Integrative Multiscale Engineering of Materials and Systems Lab

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Structural Health Monitoring using Lamb Wave, Piezoelectric Sensor/Actuator array and Computational Technique

Wavelet energy based damage parameter correlation

- Vertical crack
- 45° inclined crack
- Horizontal crack
Figure 1: Experimental arrangements for Lamb-wave damage detection using 3-D laser vibrometry as a receiver.
2.25mm thick quasi-isotropic Glass-Epoxy Laminate
Total number of layers: 12
Delamination sizes: 40mm, 30mm, 20mm
Layer locations: 5-6, 4-5, 3-4
Actuation: 60V peak, 80kHz, modulated sine
Use of Piezoelectric Active Sensor (PWAS) Network

Corrosion
Use of Piezoelectric Active Sensor (PWAS) Network

Data stored in Matrix form

Time Reversal of the Sensor Signal

Data stored in matrix form after time reversal

Affected Sensor Cluster for Damage Localization

Triangulation for estimation of size and shape of damage

Vertical crack

45° inclined crack

Horizontal crack

Damage Index J

Damage Index J vs Crack length (cm)

- 20 kHz
- 40 kHz
- 60 kHz
- 80 kHz
- 100 kHz
- 120 kHz
- 140 kHz
- 160 kHz
- 180 kHz
Amplification of Transmitted Waves Through Hidden Damages

Input signal frequency of 180 kHz

Tasks to be performed by the Software

- Take boundary type data and main panel thickness data as input
- Perform frequency sweep and obtain A0/S0 curves
- Perform damage index specific to A0/S0 frequencies for main panel. If above tolerance then damage is in main panel. If it is at some other frequencies then the damage is in the substructure.