National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Manufacturing

Calibration System for Automated Fiber Placement

Creating accurate defect standards for an in-situ inspection system

Innovators at NASA's Langley Research Center have developed a Calibration System for Automated Fiber Placement (AFP) machines. AFP is a modern composites-manufacturing method offering speed, repeatability, and waste-minimization benefits over traditional layup techniques. Used to make aerospace parts and wind-turbine blades, AFP employs a robotic arm to apply strips of carbon fiber prepreg (aka composite tape, or tows) to build up a composite part layer by layer. While advantageous, any imperfectly placed (or slipped) tows generate lap-and-gap defects relative to adjacent tows which can degrade structural integrity by as much as 30%. Currently, manual visual inspection is used to identify and fix such defects before curing, which is highly labor intensive. In-situ inspection systems are emerging, but no method exists to create accurate "defect standards" to facilitate active system calibration. NASA's new calibration system will enable the next generation of AFP in situ inspection technologies.

BENEFITS

- Precise and repeatable: NASA's new calibration apparatus can quickly design and make predictable and repeatable gap-and-overlap defects when employing AFP that can be used to certify and calibrate in situ inspection systems
- Efficient: using the new system, an entire build that has well-characterized defects at known locations can be manufactured quickly and reliably
- Low-cost: the calibration apparatus can be manufactured with extremely low-cost due to 3D-printability

THE TECHNOLOGY

NASA's new calibration system is a proprietary method to quickly design and make predictable and repeatable gap-and-overlap defects when employing AFP. The system creates defects within the course of layup with known sizes, geometries, and locations. Using this defect-creation technique, one can now accurately quantify the ability to detect defects on inspection systems, perform accurate risk assessments, and calibrate in-situ inspection equipment to specific materials. The equipment that makes the defects can be efficiently and inexpensively 3D printed. This technique is currently being used to successfully calibrate NASA's in situ inspection system for their AFP equipment.

AFP is experiencing increasing adoption in aerospace, automotive, and other industries that leverage large-scale advanced composite components. NASA's new AFP calibration system could be very useful to companies that develop and manufacture AFP machines or AFP machine inspection equipment to improve the quality of their products in a provable manner. Furthermore, users of AFP machines may find value in the tool for creating their own calibration standards.

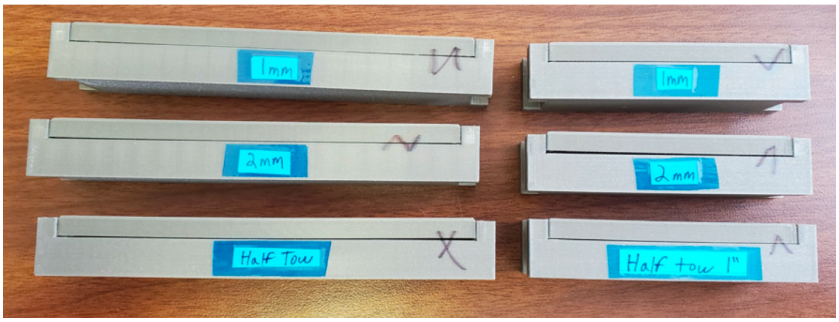

Photo of six different apparatuses for creating overlap/gap defects of different widths and lengths. Image credit: NASA

APPLICATIONS

The technology has several potential applications:

- Aerospace and Aviation
- Automotive
- Commercial Space
- Composites
- Marine
- Unmanned Vehicles

PUBLICATIONS

Patent No: 11,685,129

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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