Breakthrough in friction stir welding through an automated robotic system will contribute to European industry competitiveness

FlexiFab project has achieved its stated goal, providing clear advantages for SMEs aiming to achieve accurate robotic friction stir welding (FSW)

The aim of the FlexiFab project was to develop a flexible Friction Stir Welding (FSW) system capable of automatically fabricating complex structures, in a variety of joint configurations, from a range of aluminium alloy grades and thicknesses used in the transport sector. Aluminium has several unique characteristics which need to be considered when fusion welding. Without care given its reactivity to air and high thermal conductivity/expansion, welds are prone to a wide variation of defects such as undercutting, excessive melt-through, incomplete fusion, incomplete joint penetration, porosity and cracking.

This was the issue addressed by the project FlexiFab - "Flexible fabrication of lightweight aluminium transport structures", co-funded by the EU FP7 Research for the benefit of SME associations, which commenced on 1st November 2013. FlexiFab has a wide scope of application areas covering linear welds to more complex geometries. It will address the needs to improve labour productivity in the metal-working sector and alleviate the serious lack of skilled aluminium welding personnel in Europe.

After three years of research, the partners were able to develop an automated robotic system to enable welding of aluminium components and parts, which provides key competitive advantages to the (SME-dominated) European metal workers and fabricators, by providing a cost-effective method of fabricating aluminium structures that:

- ✓ Enables European fabricators, metal-workers and welding companies to effectively compete in the growing use of aluminium alloys for the light-weight transport sector;
- ✓ Capitalises on the increasing pressure to replace traditional iron and steel material with aluminium alloys to reduce weight and thus fuel consumption of vehicles, trains, ships/boats and aeroplanes;
- ✓ Reduces the costs associated with the fabrication of aluminium structures, especially focussed on components used within the transport sectors;
- ✓ Develops new and protectable IP in the area of automated aluminium welding systems, providing European manufacturing industries with added competitiveness and enhancing the move into the 'knowledge-based' manufacturing sector.

With this, the mainly SME-dominated European fabricators, metal workers and welding companies at large are poised to benefit from a significant reduction in the costs associated with the welding of aluminium components and structures (mainly due to the lack of scrappage and

re-working required from an automated system) and are able to create better working conditions for their workforce, as expert welding knowledge will still be required, but physical demands will be greatly reduced.

The project was comprised of a transnational consortium, which includes ten partners:

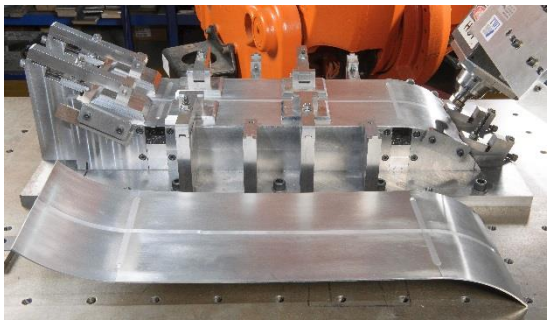
- ⇨ European Federation for Welding, Joining and Cutting (Belgium)
- ⇨ Asociatia de Sudura din Romania (Romania)
- ⇨ Meta Vision Systems Ltd. (UK)
- ⇨ Innora SA (Greece)
- ⇨ igm Robotersysteme AG (Austria)
- ⇨ Boluda Division Industrial SL (Spain)
- ⇨ RRS Schilling GmbH (Germany)
- ⇨ TRA-C Industrie (France)
- ⇨ TWI Ltd. (UK)
- ⇨ Lund University (Sweden)

Friction stir welding and robots – how it as accomplished

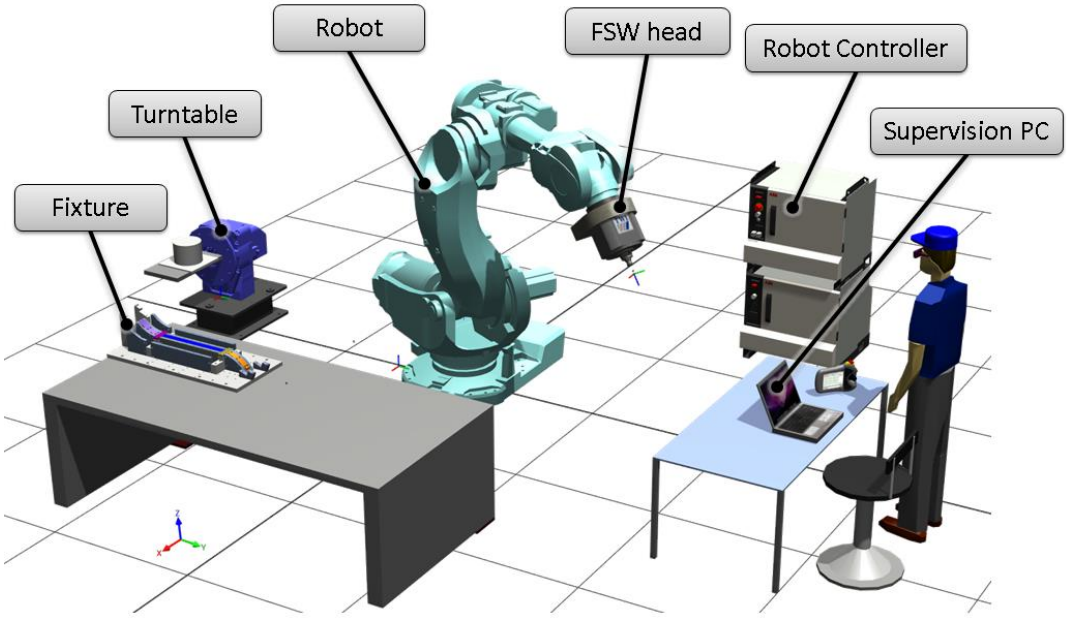
Looking back at what was developed in the FlexiFab project and answering the initial question "Can a robot be used for 2D and 3D FSW"? With FlexiFab, it can.

The bold aim of FlexiFab project, to do FSW with a robot, led into the development and demonstration of the following:

- Integration of the robot software to seam tracking sensor so that the robot end effector can follow the joint between two curvilinear components;
- Integration of the robot software to the component sensor so that the robot end effector can follow the component surface geometry either side of the joint between two curvilinear components.



The architecture of the prototype system developed consists of several subsystems and software components to enable path adjustment and control algorithm modifications at the fast low-level controllers, which can be used in any commercial robot for a diversity of FSW techniques including floating-bobbin, corner, stationary shoulder and AdStir, along linear, circumferential and complex 3D weld paths.



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