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Through thickness non-destructive residual stress-mapping on 6 mm thick Al-plates with neutron diffraction

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While x-ray diffraction is widely used to non-destructively screen residual stresses at the surface, deeper investigations are often carried out in a destructive manner. The most popular techniques are the contour method and deep hole drilling. Neutron diffraction offers the unique possibility to map the whole stress tensor in the bulk and near the surface of a given component. Penetration depth reaches for instance: 300 mm in aluminium, 60 mm in steel, 70 mm in titanium and 40mm in nickel at the SALSA instrument of the Laue-Langevin Institute. Thanks to the particular set up of the SALSA instrument, a precise gauge volume is defined. Thus, near-surface measurement is possible from about 40-100 µm from the surface into the bulk.
We present here an initial work started with OHB-System company regarding friction-stir welds of aluminium. OHB System Company is one of the leading space company in Europe, delivering satellites and high-tech components for the space sector.
Surface to bulk residual stresses from friction stir welded Al plates of 6 mm thick were investigated. Measurement points were taken starting from about 200 µm below the surface to 3 mm in depth with a 150 µm step (gauge volume of 0.6x0.6x2 mm3).
We will show profiles and mapping of residual stress across the weld line and through the plate thickness. High tensile longitudinal stresses at the weld seams were identified that compares well with a study carried out by NASA using a destructive technique (Hatamleh, 2007).

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