

Theodoros Kermanidis; University of Patras, LTSM



European aeronautics science network

## Aerostructures

### EASN Interest Groups

#### Interests Groups in Aerostructures (ACARE- ASTERA Taxonomy)

- Ageing Aircraft (P. Horst)
- Crashworthiness and structural Impact for Commercial a/c (R.Mines)
- Increased Exploitation of Metallic Airframe Materials(E.Hombergmeier)
- Surface Engg. (C. Rodopoulos)
- Damage Tolerance of Welded Aerostructures (A. Kermanidis)
- Increased exploitation of composites (G.Labeas)
- Recycling (of composites?) and Life-Cycle Management ( N.N.)

## IG: Ageing Aircraft

**IG leader:** Prof. Peter Horst, TU Braunschweig, IFL

**Technology Area:** Aerostructures

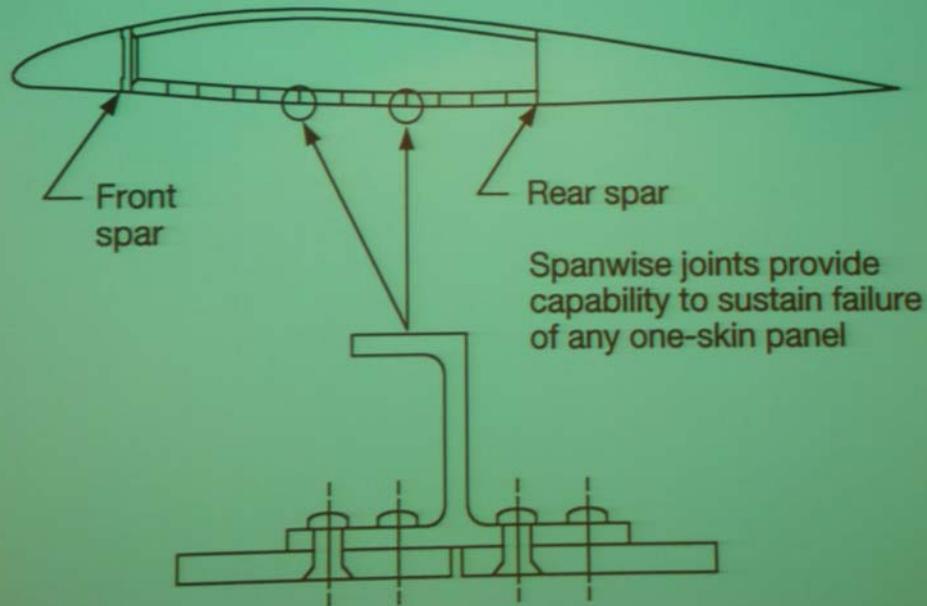
### Objective:

Ageing aircraft is the technical term indicating that an aircraft is about to reach its original design goal. It is estimated that currently more than 15000 airplanes have already or are about to reach the ageing aircraft condition. At this condition, the light alloy structures used in commercial aircraft are susceptible to Widespread Fatigue Damage (WFD) and possibly other deteriorating effects, such as corrosion, fretting, ect. The widespread cracking, resulting from WFD, leads to the condition of Multiple Site Damage (MSD), which refers to the existence of interacting fatigue cracks at different sites of a structural component. Critical crack sizes are greatly reduced by the presence of MSD, decreasing the residual strength of the structure. The sudden cohesion of such interacting cracks may lead to catastrophic failure.

## IG Members

<i>Organization</i>	<i>Surname</i>	<i>First Name</i>	<i>Email</i>
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## Wing Fail Safety

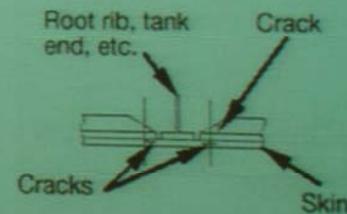
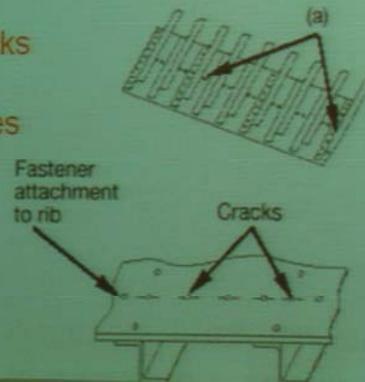


## WFD Evaluation

Australian Government  
Department of Defence  
Defence Science and  
Technology Organisation

- WFD is precluded by establishing
  - A Structural Modification Point (SMP) beyond which an aeroplane cannot be operated unless the relevant structural feature is modified or replaced
- Precautionary inspections, where viable, are introduced at
  - An Inspection Start Point (ISP)
- WFD comes in two types MSD and MED

MSD Example:  
Chordwise cracks  
link up at rib  
attachment holes



MED Example:  
Cracks in multiple components  
at stiffener run-outs at root rib  
or tank end rib

## EASN IG-Aging aircraft

### IG-Activities so far

Several Projects have been proposed under this title.

