TECHNOTES

A PUBLICATION OF THE COMPOSITES MANUFACTURING TECHNOLOGY CENTER
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HOW DOES THE COMPOSITES MANUFACTURING TECHNOLOGY CENTER (CMTC) WORK?

CMTC issues calls for new project concepts on behalf of the Office of Naval Research. Any company or team of companies can submit project concepts. CMTC works with proposers to refine concepts and ensure alignment with Department of Defense challenges.

This process leads to formal technical and cost proposals. ONR evaluates these proposals and selects sources. CMTC awards projects and work begins.

Automated In-Process Inspection for Automated Composite Lamination

Status: New Start

Start / End Dates: May 2021 - June 2023

Navy ManTech Investment: $2M

Weapon Systems: F-35 Lightning II

Project Performers:

- ATI/CMTC: Program Manger/COE
- ONR: Government Sponsors
- JSF: Platform Program Office
- Northrop Grumman: Manufacturer

Objective: The demanding performance requirements of modern composite structures is predicated on tightly controlling the tolerances of the as-built part. This duteous approach ensures that the as-designed part is manufactured within the established design limits. Defects that cause the part to deviate from the design can come from a wide variety of sources. One of the defining strengths of automated composite layup and forming is that it removes a considerable degree of the variability introduced by manual layup. Although automated layup and forming technologies provide a significantly more robust and repeatable process, automated manufacturing equipment is still susceptible to producing a part that deviates from nominal and violates specification tolerances. To detect, correct, and control these deviations some form of inspection system is required.

The current industry standard for inspection of composite parts is manual ply-by-ply inspection of the composite layup. This approach to inspecting composite parts has a number of limitations and drawbacks that result in costly rework, excessive material consumption, and reduced production rates. An automated in-process inspection system has significant potential to mitigate and eliminate these aforementioned drawbacks of the current industry standard. This Composite Manufacturing Technology Center (CMTC) project, which includes Northrop Grumman and FIVES, will use a phased approach to develop and demonstrate an automated in-process inspection system capable of transitioning to production.

Implementation: Upon successful completion of this project, the intent is to pursue the transition of the technology onto automated fiber placement (AFP) machines used to produce nacelles on the F-35 program. Qualification of the system will take approximately three months minimum beyond the end of this CMTC effort, and orders for inspection systems could be placed as soon as 2023.

CMTC IS NOW ACCEPTING RESEARCH PROJECT CONCEPTS

CMTC is currently accepting project ideas that will reduce the cost and time to manufacture or improve the performance of the following U.S. Navy platforms.

- Columbia Class Submarine
- DDG 51 Class Destroyer
- CVN 79 Class Carrier
- F-35 Joint Strike Fighter
- Virginia Class Submarine
- FFG(X)

To discuss your project ideas, please contact:

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AUTOMATED FILLET & CAP SEAL

Status: New Start

Start / End Dates: March 2021 to October 2022

Navy ManTech Investment: $1.6M

Weapon Systems: F-35

Project Performers:
- ATI/CMTC: Program Manger/COE
- ONR: Government Sponsors
- JSF: Platform Program Office
- Lockheed Martin: Manufacturer

Objective: Fillet and Cap Sealing for F-35 is currently a labor-intensive process in which assemblers manually apply sealant to the aircraft using a variety of disposable tips and hand smooth the material to final shape. This process is very time consuming and has multiple application issues such as material overflow leading to slump, dripping, voids, and excessive material usage increasing cost and subsequently increased aircraft weight. This sealant is utilized on a variety of grooves requiring fillet seals and hardware requiring cap sealing on Eddie-Bolts. An automated sealant dispensing system has significant potential to reduce labor costs and increase uniformity of fillet and cap seal which minimizes aircraft weight. The ManTech project, to include Lockheed Martin and Encore Automation, will implement a phased approach that aims to develop and demonstrate an automated application system capable of transitioning to production.

Implementation: Initial implementation is expected at the Lockheed Martin Fort Worth facility with a follow-on implementation at the Lockheed Martin Marietta facility. The implementation process is expected to commence immediately following the successful conclusion of the ManTech project. Implementation is expected to include procurement of the capital system, performing qualification testing and any necessary changes to procedures, work instructions and drawings.

AFP/ATL HYBRID STRUCTURES

OBJECTIVE

The Automated Tape Layup (ATL) and Automated Fiber Placement (AFP) manufacturing processes have significantly advanced over the past 30 years. However, both ATL and AFP developers have evolved within their distinct paths and optimized each process with respect to their suitable products. The separate development paths of ATL and AFP have resulted in distinct software and hardware capabilities for each manufacturing process. With the Navy considering future systems utilizing a larger proportion of composites, such as the Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS), the need to fabricate large, complex contoured parts will increase. A novel hybrid-manufacturing solution that optimizes the weight of the AFP process and the affordability benefits of the ATL process is highly desired.

Phase 1 demonstrated the technical capabilities and the potential cost and weight savings of the new hybrid AFP/ATL technology on bismaleimide (BMI) materials. Phase 2 of the program studied the hybrid AFP/ATL concept with epoxy materials.

STATUS:
Project Complete

PERIOD OF PERFORMANCE:
May 2016 to February 2021

PARTICIPANTS:
Navy ManTech, ATI/Composites Manufacturing Technology Center, Northrop Grumman

MANTECH INVESTMENT:
$2.4M

Successful demonstration of this new technology enables future Navy systems to achieve the affordability benefits of ATL and the performance benefits of AFP. At the completion of this project, this will be true of both BMI and epoxy material systems.

ACCOMPLISHMENTS / PAYOFF

PROCESS IMPROVEMENT:

The team learned that the hybrid process is not ideal for every part. The savings from utilizing this process come from a combination of part size, complexity, and material costs. Smaller complex parts are not favorable candidates because there is a loss in efficiency during layup due to their small surface area, and lack of material. Adding core pads to parts further increases the complexity, AFP challenges, and costs. Fiber placing over core must be well understood before attempting on future production programs. Automation is more efficient at laying up larger acreage parts resulting in better savings on material and labor costs.

IMPLEMENTATION AND TECHNOLOGY TRANSFER:

The technology resulting from this project could support acquisition programs currently in place, such as the F-35 Lightning II, as well as future acquisition programs, such as the UCLASS, TERN, and F/A-XX. Since these future programs are still in the early development phases, no specific implementation plan is prepared.

Demonstrating this technology will enable future platforms to make informed, baseline decisions on part design and fabrication options by understanding the cost and weight implications of such decisions. With respect to current platforms, the F-35 may require additional wing part fabrication capacity depending on the full production build rates that are achieved. If the F-35 supply chain requires additional equipment, successful execution of this project will enable the part producers to make informed decisions about the proper equipment to purchase to support the increased rates. If the supply base elects to use the hybrid system, then typical F-35 implementation methodology will be followed.

EXPECTED BENEFITS AND WARFIGHTER IMPACT:

Successful implementation of the novel hybrid AFP/ATL technology is anticipated to have the following benefits:

- 10% reduction in part cost through reduction in material costs and increased layup rates
- Reduction in manufacturing downtime
- Ability to consolidate multiple parts into a single complex part
- 15% improvement in material deposition rate
- Weight optimization