Detection of Defects in C/C Composites Using Infrared Thermography

**INTRODUCTION**

The objective of this study is the use of NDE to determine subsurface defects in C/C composite disk brakes. With the use of existing NDE methods the equipment is expensive; this project deals with the ability to use thermography method but with less expensive equipment. The following main objectives of this work include:

1. Use FEA Models to better understand the capabilities/limitations of the NDE methods available.
2. Use various thermography techniques currently available at SIUC to determine the capabilities/limitations.
3. Use both heat treated and non-heat treated C/C composite disk brake samples.
4. Create an inexpensive method for determining subsurface defects in C/C composite material as a visual/quality inspection system.

**Experimental Setup**

**Thermal Contrast**

$$C(t) = \frac{T(t) - T_{ref}(t)}{T_{ref}(t)}$$

**Commercial Defect Detection with Thermography**

**Experimental Results for Blind Hole and Drilled Side Hole**

**Machined Defects (CAFS-CVI C/C)**

**Manufactured Defects**

**Thermography Testing of C/C Composite Disk Brakes**

**Sample Preparation**

**Thermal Measurement with IR Camera**

**Heat Flux Application**

**FEA Models**

**Verification of results with SEM**

**Experimental Results with SEM**

**Mapping of CAFS-CVI C/C Samples**

**Defect Detection**

**Region of Highest Thermal Contrast**

**Heat Treated MABS C/C Disk Brakes**

**Temperature-Time Curve of Commercial Disk Brake**

**Commercial Defect Detection with Thermography**

**MABS C/C Disk Brake Image**

**MABS C/C Disk Brake Thermal Image of Delamination**