

# Embedded Sensor Processes for Aviation Composite Structures

*Develop and demonstrate new manufacturing techniques for integrating sensor networks into composite aviation structural components.*

## OBJECTIVE / SOLUTION

Develop and demonstrate manufacturing techniques for integrating electrically conductive polymer based shock, vibration, and damage-assessment sensors in composite structures. The program will: identify or develop adhesive materials or binding techniques for integrating sensors with composite materials; evaluate current composite repair techniques for incorporation of sensor network repair processes; develop affordable processes for manufacturing of sensors on flexible substrates; and demonstrate sensor network conductivity.

Continual efforts to add more mission equipment to the aircraft have increased weight and stresses on the airframe with no way to monitor or assess the lifetime effects on the structural components. Integrated composite components are currently the best solution to allow for weight savings and potentially increase the Time Between Overhaul (TBO) of components. There is also an immediate need to incorporate structural (battle damage) monitoring capabilities into these composite structures to accurately measure effects of hostile fire on the airframe. This program will produce two prototype composite vertical stabilizers integrated with sensors to demonstrate feasibility and incorporate designs into outyear helicopter production.

## ACHIEVEMENTS

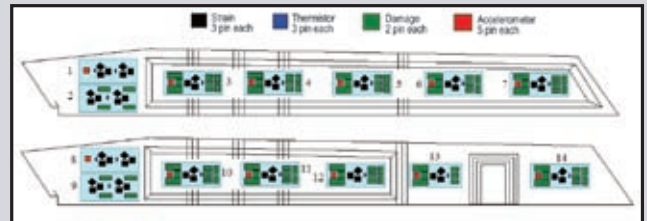
Strain/temperature sensor suite and battle-damage sensor technology have been proven out for this program (TRL/MRL 4). There are currently 14 flexible sensor sheets attached to both IML (inner mold lines) of the prototype Composite Vertical Stabilizer (CVS) as shown in illustration of the layout and design of these sensors. Ground testing of the sensors and CVS is scheduled for 1QFY10.

## BENEFITS

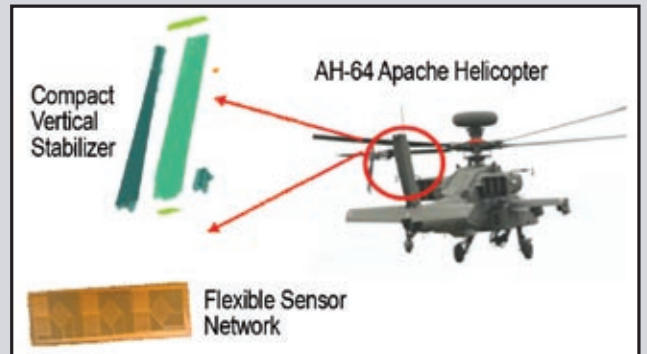
- Advance the capability for realtime aircraft damage detection
- Provide opportunity to integrate into the Army Modernized Signal Processing Unit (MSPU) to produce structural health indicators
- Leverage composite technology to produce lighter aircraft structures to allow larger payloads that can expand warfighting capabilities
- OEM leveraging with 2 composite vertical stabilizers and 1-2 composite tail booms



AH-64 Apache Helicopter



Active Sensor Network Installation Locations on the Composite Vertical Stabilizer



Composite Vertical Stabilizer with Electrical Bonding and Lightning Protection

## STATUS

- Program is currently in its second year of funding (FY09)
- FY08: Initial prototype of Compact Vertical Stabilizer (CVS)
- FY09: Development of sensor manufacturing; Integration, assembly, and test of CVS prototype with sensors
- FY10: Testing of integrated Composite Aft Fuselage (CAF) to include composite vertical stabilizer, horizontal stabilator, and composite tail boom)

## WEAPON SYSTEMS / SECONDARY ITEMS IMPACTED

- AH-64 Apache Helicopter
- Unmanned Aerial Systems
- Manned aircraft structures

## POTENTIAL COST AVOIDANCE

- Return on Investment up to 17:1 with a cost benefit of \$95.3M