Low Frequency Eddy Current Testing for Subsurface Cracks in Aluminum Aircraft Supports

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Outline

- Introduction
- Problem definition
- Probe design
- Simulation Results
- Experimental Results
- Conclusion and Future work
Introduction

Location of CF-188 Stub Flanges on the CF-188 Fighter Jet.
Test Samples - Eyebrow Crack

A = 0.4", 0.5", 0.6"
B = 3/8"
RC = 0.288"
Crack height = 0.15"
Scanning Probe

Differential pick-up coils

Drive coil
Problem Definition

Slanted sample

EC probe

Bolt

Slanted sample
Proposed Solution

Scanning probe

Sample
FEM Modeling Using COMSOL

Challenges

- Build the 3D geometry
- Meshing
- Material parameters
Horizontal Sample VS Slanted Sample

- No crack with 5 deg. slope surface
- No crack in horizontal sample

Images and diagrams illustrating the comparison between horizontal and slanted samples.
The Response as a Function of Sample Thickness

- NC_500Hz_5deg_0.25"thick
- NC_1000Hz_5deg_0.25"thick
- NC_500Hz_5deg_0.35"thick
- NC_1000Hz_5deg_0.35"thick
The Response as a Function of Sample Slope

500 Hz_NO crack_ 0.25"_thickness_without edge

- 1 degree
- 3 degrees
- 5 degrees
The Response as a Function of Sample Slope

1000 Hz_NO crack_ 0.25"_thickness_without edge
Different Crack Heights for rounded edge sample at 1 kHz
FEM modeling of edge effect

NO Edge  Edge 1  Edge 2
Edge Effect Without a Crack at 1 kHz for height of 0.15"

![Graph showing edge effect comparison between round and sharp edges.](image-url)
Measurements

NORTEC 600 D

Real Sample
Measurements

NO crack, 0.15”, rounded edge, 1000 Hz, 60 dB

0.6” crack, 0.15”, height, rounded edge, 1000 Hz, 60 dB
Measurements

NO crack, 0.15”, rounded edge, 200 Hz, 60 dB

0.6” crack, 0.15”, height, rounded edge, 200 Hz, 60 dB
Conclusions

- Simulations were performed to give information about different geometries and conditions.
- Experimental measurements demonstrate ability to size crack in terms of depth and length.
Future work

- Refine probe (make thinner, use spherical washer)
- Develop eye brow probe
Thank you!