

Detection of Surface Discontinuities in Additively Manufactured AlSi10Mg Using Thermoelastic Stress Analysis

ICAS ECSC Pitch Session

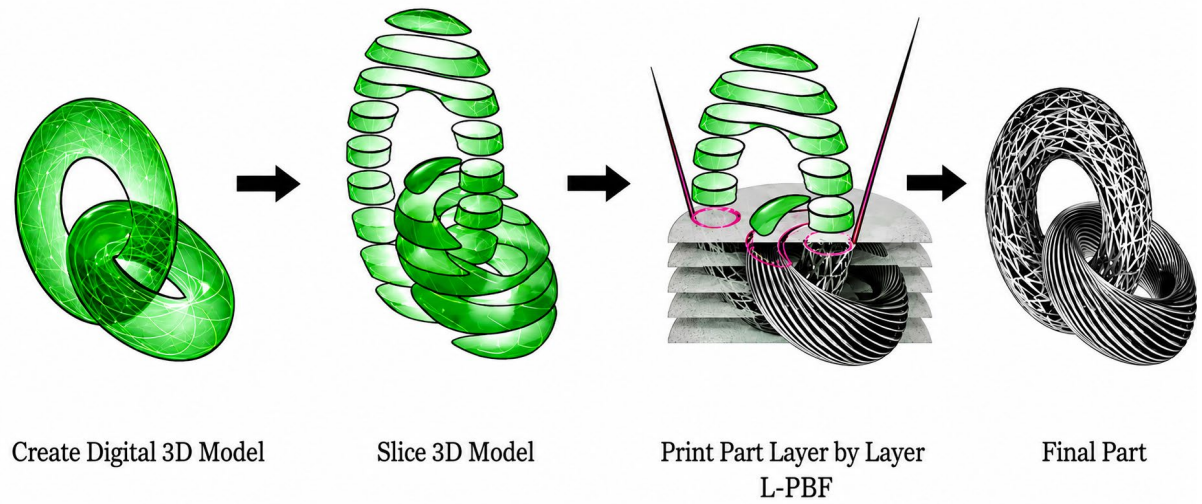
Joshua Rodrigues[1, 2]

[1]Centre for Advanced Defence Structures and Materials Experimentation (CADSME), RMIT University, Melbourne 3000, Australia
[2]Centre for Additive Manufacturing, RMIT University, Melbourne 3000, Australia



What's wrong?
…in a good way?

- **Aerospace** industry is **growing**
- **Lighter designs** to **reduce cost** and **pollution**
- **3D-printing** - additive manufacturing (**AM**) - is a **way forward**



AM process of metal: laser powder bed fusion (L-PBF)

What's the problem?

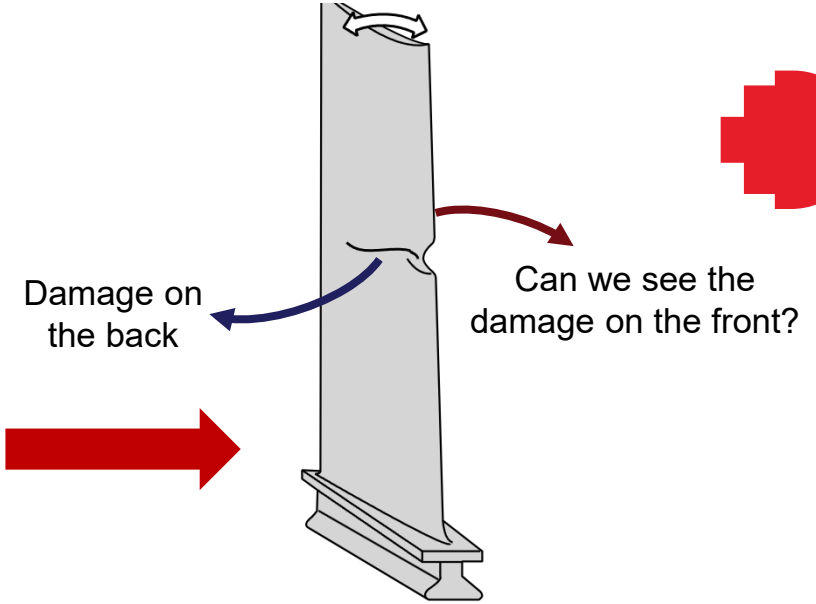
- **How** do we **assess** if a **part** is **useable**?
- **How** can we **know** if a **part** is **damaged**?



Original (left) and lightweight AM (right) component

What can we do?

- **Check** for **damage** in a 3D-printed **structure**
- **Can** we see **damage** from the **side opposite** to where it is?



Aircraft turbine blade

How do we do that?

