7 Discussion

The work presented in this section presented a generalized workflow for the generation of stiffening devices to be used in combination with planar and singly-curved sheet metal, as well as the building up of 2.5D connection details in metal. Referring back to **Fig 6.3**, in which a semi-automated design to production workflow is required, the following points are to be made:

a) With regards to 3D scanning: Although the conventional scanning techniques tested allowed for the generating of high-resolution digital representations of a bent sheet material, there existed many problems with both the surface reflectivity of the material as well as the numerous post-processing steps required to obtain a useable model. Moreover, the resulting mesh geometry also made analysis for obtaining robotic trajectories, as well as varying co-ordinate systems made such processes less than ideal. This was due to the geometry consisting of thousands of planar mesh faces. The use of robotic touch sensing allowed for the extraction of a targeted pointcloud, from which it was possible to directly reconstruct a surface model. This was beneficial in that the issues of surface reflectivity, excessive data and post processing were all solved. The resulting surface model, which shared a co-ordinate system with the welding device, could be directly analyzed, and welding paths generated.

b) The use of a curve-based approach, rather than a conventional AM process of slicing solid geometry proved beneficial on multiple parts. Firstly, by generating geometry directly from curves, it is possible to control aspects, such as the spacing and maximum lengths of welding paths. This opens up the possibilities to elaborate on existing design strategies, such as the use of isostatic curves, to automatically generate curve-based reinforcement patterns.

c) The process illustrated was carried out only on singly-curved sheets. Therein still exist a number of issues yet to be solved, particularly the need for adaptive process parameters to deal with the constantly-varying printing angles of inclination when printing along a curved surface. It is envisaged that, once an adaptive welding process is developed, then the entire design-to-production process may be applied to more arbitrary and free-form surfaces.

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