Topic: N162-085

Hill Engineering, LLC

Analytical Tool for Design and Repair of Engine Hardware for Robust High Cycle Fatigue Performance
ERS-Toolbox® by Hill Engineering, a global leader in improving the performance of materials, quickly provides accurate and reliable predictions of residual stress and distortion resulting from surface treatment processes like shot peening, laser shock processing, and cold hole expansion. ERS-Toolbox® uses an award-winning methodology to map process information from our proprietary database directly into leading finite element modeling tools for easy integration with your unique internal workflow. ERS-Toolbox® is designed for engineers and analysts who need to design, analyze, and optimize the use of engineered residual stress surface treatments to maximize the performance of critical structural details. ERS-Toolbox® has proven to be successful for targeted airframe and engine applications and we are constantly improving the software to expand its capability, applicability, and reach.

Technology Category Alignment:

Materials & Manufacturing Processes
Air Platforms
Engineered Resilient Systems (ERS)

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SYSCOM: NAVAIR
Contract: N68335-18-C-0240
Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-18-C-0240

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-833

Topic # N162-085

Analytical Tool for Design and Repair of Engine Hardware for Robust High Cycle Fatigue Performance

Hill Engineering, LLC

WHO

SYSCOM: NAVAIR

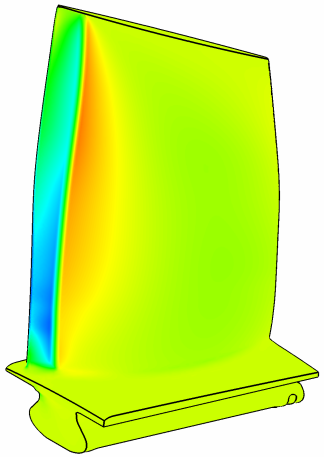
Sponsoring Program: F-35 JSF Program Office

Transition Target:

TPOC:
(301)757-5190

Other transition opportunities: Aircraft engines (Navy and USAF), aircraft structures, and other applications where compressive residual stress surface treatments are used to enhance performance.

Notes: ERS-Toolbox® supported design and analysis of a structural retrofit to the F-22 aircraft using laser shock peening to restore performance and extend the service life of the airframe. ERS-Toolbox® offers a fast and flexible approach to design an optimal process for the desired level of compressive residual stress benefit while managing potential detriments from tensile residual stress and process-induced distortion.



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WHAT

Operational Need and Improvement: A robust analytical tool for the design and repair of high cycle fatigue (HCF)-resistant integrally bladed rotor (IBR)/blisk airfoils.

Specifications Required: Define the residual stress profile (including the equilibrating tensile residual stress) as a function of depth in the airfoil post surface treatment while accounting for the probabilistic variability innate to airfoils (e.g., manufacturing, material, in-service damage, and blend accuracy). Support various applications including: component life assessment, HCF design or surface treatment definition following a service-revealed HCF deficiency, airfoil serviceable limit expansion, and airfoil repairable limit expansion. The software should be: accurate within 10% on residual stress, maintain, or improve, the mesh size of the parent finite element method (FEM) model, and leverage modern computer aided design and analysis software.

Technology Developed: ERS-Toolbox® by Hill Engineering quickly provides accurate and reliable predictions of residual stress and distortion resulting from surface treatment processes like shot peening, laser shock processing, and cold hole expansion. ERS-Toolbox® maps process information from our proprietary database directly into leading finite element modeling tools for easy integration. ERS-Toolbox® is designed for engineers and analysts who need to design, analyze, and optimize the use of engineered residual stress surface treatments to maximize the performance of critical structural details.

Warfighter Value: Premature failure due to high cycle fatigue (HCF) or in-service damage, for some aircraft propulsion systems, has resulted in limited mission capability. in addition, maintenance costs and asset readiness are a significant challenge for aircraft engine operators. ERS-Toolbox® can accurately and efficiently predict residual stress for a wide variety of surface treatment processes, materials, and part geometry, enabling higher performing parts, and leading to a reduction in sustainment costs, an increase in readiness, and improved safety.

WHEN

Contract Number: N68335-18-C-0240 **Ending on:** March 30, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Proof-of-concept demonstration of software prototype	N/A	Prototype software demonstration for representative test cases	3	March 2017
OEM technology integration workshop	N/A	Developed integration plan	3	October 2017
Legacy airfoil validation	N/A	Residual stress accuracy verified	4	September 2019
Advanced engine airfoil validation	Med	Achieve goals and objectives for demonstration	5	March 2021

HOW

Projected Business Model: Hill Engineering will sell ERS-Toolbox® software licenses to government and industry organizations who need to design, analyze, and optimize the use of engineered residual stress surface treatments to maximize the performance of critical structural details. Hill Engineering will provide technical support and we will continue to add new features and capabilities to ERS-Toolbox®.

Company Objectives: Hill Engineering is a global leader in improving the performance of materials. We are a trusted partner to engineers seeking solutions in design, manufacturing, operations, and sustainment; delivering expertise in residual stress measurement, mechanical design, material testing, structural integrity, and service life extension.

We are looking to connect with organizations who have a need for and employ potential users of our software including engineers and analysts responsible for structural integrity who want to use engineered residual stress surface treatments to maximize performance, improve reliability, and reduce sustainment costs. ERS-Toolbox® has proven to be successful for targeted applications and we are constantly improving the software to expand its capability, applicability, and reach.

Potential Commercial Applications: Commercial products have many of the same challenges and opportunities from a structural, readiness, cost, and safety perspective as their military counterparts. ERS-Toolbox® can benefit many commercial products including: aircraft engines, aircraft structure, space structures, automotive vehicles, automotive engines, heavy equipment, and many more.

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