F-35 High Fidelity Fastener Feature Measurement

Problem/Objective:
High fasteners are a critical issue on the F-35, especially if not caught until the latter stages of the manufacturing process. F-35 fastener feature measurements must be taken for countersink depth, installed fastener flushness, and final fastener flushness after fill material has been applied. Current methods for inspecting fastener features at various stages of manufacture are dependent on handheld gauges which have proven unreliable and non-repeatable. Single line laser scanners have also been evaluated by our partners at Lockheed but rejected because these systems cannot detect fastener tilt that is perpendicular to the measurement direction nor can they characterize the cunature of aircraft panels. The F-35 team at Lockheed Martin and Northrop Grumman desires a portable inspection device which can measure these features precisely, quickly, and affordably.

The goal of this program, and a complementary SBIR-funded effort, is development and validation of a non-contact laser scanner for measurement of the flushness of unfilled fastener heads on the production floor. The results of the program should provide aerospace prime contractors with sufficient information to determine if they would like to purchase systems for use during production. The system will be designed to measure the position of unfilled fastener heads with respect to the profile of the outer skin of the aircraft. The target accuracy for the system is ±0.01" (one standard deviation).

The Creare Fastener Measurement Tool (FMT) is intended to provide three important advantages over existing inspection methods: (1) greatly improved accuracy, (2) significantly reduced dependence on operator skill (measurement accuracy will no longer depend on the position and orientation of the measurement device), and (3) reductions in both inspection time and cost (an initial evaluation by Lockheed Martin shows that the technology can reduce lifecycle program costs by more than $13M for unfilled fasteners alone). Accomplishments/Payoff:

The FMT has been shown to be a precise and accurate handheld device, while also being fast and easy to use. Multiple rounds of testing have consistently produced results showing an expected FMT precision-to-tolerance on the order of 12% (when calculated according to current F-35 unfilled-fastener-depth manufacturing tolerances). This is a very strong level of performance both with respect to our specific device requirements and general metrology standards in manufacturing. Furthermore, both FMT accuracy and measurement time have been shown to improve on fastener measurement methods, suggesting a significant cost saving when the FMT is incorporated into F-35 production.

Lockheed Martin has performed an affordability analysis to determine if the purchase of production units of the FMT is justified. Per Lockheed Martin's assessment, the application of this technology on unfilled fasteners alone would save over $10,000 per aircraft. Further savings could be realized with this device as the capabilities are augmented for filled fastener flushness measurement.

Implementation
The necessary steps have been taken to ensure that a low-cost method of surface feature measurement has been demonstrated that meets the requirements of the program and is safe for operator use. A functional measurement hand tool has been built and proven on production equivalent aircraft parts. No qualification testing is anticipated to be required at this time. In addition, the cost benefits of adopting the technology on the production floor will be quantified via (1) a refined estimate of inspection time and cost savings per aircraft, (2) pricing analysis for the FMT, and (3) evaluation of additional benefits provided by the technology. Implementation is expected late FY16.

Timeline/Milestone:
Start Date: September 2013
End Date: March 2016
Funding:
ONR Navy ManTech Investment: $500K

Participants:
ONR Navy ManTech, SCRA/Composites Manufacturing Technology Center, and Creare

Join Us At:
CAMX 2016 in Anaheim, CA on September 26th through 29th in Booth N56. We look forward to seeing you there!

PHOTO CREDITS:
Page 3 - Enabling Technologies Submarine Composites Photos courtesy of Material Sciences Corporation
Page 2 - Rear Admiral Matthews W. Winter and Marty Ryan, ATI Vice President, discuss CMTC’s Enabling Technology efforts...“Transitioning Advanced Manufacturing Technology for an Affordable Fleet”
Other graphics on Cover:
Office of Naval Research logo
ASA Logo
NavalTech Logo
Cover of Navy ManTech
Questions of the Quarter

Our new section, “Questions of the Quarter” is dedicated to what YOU want to learn more about the CMTC, advanced materials, new technologies, etc. It is also a space for the CMTC to learn about what YOU would like to see featured within our CMTC TechNotes Newsletter.

