

Acoustic Emission Detection and Neural Network Classification of Fatigue Cracks in a Simulated Aircraft Fuselage Structure

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Simulated Aircraft Fuselage with Riveted Repair Patch and AE Transducers Attached Bolted into Pressurization Fixture with Stiffened Steel End Plates

OBJECTIVES

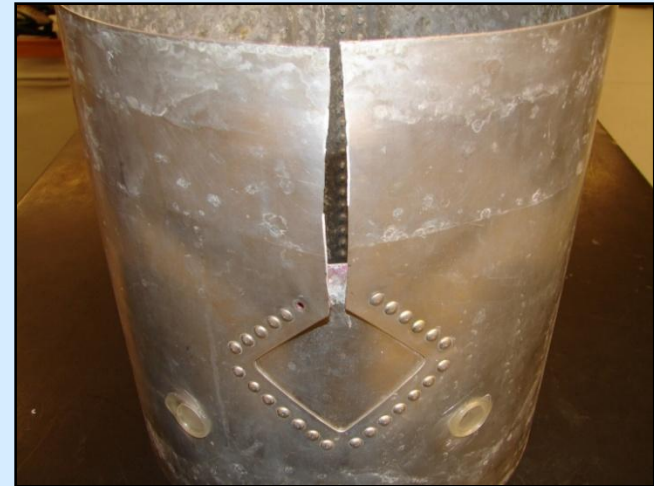
- Use Kohonen self-organizing map (SOM) neural network to classify acoustic emission (AE) data from fatigue cracking, plastic deformation (ahead of crack tip), and the noises associated with rivet fretting and joint rubbing in a simulated cylindrical aircraft fuselage structure
- **Goal:** Demonstrate the ability to **differentiate AE fatigue crack growth signals** from other structural noises in a laboratory environment

APPROACH/TECHNICAL CHALLENGES

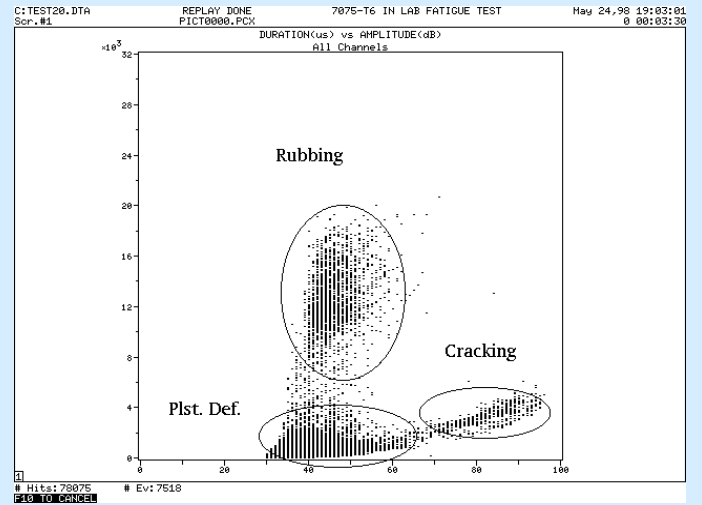
- Monitor cyclic fatigue crack growth in 7075-T6 aluminum simulated cylindrical fuselage structure under pressurization/depressurization using a hydraulic cylinder and the MTS machine
- Train SOM neural network to accurately detect fatigue crack growth AE signals from both the power spectra of the raw AE waveforms and the standard AE waveform quantification parameters

ACCOMPLISHMENTS/RESULTS

- **SOM neural network successfully classified AE fatigue cracking data with a 99% accuracy**

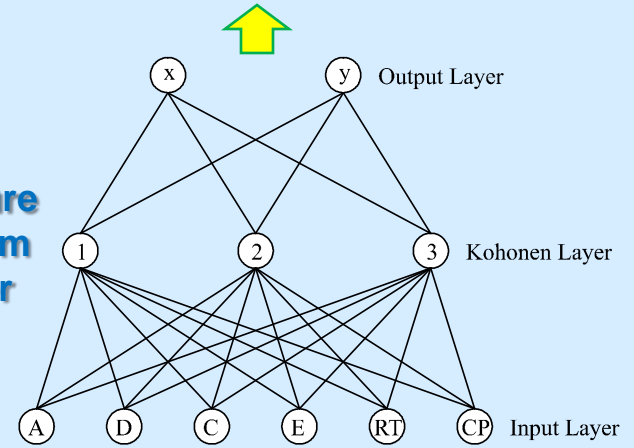


Simulated Aluminum Fuselage Structure with Riveted Repair Patch Fatigue Cracked to Failure



AE Source	Duration [μ s]	Amplitude [dB]
Fatigue Cracking	0-6,000	65-100
Plastic Deformation	0-6,000	30-65
Rubbing/Fretting	6,000-32,000	30-70

SOM Failure Mechanism Classifier



AE Signal Parameters