- DaToN
- ...
- BICPAN

## EASN IGs

### DaToN: Short History

1st proposal : was not successful

2nd proposal was successful under 6th FP  
(approx. 2.8 M€)

The project just ended (Sept. 08)

Dissemination takes place  
(e.g. by a special issue on the project in a scientific journal)

## EASN IGs

### DaToN:

IFL TU Braunschweig	Germany
Airbus Deutschland	Germany
EADS CCR	France
EADS CRC	Germany
IAI	Israel
ASMT	Netherl.s
FOI	Sweden
DLR	Germany

NLR	Netherl.s
IDMEC	Portugal
Pisa	Italy
Brno	Czech Rep.
Sheffield Hallam	UK
Patras	Greece
Imperial	UK
* ALCAN	France

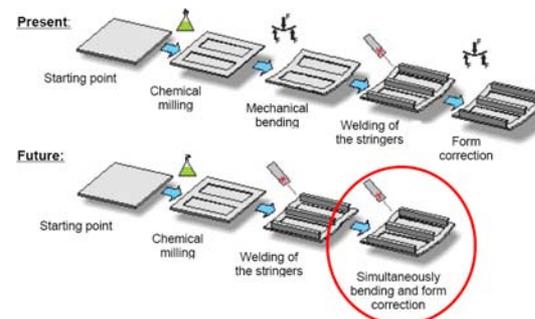
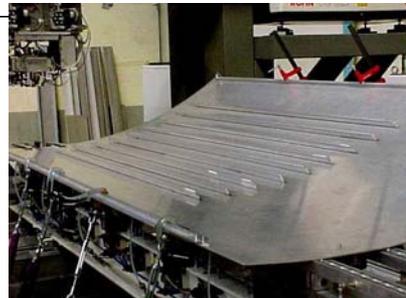


UNIVERSITY OF PATRAS  
DEPARTMENT OF MECHANICAL AND AERONAUTICAL ENGINEERING

LABORATORY OF TECHNOLOGY & STRENGTH OF MATERIALS

## Modern manufacturing techniques

The target of cost reduction and productivity increase leads industry to the production of **integral structures** by adopting new manufacturing techniques.



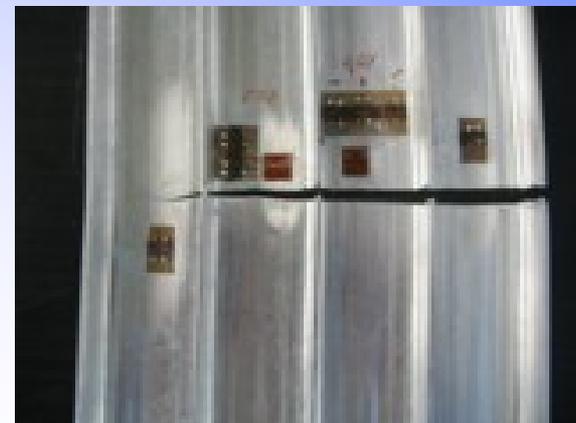
- Modern manufacturing techniques
- Residual Stresses
- Problem definition
- FE analysis
- Effect of RS field on SIFs
- Prediction of crack propagation angle
- Conclusions

## EASN IGs

### DaToN:

New manufacturing techniques available :

