like a beam in an office scanner, spreading a thin layer of powdered material onto the build tray.
- A laser then draws out the design per programmed instruction using applied heat that binds the material.
- The build tray lowers one level, and the next layer is built on top of the previous, now-solidified layer .
- This process repeats until the design is completed.

Directed Energy Deposition

- In this method, a multi-axis robotic arm directs an energy source such as a plasma arc, laser or electron beam following a CAD model.
- As the nozzle extrudes a filament likely a lightweight, metal alloy including aluminum or titanium it melts the material and deposits it onto a revolving build tray.
- 3D-printers oriented toward building rockets would tend to have spatial robotic manipulators working in conjunction with a very large, central turntable.
- This way, digital renderings can be turned into physical, functional components of scale, with the limitations being the size of its base and the chamber in which a piece is being built.

Application of 3D Printing for Satellites

- Additive manufacturing facilitates the creation of microsatellites and nanosatellites, opening up new opportunities for Earth observation, communication and scientific research.
- A satellite can be broken down into two main subsystems: the payload and the platform
- 3D printing offers interesting possibilities for the manufacture of lightweight, optimized structural parts.

3D Printed Panels and Supports

- Structural panels and supports are key elements of a satellite's structure.
- They can be printed using fiber-reinforced composite materials, such as carbon or glass, to achieve high strength while reducing weight.
- 3D printing can also be used to create complex internal structures to optimize panel rigidity and lightness.
- In fact, the mechanical structure is made up of panels that are assembled to form a strong, rigid envelope.
- Sandwich" technology panels are mainly used.
- An aluminum honeycomb mesh is sandwiched between two aluminum or carbon fiber panels.
- This technology offers a very attractive weight/performance ratio.

CONCLUSION

Additive manufacturing is revolutionizing the space industry, providing tangible opportunities for the manufacturing of rocket parts and satellites. With its capabilities in geometric complexity, structural lightening, functional integration, and customized production, this technology is pushing the boundaries of space exploration, simultaneously reducing costs and enhancing performance.

THANK YOU