Bachelor-/ Master – Thesis

Investigation on damage tolerance improvements in aircraft structures via friction surfacing (FS)

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

Helmholtz-Zentrum Geesthacht, Institute of Materials Research, Solid State Joining Processes

Scope of Work

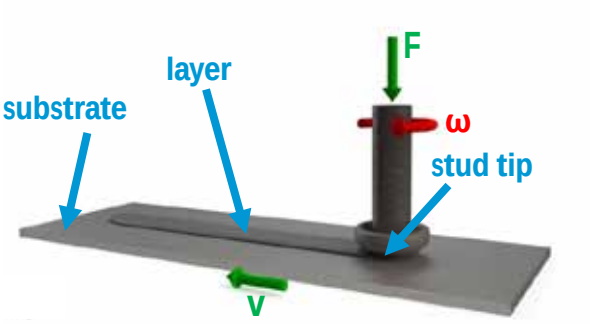
Damage tolerance in aircraft structures is the capability of these structures to endure the designed service loads in the presence of damage. Cracks e.g. in the outer skin of the aircraft should grow slow enough to be safely detected in-between service checks before they can reach a safety critical size. Crack stopping or retarding techniques can help to bring these cracks to a complete stop or slow them down sufficiently.

Within the scope of an industrial project, you will examine the friction surfacing (FS) process as a future method to locally generate crack stopping and / or retarding areas on aircraft grade materials. The particular advantages of this technology is a low heat input layer generation as well as the ability to locally introduce beneficial residual stress areas through elastic-plastic deformation in the vicinity of these layers.

Your work comprises of performing friction surfacing (FS) experiments of specific aluminium alloys on aircraft grade aluminium substrates and investigating ways of potentially increasing the layer to substrate bonding strength. This includes the preparation of the materials and tools, the set-up of the welding machine as well as the subsequent evaluation of the recorded data (e.g. process forces, process temperatures, etc.).

Furthermore, you will carry out evaluations of the modified material areas by means of metallographic characterisation as well as micro hardness tests. Selected welds will be further characterised by e.g. micro hardness mappings, bending tests as well as compact tension tests to determine their mechanical and technological properties.

The place of employment would be the Helmholtz-Zentrum Geesthacht.



Schematic of the friction surfacing (FS) process. Axial force (F) and rotational speed (**V**) plasticise the stud tip. A translational movement (v) is superimposed and a layer deposited on to the substrate surface. At the end the used stud is retracted from the substrate.

Aluminium substrate plate showing two parallel aluminium friction surfacing (FS) layers in as welded condition.

Tasks

- Literature research (e.g. materials, joining processes, intermetallic phases, dissimilar joints, surface activation).
- Development of the experimental design and execution of the desired experiments including data acquisition as well as mechanical and metallographic characterisation.
- Evaluation and presentation of the results as well as documentation of the experimental work (in English or in German).

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Issued: 05.2019