- **Analyse** the **temperature** of a **part**
- Thermoelastic stress analysis (**TSA**)

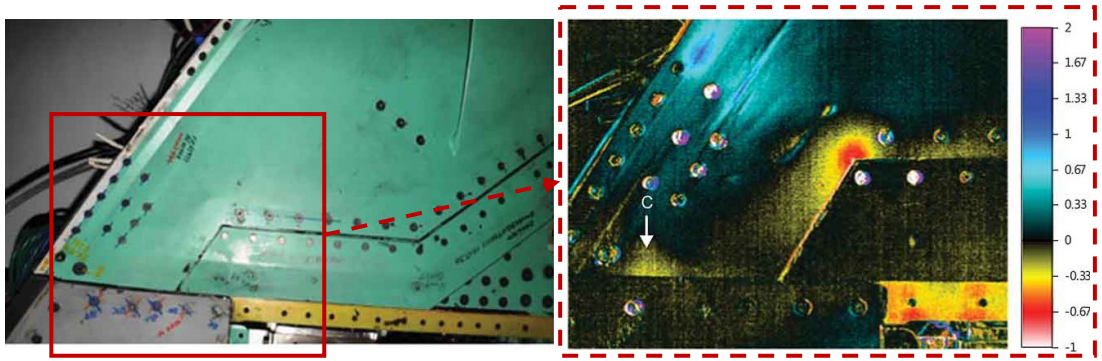
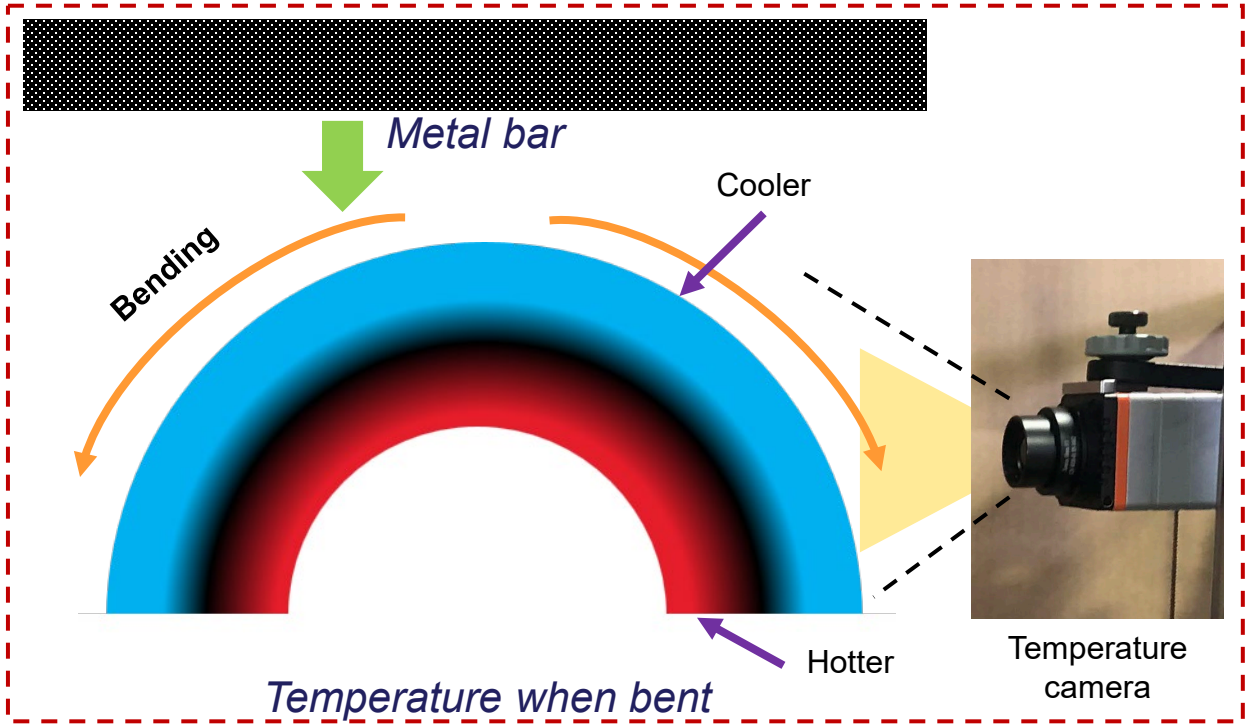


