Modelling

A thermal model was used to estimate the heating during the initial phase. A uniform heat flux was applied across the interface and linearly reduced to 50% of its value 2 mm away from the edge, which corresponds to the amplitude of the process. The input in the weld interface per phase can be computed by the product of the force at the weld interface and speed at a given instant. Also, a plastic flow model is used for the equilibrium phase, to which it is assumed total contact of the interfaces of the workpieces, thus one plastic work piece is assumed. The model was thermo-mechanically coupled.

Experimental validation

Figure 1 presents the comparison between the thermal model and thermocouple recordings during the initial phase of the process and satisfactory agreement between the experiments and model was obtained. This means that the thermal profile can be used as input for the mechanical model calculating the plastic flow. The plastic deformation that occurs in the initial phase of the process is not taken into consideration in the model.

Impact and effects

This FEA proves to be useful to understand the mechanisms behind flash formation.
Figure 2 shows a comparison between the flash morphology of the FEA and the experiments. The smooth appearance of the flash is a result of a relatively wide heat affected zone (HAZ) and low oscillation amplitude, thus no separation between the flash and edge of the workpiece occurs. Hence, it is intimately related to the welding parameters used. Also the experimental flash is bent in relation to the numerical model due to the interaction between the expelled material and the tooling.

To sum up, this approach allows to understand the influences of the welding inputs on the flash generation as well as other outputs.