Life-Cycle Management of Multifunctional Composite Materials

Colleen Rosania

Structures and Composites Laboratory (SACL)
Department of Aeronautics and Astronautics
Stanford University
Introduction

- Carbon Fiber Reinforced Polymers (CFRPs) widely used in application
  - High strength to weight ratio
  - Used in high-performance structures
- Nondestructive inspection processes needed to monitor these materials
  - Damage and condition more difficult to sense than with traditional metal structures

Boeing 787, 50% composite

BMW i-series, carbon fiber body
Problem Statement

Create intelligent composite materials with embedded sensors that can monitor their manufacturing process and material quality, sense the state of the structure and current damage, and predict damage propagation throughout the material during its lifetime.
Method of Approach

Continuous Process Control
- Temperature
- Pressure

Manufacturing the Material

Information from the composite during cure

Cured Composite

Use the sensor network to monitor the material during use

Quality Control
- Material Properties
- Void Formation
- Defects

Information from the composite immediately after manufacture
Results

• Data collected in cure monitoring experiments
  – Algorithm development underway
  – Will be applied to real-time manufacturing
  – Further experiments needed

Future Work

• Material property verification
• Integration of previous research on life cycle management will be combined for a complete monitoring system
  – State awareness (temperature, load, etc.)
  – Damage detection & prognosis

Experimental cure monitoring set-up, with sample in oven wired to data acquisition equipment