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Industrial Member Report Summary – Key Findings for Industry

Development and Assessment of Robotic Bobbin and Stationary Shoulder Friction Stir Welding

TWI Core Research Programme

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Industrial need

Although friction stir welding (FSW) is an established joining technology, the majority of applications utilise linear joints made on bespoke, product specific FSW machines. The industrial adoption of robotic FSW for multidimensional joints remains low. This report describes the assessment of a range of FSW process variants, applied using a robot, for linear, curvilinear and circumferential joint geometries, with the aim of facilitating industrial uptake.

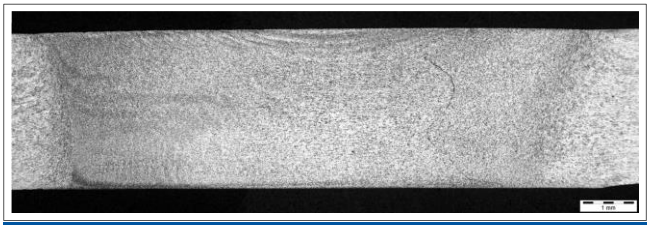
Work was undertaken to compare and contrast floating-bobbin and stationary shoulder with conventional FSW when implemented on a robot. Both linear and corner SSFSW configurations were considered. Emphasis was placed on establishing capability, including the effect of welding forces on robot path accuracy, the range of component thicknesses that could be welded robotically and the overall repeatability of the process.

Key Findings

All of the FSW variants assessed, originally developed for linear joints, are transferable to multidimensional joints using a FSW system based on an industrial robot. The main restriction is the lack of stiffness and payload of robots, which significantly restricts the achievable joint thickness, welding speed, workspace and positional accuracy. A robot platform with higher stiffness and force capability is therefore needed.

- Floating bobbin FSW along multidimensional joints was demonstrated to be feasible but challenging and is not recommended for industrial applications.
- Stationary shoulder FSW is very suitable for implementation on robots. The shoulder acts as a damper, stabilising the process and making it more repeatable than conventional FSW.
- Corner SSFSW provided good results but high traverse forces limited the weld depth and welding speed in high strength aluminium alloys such as AA2024-T3.
- The newly developed stationary shoulder bobbin FSW technique combined the stability of the SSFSW process with the advantages of bobbin welding, such as reduced fixturing requirements and no risk of lack-of-penetration defects. The best performing SSBFSW joint achieved 78% of the parent material strength.

Corner SSFSW of a rib onto a curved aluminium sheet



Macrograph of a stationary shoulder bobbin FSW joint

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- As an Industrial Member of TWI, you have free access to the full report
- If you are not an Industrial Member of TWI, find out how your company could benefit from Membership www.twi-global.com/membership
- Read more about TWI's robotic FSW capabilities on the web page or in the literature survey on robotic FSW.
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