- LBW
- FSW
- HSC / HPC



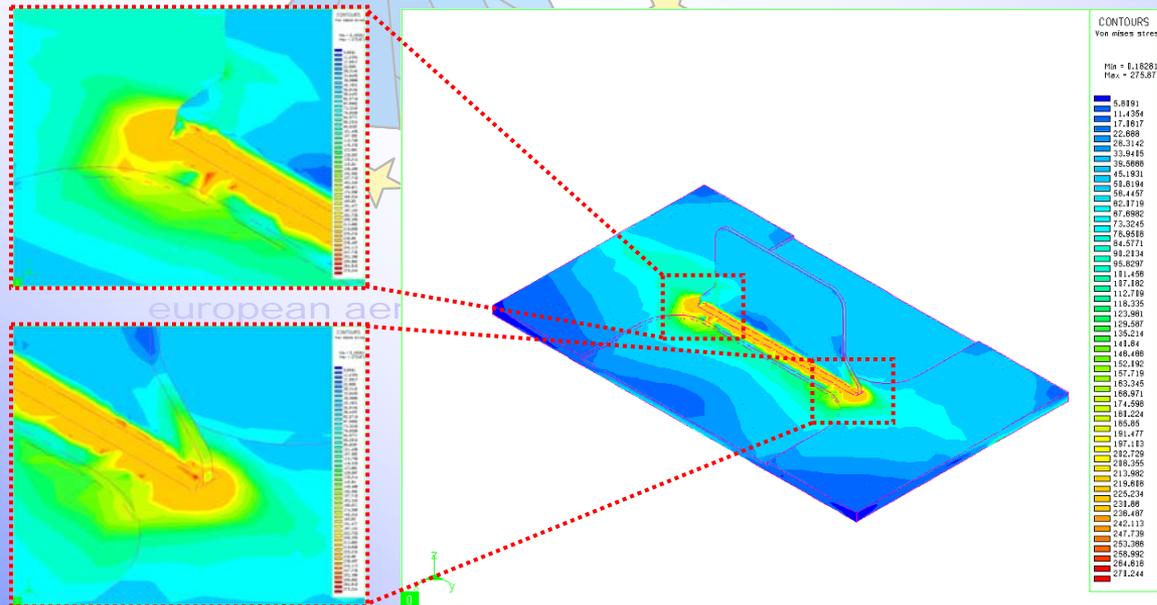
All resulting in a more or less „integrally stiffened structure“

Ability to manufacture is clearly proved.

In order to allow a reasonable (broad) application in aeronautics,  
reliable assessment methods  
are needed.

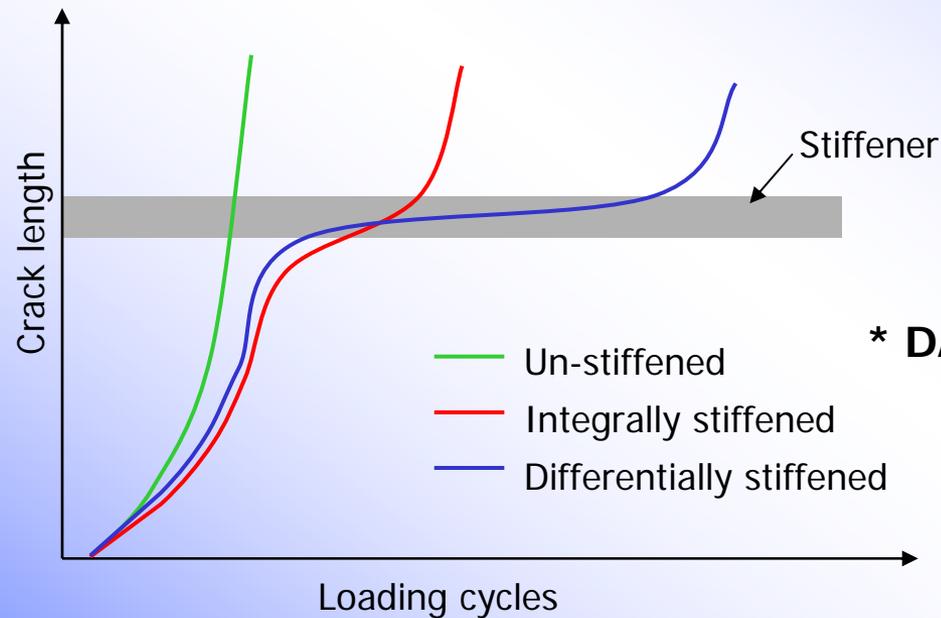
Residual Stresses in welded structures can be determined by:

- Experimental techniques (x-ray, neutron de-fraction etc.)
- Complex numerical simulation



Application of these techniques leads to:

- Development of residual stresses and deformations
- Different mechanical and damage tolerance behaviour compared with conventional differential structures



\* **DATON project**

## EASN IGs

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## EASN IGs

Area of Interest: Aerostructures:

- **Recycling (of composites) and Life-Cycle Management ( N.N.)**

proposed during Munich meeting

up to now interest by

- Villu Mikita (Eesti Lennuakadeemia)
- Andris Chate (Riga TU)
- ...
- Dr.-Ing. habil. Herrmann (TU Braunschweig)

Questions .. Proposals...?