Future Trends – Internet of Things, Automated Welding and Additive Manufacturing in India

Friction Stir Welding

Materials Joining and Engineering Technologies
Friction Stir Welding in Action
Take-up of FSW by Industry
Applications
- Contact high force process
- Workpieces must be rigidly clamped.
- Backing bar required for single sided welding.
- Keyhole at the end of each weld.
- Equipment needs to react forces.
Industry Drivers

Cost of equipment
More joint configurations
More complex geometries

Robotic FSW
Issues with Robots
- Relatively low payload
- Large deflections
- Potential for the tool to over plunge

Developments
- Low force tooling
- Tool path compensation
- New techniques to increase joint configurations
Stationary Shoulder FSW (SSFSW)

- Originally developed for FSW of low conductivity materials i.e. titanium.
- The FSW probe rotates through a stationary shoulder / sliding component.
- The non-rotating shoulder component adds no heat to the weld surface.
- The resulting heat input profile is basically linear.
Stationary Shoulder FSW (SSFSW)

Results in

- Improved surface finish
- Minimal surface undercut
- Reduced surface heat input
- **Significantly lower process forces**
Benefits – Robotic SSFSW

Benefits when implemented on robots

- Shoulder acts as a stabiliser and damper
  - No “meltdown”
  - Reduced vibrations

- Reduced spindle torque
  - Majority of torque produced by shoulder in conv. FSW
  - More compact FSW head

- Reduced heat input
  - Beneficial for complex (3D) joints

Conventional FSW
Benefits - New weld geometries

- Process variants of SSFSW
  - Corner welding (T-joints)
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  - *Tailor welded blanks (dissimilar thickness)*
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- Process variants of SSFSW
  - Corner welding (T-joints)
  - Tailor welded blanks (dissimilar thickness)
  - Bobbin welding
FlexiFab System - Seam Tracking

Error reduced from >2mm to <0.5mm
Ways Forward

Parallel kinematics © Exechon

ABB IRB7600 robot (left) and the ABB IRB8700 robot with spring-loaded parallel links (right)
Robotic Friction Stir Spot Welding
Robotic Friction Stir Spot Welding
Welding Systems Integration (WSI): Summary

• Working with the supply chain and end users to manage, develop and prove the **latest automated digital production systems** ensuring compliance with relevant industry guidelines.

• Implementation of Industry 4.0 knowledge and understanding:
  • **Integrating innovative turnkey joining solutions** which combine the latest automation and welding techniques.

• Enabling: **cost effective, high quality & safety compliant production for high value manufacturing.**
Use of aluminium is growing

The demand for complex joint geometries and configurations is increasing

FSW is a maturing joining technique which provides an environmentally benign technique producing high quality joints

Development of low force tooling and feedback system offers a robotic FSW solution

Further developments in robot system configurations, such a PKM systems should extend the thickness of components capable of being joined and improve path accuracy.
Friction Stir Welding

- Integration into automated digital production systems
- Machine based process, sensors and feedback systems can control and predict quality (Industry 4.0)
- Solid state process with capability of joining dissimilar materials
- Safe
- Reduction in qualified welders