Extreme Lightweighting for Sustainability

S&T Campaign: Sciences for Maneuver
Logistics & Sustainability

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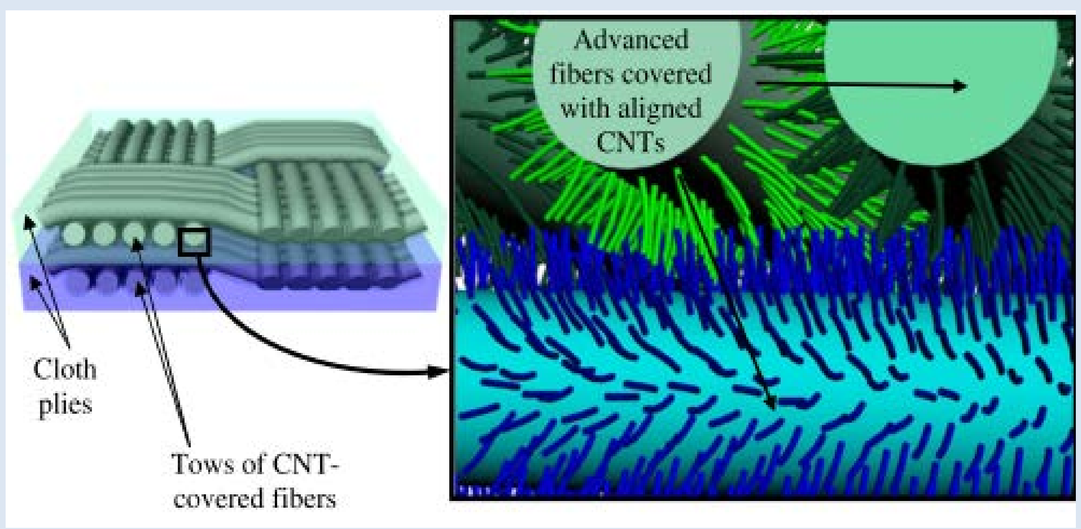
Research Objective

- **Establish and mature XLADD structures to enable "fatigue-free" operation of Army Future Vertical Lift (FVL)**
- **Engage in discovery of novel concepts and physics-based models to improve fatigue resistance for enhanced structural reliability and durability**
- **Develop self-sensing, lightweight structural composite for aerospace applications.**



Garcia, Wardle, Johnhardt & Yamamoto, 2008
An, Rider, & Thostenson, 2012

Challenges

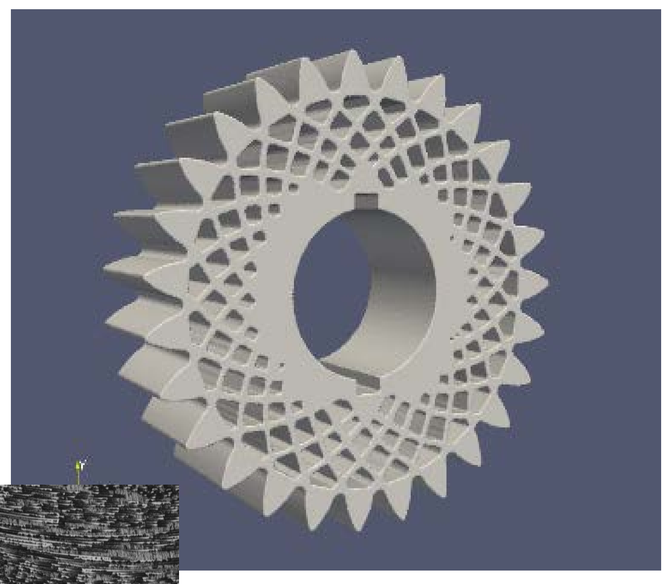
- **Lightweight, high-strength, composite/metallic and multifunctional structural configurations and designs are sought to increase damage tolerance**
- **Advancement of probabilistic algorithms for fatigue life management by increasing prediction accuracy and reducing computational times**
- **Additive manufacturing of multifunctional fatigue-resistant lightweight structural components**

Next-Generation Rotorcraft Concept

ARL Facilities and Capabilities Available to Support Collaborative Research

- **Quasi-static, fatigue, and "high-cycle fatigue" testing capability including 100-kN Servo-hydraulic Mechanical Testing Machines; 1-kHz, 22-kN Servo-hydraulic Mechanical Testing Machine; and 5-kN Electromechanical Testing Machine with Environmental Chamber**
- **ASTM test fixtures for tension, compression, and bending tests of metals and composites**
- **Temperature and humidity chamber for accelerated aging experiments**
- **Dimension Elite and Replicator 2X for 3-D printing multifunctional structural components**

Topologically Interlocking Structures



Durable/Fatigue-Resistant Structures

Complementary Expertise/Facilities/ Capabilities Sought in Collaboration

- **Advanced characterization and modeling of precursors to damage with particular emphasis on fatigue failure initiation**
- **Advances to enable the next generation of self-healing structures**
- **Hybridization of materials and processes for 3-D printing multifunctional structural nanocomposites with hierarchical ordering**

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