Image of (left) aircraft part and (right) TSA heat map

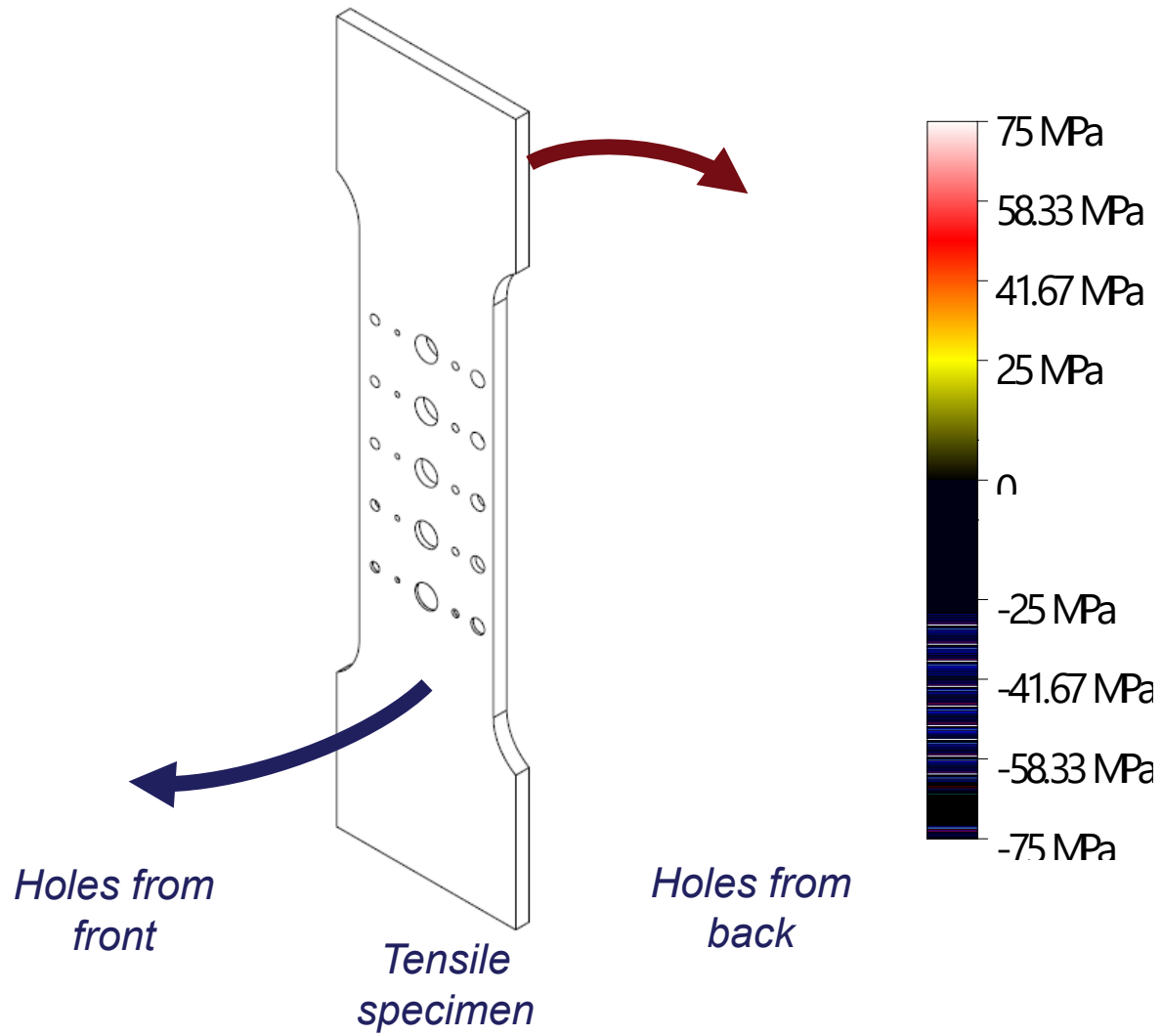


Temperature when bent

What did we learn?

- **Can see holes** on **part** using **temperature**
- **Holes** can be **seen** from **opposite side**
- **Big** (+3 mm diameter) and **deeper holes** (~1.5 mm) are **easy to see**
- **Smaller** and **shallower** holes are **difficult** to **see**





