Crack Growth Analysis and Detection

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with

Summer Institute 2008
Clarence Mitchell School of Engineering,
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Agenda

- Introduction
- Problem
- Challenges
- Assessment
- Objectives
- Methodology
- Results

INTRODUCTION

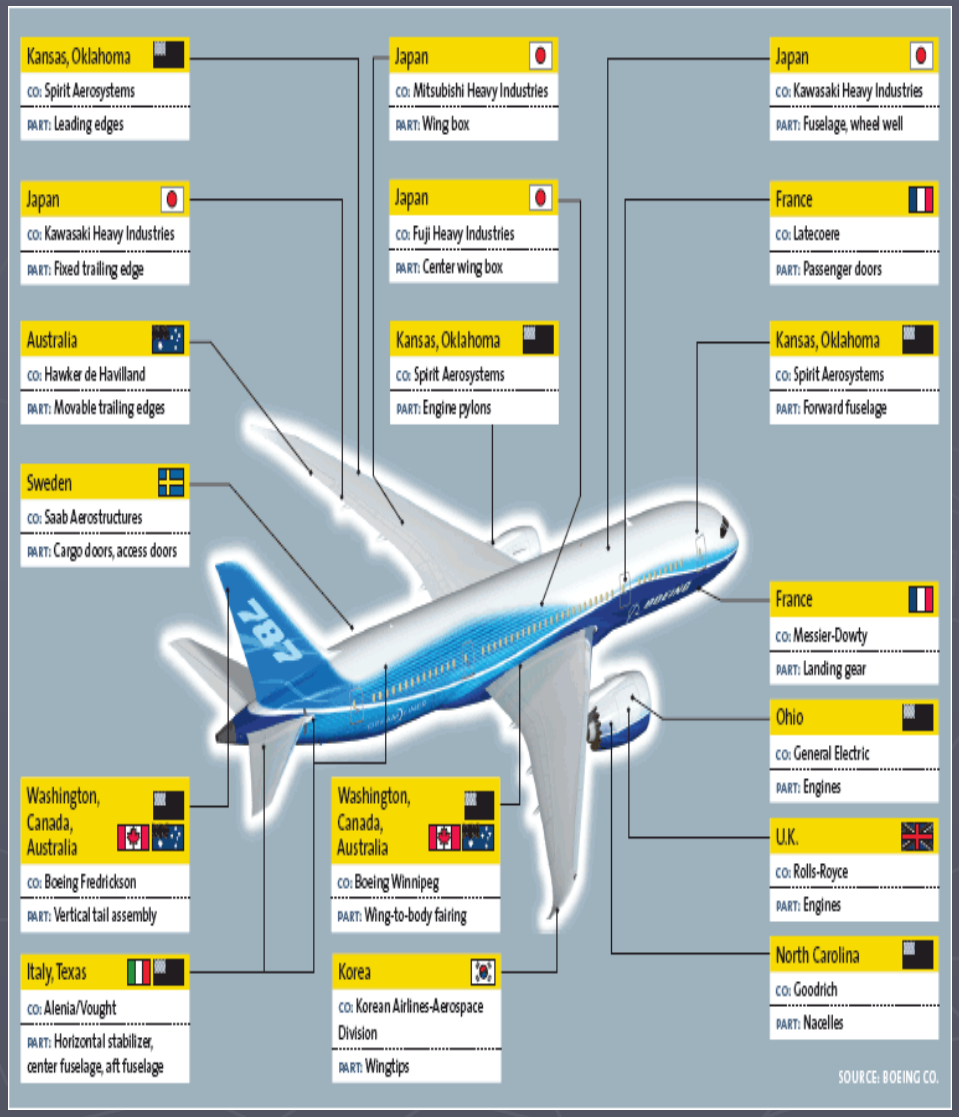
- Aging of commercial aircraft critical issue for passenger safety.
- Potential threats and vulnerabilities include weather, flutter and wind loadings.
- Countermeasures include fracture mechanics analysis.

BACKGROUND

- Composite materials supersedes the previous use of metals in airline construction.
- The Boeing 787 is the largest commercial air vehicle and aerodynamically supports the majority of the load with its wings during flight.
- Material imperfections will be modeled with the finite element modeling method and fracture mechanics theory.

AIRCRAFT ATTRIBUTES

- Seat for 290 to 330 passengers
- Range: 3,050 mi.
- X-section: 226 inches
- Wing Span: 170 ft.
- Length: 186 ft.
- Height : 56 feet
- Speed: Mach .85
- Entry Service: 2010
- Take Off Wt.: 364,000 lbs



NEEDS ASSESMENT

- April 28, 1988 multiple fatigue cracks (737-200) aircraft lost part of fuselage (1 life lost).
- May 9,2005 Rockwell international model shj-6(at-6f) airplane crash large fatigue crack (2 fatalities).
- 1988, Aloha airlines 737 micro-crack
  (3 critically injured)

RESEARCH OBJECTIVES

- To improve commercial air safety (passenger) thru multi-physics analysis.
- To accurately model crack propagation in virgin composite material.
- To obtain theoretical results that can be validated through experimentation.

COUNTERMEASURES

- Composite materials are those containing more than one bonded materials with different structural properties.

- Ansys and FEM will allow one to model crack growth and propagation negating adverse aging aircraft wing failure.

TECHINCAL CHALLENGES

- Securing proprietary Boeing composite material properties.
- Obtaining current Boeing composite virgin experimental data.
- Morgan State University will collaborate with NASA officials to obtain this data.

RESEARCH METHODOLOGY

- The Elastic Plastic Fracture Mechanics Methodology has evolved significantly in the last several years. Nevertheless, some of these concepts need to be extended further before the whole methodology can be safely applied to structural parts. Specifically, there is a need to include the effect of constraint in the characterization of material resistance to crack growth and also to extend these methods to the case of 3D defects.

RESULTS AND DELIVERABLES

- Crack growth calculations.
- Stress results associated with crack growth.
- ANSYS input/output files.
- Recommendations that will minimize crack growth and increase air safety.
- Publication

Acknowledgements

- I would like to thank:
  - Mrs. Ransom
  - Dr. Johnson
  - Mr. Haynes
  - Prof. Willoughby
  - School of Engineering
  - CIBAC funding and Sponsors
  - All others who contributed indirectly

Questions

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