We will use your questions and suggestions in order to ensure we are providing you with the most current, relevant information within the industry. Each quarter CMTC will highlight questions that are asked and provide insight to all TechNotes readers.

Q: Who doesn’t contact if I have a question about CMTC or a request for future TechNotes?
A: Please send your questions, suggestions, and requests to:
Leslie Hill
Sr. Program Administrator, CMTC
Office: 864-646-4505
Mobile: 864-704-2479
Email: Leslie.Hill@ati.org

Q: How are featured “Questions of the Quarter” selected?
A: CMTC will select several questions for each TechNotes publication to feature based on how frequently the question is asked, its benefits to TechNotes readers, and its relevance to the Composites Manufacturing Technology Center.

Q: Is sent in a question, but it is not a featured “Question of the Quarter,” how can I learn the answer?
A: Regardless of whether your question is featured, CMTC will respond to all requests via phone call or email.

Q: I have a question, but do not want it featured in TechNotes?
A: We will not feature your question. Please let us know that you would prefer to keep your question, request, or suggestion private and you will not see it in any TechNotes publication.

The only exception to this is if it is a frequently asked question that many other readers have sent in and are also curious about.


CMTC participated in the Sea-Air-Space Exposition 2016 in National Harbor, MD on May 16-18, 2016. This annual exposition brings together stakeholders from each branch of the military, industry, and community in order to collaborate, network, educate, and learn about United States maritime efforts. The event displayed several exhibits that showed current information and technology relevant to maritime, defense, and energy. In addition to exhibits, educational seminars were held to educate and learn about key technologies, efforts, and issues surrounding Sea Services. The next Sea-Air-Space Exposition will be held on April 11-13, 2017 in National Harbor, MD. For additional information about the Conference, please visit: www.seaaispace.org/page.cfm/?Link=1/t/m/g50Section=1Newsport.

Enabling Technologies for Integrated Manufacturing of Submarine Components

Problem/Objective:
Like other programs in the Department of Defense (DOD), the VIRGINIA Class submarine (VCS) and the OHL (Advanced Technology International) submarine (OR) program face substantial financial challenges due to the current fiscal environment. OR is additionally challenged because of considerable procurement cost and maintenance cost for the lead ship and target costs for ships 2-12 of the class. Reaching the target procurement costs for the lead ship, and only attainable through cost-effective designs that save money over the entire life of the submarine and manufacturing approaches that reduce acquisition costs. The objective of this project is to develop and validate repeatable manufacturing approaches, and their associated cost and weight impacts, for submarine applications. This project uses a systems-engineering approach to determine groups of components with similar requirements that can then be mapped to enabling technologies and/ or combination of technologies. Enabling technology and manufacturing approaches to be considered under this effort include: out-of-autoclave (OOA) processing to enable efficient use of carbon fiber; multi-material (glass/carbon fiber) solutions for cost/weight reduction; integrated manufacturing of structural-aesthetic windows; integrated manufacturing of laminates with structural damping treatments; and integrated manufacturing of laminates with polymer coatings. This project is one of Navy ManTech’s Manufacturing Science and Technology efforts. These efforts typically do not meet all of ManTech’s normal project criteria, as they are higher risk projects with longer transition timelines.

Accomplishments/Payoff:
Significant cost and weight can be removed from both platforms by replacing conventional metallic and traditional GRP components with state-of-the-art composite structure. While innovative composite materials and the integrated manufacturing technologies that they afford offer cost/weight reduction opportunities, a platform-wide analysis of the system/components that can benefit from these technologies is required in order to define the technology/ combination of technologies that result in the largest payoff. Understanding the technical and cost relationships between innovative composites and the spectrum of components that they can improve provides alternative design and manufactur- ing approaches for groups/families of components currently manufactured using GRP or steel on a broader level, thereby affecting a comprehensive impact to cost/weight reduction initiatives compared to historical single component analysis. The deliverables developed as a result of this effort will also provide a valuable data attribute to be used by both the government and General Dynamics Electric Boat (GDEB) for performing design trades and component pricing estimates.

