DEPARTMENT OF MECHANICAL ENGINEERING

Field-Portable NDE Equipment Concepts for Tagged Smart Composites Applications -- Part I

Progress Report for the period 9/03/98 - 2/28/99
Contract DACA88-98-K-0001

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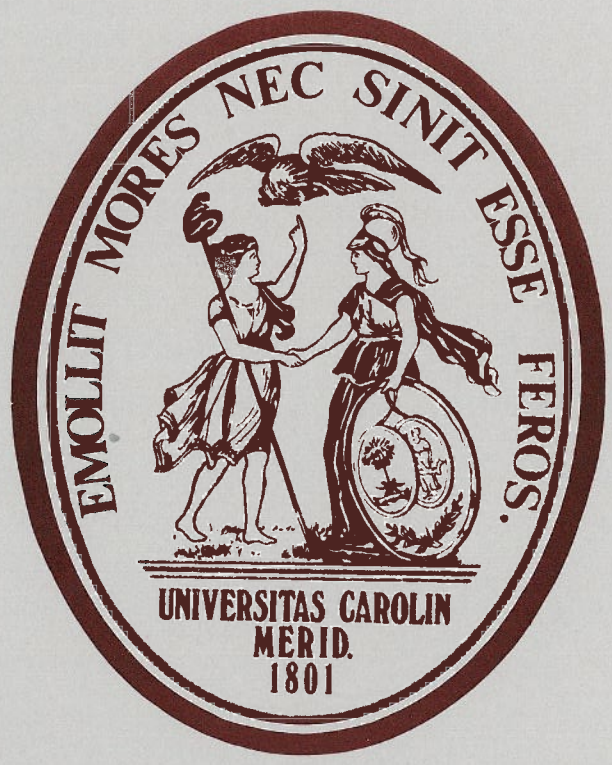
REPORT # USC-ME LAMSS 99-102



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1. BACKGROUND

The work to be perform in the Laboratory for Adaptive Material Systems and Structures (LAMSS), Department of Mechanical Engineering, University of South Carolina under the 1998-99 US Army CERL contract # DACA88-98-K-0001 consists of 3 major tasks:

Task 1:	Concepts for Field Inspection and Evaluation (Including Remote Evaluation) of Structural Health of Military Infrastructure or TO Structures Fabricated from Smart Composites (such as MC), or containing Smart Composite Upgrades or Patches, by Exploiting the Smart Composite Phenomenon
Task 2:	Equipment Needed to Implement a Smart Composite Field Inspection/Evaluation Procedure
Task 3:	Transfer the Smart Composites Technology to the Ultimate Field User

2. STATUS

2.1. Planning for First Quarter

During the first quarter of the project duration, work was done on Task 1 and Task 2. In summary, the work done on these two tasks during the reported period can be described as follows:

Task 1: Concepts for Field Inspection and Evaluation (Including Remote Evaluation) of Structural Health of Military Infrastructure or TO Structures Fabricated from Smart Composites (such as MC), or containing Smart Composite Upgrades or Patches, by Exploiting the Smart Composite Phenomenon.

The work done on this task during the reported period has been mostly literature review and information gathering. The project team has studied the Government-Furnished Information (GFI), i.e.,

1. Information derived from the research conducted at the University of Illinois under US Army CERL contract No. DACA88-97-K-0001, entitled "Smart Materials for Infrastructure Applications".
2. Information resulting from the research conducted by Strain Monitoring Systems, Inc. (SMS) under contract No. DACA88-97-C-0002, entitled "Development of Wireless, Structural Health Assessment Systems"
3. Information available from the calendar year (CY) 1998 USACERL / Composites Institute (CI) Smart Tagged Composites Working Group meetings.

Task 2: Equipment Needed to Implement a Smart Composite Field Inspection/Evaluation Procedure

The work done on this task during the reported period has been mostly literature review and information gathering. A wide literature search for commercially available devices for magnetic field detection/inspection has been performed. A detailed report resulting from this effort has been compiled in draft format.

2.2. Degree of Completion

Task 1 is completed 60%.

Task 2 is completed 40%.

Task 3 has not been started yet (completion 0%).

3. RESULTS - PROPOSED CONCEPT AND METHOD FOR FULL-SCALE NDE INSPECTION EQUIPMENT

Based on the investigation performed during Task 1, preliminary conclusions can be already drawn. The three top-ranking candidate systems for field inspection/evaluation of smart composites for military infrastructure or TO structures fabricated from smart composites, or containing smart composite upgrades or patches, are:

1. Magnetostrictive composites (MC) tagged with magnetostrictive TERFENOL-D powders to be examined by non-contact scanning equipment under operator control for determining the strain distribution in the structure and the state of structural health.
2. Piezoelectric composites (PZC) containing sensory layers consisting of regularly distributed wafer-size piezoelectric active sensors connected in a sensory array, to be interrogated remotely for determining the state of structural health.
3. Fiber optics composites (FOC) containing interwoven optical fiber sensors with multi-site Bragg gratings, to be interrogated remotely for determining the strain distribution in the structure.

All the three concepts listed above will be interfaced, as an option, with a data acquisition/telemetry unit for data transferring to a remote central monitoring station equipped with artificial intelligence software for structural health monitoring, diagnosis, and failure prevention.

4. PROPOSED WORK FOR NEXT QUARTER

Task 1: Expand the concepts for field inspection and evaluation (including remote evaluation) of structural health of military infrastructure or TO structures fabricated from smart composites (such as MC), or containing smart composite upgrades or patches. Exploit the smart composite phenomenon to target specific applications. Develop illustrative examples of convincing proof-of-concept applications with compelling argumentation for life cycle cost saving and safety/effectiveness improvements.

Task 2: Develop details of the equipment needed to implement a smart-composite field-inspection/evaluation procedure. Construct laboratory-scale proof of concept demonstrations.

Task 3: Start addressing the issue of transferring the smart composites technology to the ultimate field user. Develop a public presentation to be delivered to potential end users in an interactive (Questions and Answers) format.