Fretting fatigue occurs when two bodies in contact move slightly relative to each other. The amplitude of the reciprocating sliding is in an order of several micrometers. Fretting fatigue may reduce lifetime of materials or components significantly, and it can occur within mechanical joints such as: bolts, rivets, dovetails or press-fits.

In order to improve understanding of failures of mechanical joints which are widely used in transport vehicles and machineries, a new contact type, perpendicular-cylindrical contact is experimentally evaluated in addition to the conventional cylindrical-plane contact.

### Background

Cracks could originated from different contact types depending on the application. Both Conformal contact type and Incomplete contact type are arising in practical engineering problems. Which contact type is placed to the application is crucial for the feasibility of the performance of the component. Typical bolted lap-joint is shown for conventional cylindrical contact type. Different contact types in laboratory tests are required.

### Experiments

Schematic drawing of the fretting fatigue test is presented. Perpendicular-cylindrical contact is shown. Experimental set-up is presented. On-line temperature acquisition and On-line data processing are explained.

### Results

Thermoelastic temperature amplitude, $T_1$, of the four regions of interest is extracted on-line to detect crack initiation: $T_1 = -k(\sum \sigma_i)$. Materials, Young’s Modulus, Yield Strength and Ultimate Strength are presented in the table below.

<table>
<thead>
<tr>
<th>Specimen (AL2024-T3511)</th>
<th>73</th>
<th>450</th>
<th>570</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pad (AL2024-T3)</td>
<td>73</td>
<td>383</td>
<td>506</td>
</tr>
</tbody>
</table>

Optical microscopy for crack at the left contact, $R_1$, and optical microscopy for crack at the right contact, $R_2$. Crack initiation, Crack propagation area, Brittle failure, Fractured surface (top view of the failed specimen) and Fretting scar (right view of the specimen) are presented in Fractography.

### Conclusions

- Fretting fatigue under perpendicular-cylindrical contact could be performed and monitored on-line by an infrared camera.
- On-line detection of crack initiation is feasible with a detection threshold of around 200 µm crack depth.
- Multiaxial fatigue prediction models will be validated for this contact type in addition to the commonly used cylindrical-plane contact before extending them to real engineering fretting fatigue.

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