Implementation:
The techniques and processes developed in this project will be leveraged to all composites currently under the submarine programs. This project will demonstrate a production ready composite article that could transition at the end of this Manufacturing Science and Technology effort. Implementation is planned to occur beginning with SSN 792.

Timeline/Milestone:
Start Date: December 2014
End Date: July 2016
Funding:
Navy ManTech Investment: $691,000
Status: Active
Participants:
Materials Sciences Corporation and Seemann Composites

ATI and SCRA’s Organizational Separation

Effective July 1, 2016, SCRA Applied R&D will return to operating under the name ATI (Advanced Technology International). This name change marks a return to the name used by the company until 2010 and formalizes a shift in the South Carolina Research Authority’s (SCRA) overall corporate strategy that clearly differentiates ATI’s business operations from the economic development mission of SCRA, its corporate parent. ATI’s staff and corporate strategy will be aligned with its new mission, as a S&O(3) not-for-profit, will be to support SCRA and SC, while lessening the burdens of Government as a market leader in managing collaborative research and development programs for federal government, industry and academic clients. The new name is part of a larger re-branding initiative to align the company’s name with its current business and future strategy.

The transition allows ATI to focus on its mission to build and lead technology development collaborations. As part of the process, both SCRA and ATI have launched new websites (www.scra.org and www.ati.org), allowing the organizations to maintain separate identities for their respective constituencies. ATI also has a new logo to differentiate it as an affiliate. The new ATI logo is a combination of elements, some familiar and some new, designed to simultaneously convey who we are, what we do, and why.

CMTC Project Portfolio

Active Projects

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Project Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2601</td>
<td>Low Cost Hybrid Fairings</td>
</tr>
<tr>
<td>S2332</td>
<td>Composite Hybrid Rotating Coupling Covers</td>
</tr>
<tr>
<td>S2455</td>
<td>Light Weight Low Cost Seafall 11-Round Guide Phase 1 &amp; 2</td>
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<tr>
<td>Q2596</td>
<td>Enabling Technologies for Integrated Manufacturing of submarine Components</td>
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<tr>
<td>Q2533</td>
<td>Composite Manufacturing Technology for Fire Safe Resins</td>
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<tr>
<td>A2587-7</td>
<td>Automated Material Mixing for F-35</td>
</tr>
<tr>
<td>A2583</td>
<td>Smart Processing Manufacturing Technology</td>
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<tr>
<td>A2513</td>
<td>F-35 Automated and Rapid Boot Installation</td>
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<tr>
<td>S2655-1</td>
<td>Automated Manufacturing of Hull Tiles Phase 1</td>
</tr>
<tr>
<td>M2676</td>
<td>Back-fit Composite Flood Gates</td>
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</table>

Near Term Proposed New Start Projects

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Project Name</th>
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<tbody>
<tr>
<td>Q2688</td>
<td>APP/ATI Hybrid Structures</td>
</tr>
<tr>
<td>Z2685</td>
<td>Carbon Fiber Substitute for Composite Rocket Motor Cases</td>
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<tr>
<td>Z2684</td>
<td>Lulibekhead T-Flange Crease Elimination (Mega Rapid Response)</td>
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<tr>
<td>D2680</td>
<td>3-D Composites for Out of Plane Strength</td>
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<tr>
<td>S2679</td>
<td>Fire Resins Phase 2</td>
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<tr>
<td>A2678</td>
<td>F-35 Automated Optical Distortion Measurement and Correction</td>
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<tr>
<td>S2677</td>
<td>Plug and Play Composites</td>
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<tr>
<td>A2670</td>
<td>Girar Box High Temperature Fairing</td>
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<tr>
<td>A2669</td>
<td>Main Rotor Hub Faring</td>
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<tr>
<td>A2857</td>
<td>Plasma Surface Preparation for Composite Nutplate Installation</td>
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<tr>
<td>A2654</td>
<td>CH-53K Canopy Frames</td>
</tr>
<tr>
<td>A2574</td>
<td>Automated Conformable Tooling For Mold-In-Place Coatings</td>
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<tr>
<td>A2568</td>
<td>JSF Infometrics</td>
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