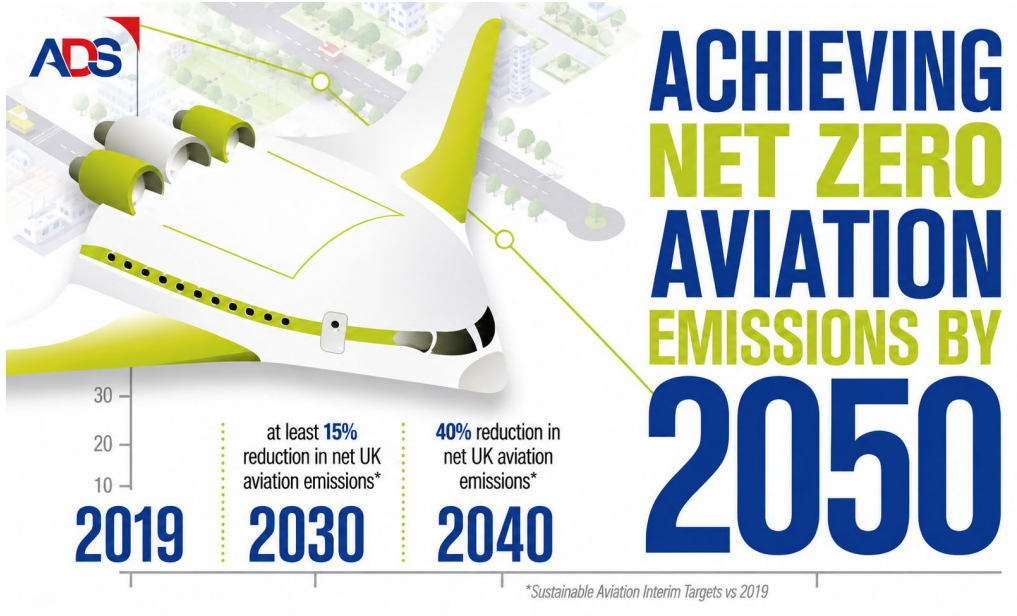
So what?

What does this mean?

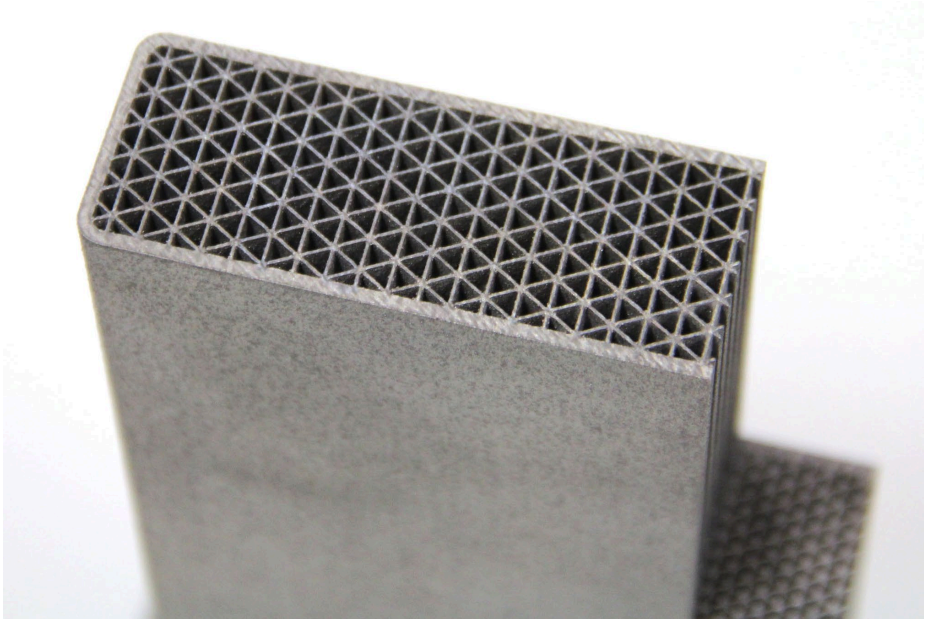
- **Heat** can **show damage** in **components**
- Can be **used** for **complex designs**

Where does this lead?

- **Trust** in using **3D-printed designs**
  - Reduced weight
  - Cheaper parts
  - Less emissions
  - Safer structures



Prospects towards sustainable aerospace



AM part with internal structure

What's next?



Can we help other industries with this approach?



Can we do this underwater?



Can we use this on real aerospace parts?

What can we explore?



Does it work for different materials?



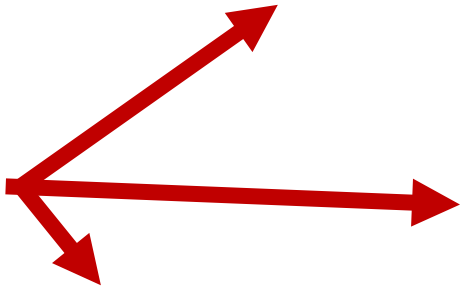
How small can we go?



How large can we go?

What should you take away?

- **Temperature** is a **good method** to **find damage**
- **Technique** is **widely applicable**
- Even **small damage** can be **seen**
- Our **team** is **actively progressing** this **approach**



Complex designs

- My contact:
  - joshua.rodrigues@rmit.edu.au

3D structures

Advanced lattice designs