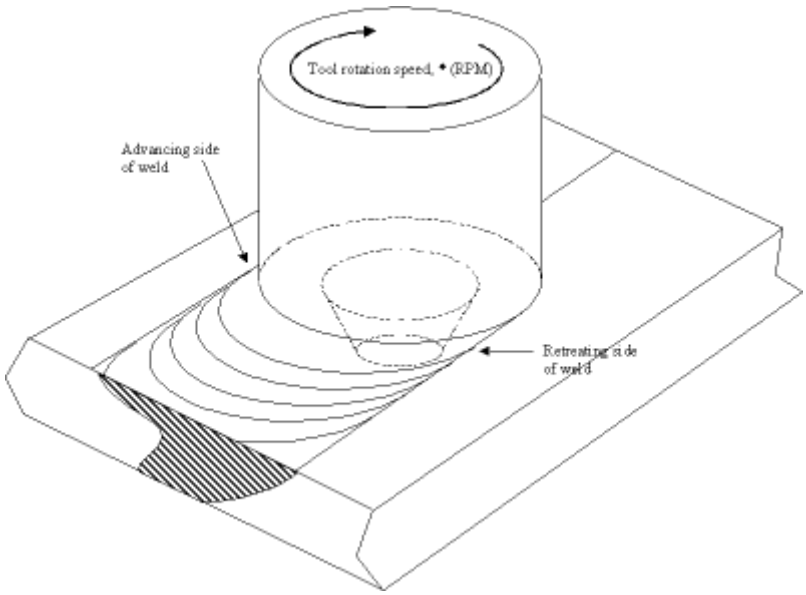
PRESS INFORMATION

BAE Systems uses LOWSTIR to optimise welding processes

Low cost Friction Stir Welding Now uses Bluetooth for Data-Transmission



Introduction

Friction Stir Welding (FSW) is a welding process invented by TWI in 1991. The process involves a spinning tool, in contact with the material to be welded, with sufficient down force to create frictional heat in the material (about 80% of the material's melting point). This causes the material to become soft, allowing the spinning tool to create the weld.

FSW has significant advantages over other joining techniques including good mechanical properties, low distortion, and an ability to weld some materials that

cannot be welded by other methods. Most current uses involve the joining of Aluminium alloys, for applications including:

- airframes
- aircraft components
- ship decking
- structures
- rail carriages
- automotive components
- bridge components
- pressure vessels
- space launch systems

In addition to Aluminium components, development of FSW has recently been reported for the joining of magnesium, copper, steels, and titanium alloys

Industrial take up of friction stir welding has been limited to those industry sectors that have sufficient capital to invest in the high technology costs. The need for purpose built 'FSW' machines can make it difficult for product manufacturers to justify implementation of the technology. An alternative approach is to adapt milling machines.

LOWSTIR Project

Unlike other friction stir welders, the LOWSTIR friction stir welding system includes a unit that attaches to most standard milling machines via an ISO taper, making it an affordable option for smaller enterprises. It is supplied with software to calibrate the system, monitor the welding process and log welding parameters for later analysis.

However, standard milling machines lack the process monitoring capabilities required to ensure high quality friction stir welded joints. LOSTIR (no 'w'), the original project part funded by the European Commission in 2005 developed a low cost FSW monitoring system for retro fitting to milling machines to facilitate their application to FSW.

This process used a bespoke sensing head incorporating the tool holder, electronics, a ceramic heat shield and rotating antenna for transmission of the data to a stationery receiver, mounted onto the frame of the machine. The

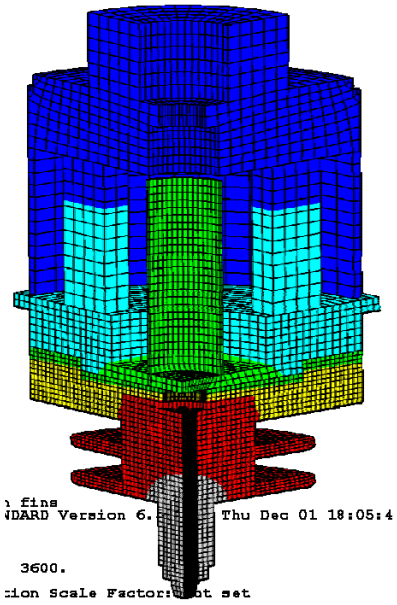
receiver is connected via cables to a signal processing module, computer and mains power supply.

Whilst this system has been used successfully for a number of years, the use of telemetry for the signal transmission means an antenna / receiver arrangement is necessary complete with cable connections. Additionally the electronics mounted within the sensing head are subject to severe vibration and heat.

Original system in action incorporating revolving antenna and static receiver

Bluetooth Data Transmission

To ensure the forces from the welding process do not affect the electronics and gain the benefit of a wireless system, the sensor head has been modified to use a battery power supply and a Bluetooth connection to transmit machining data to a stationery receiver I.E. a notebook computer fitted with a standard Bluetooth module. This modification means that the sensitive electronics and rotating antenna for the telemetry transmission is no longer required, nor are the stationery receiver or the signal processing unit, power supply or associated trailing cables.
The original design has been considerably revised to accommodate these changes, resulting in a reduction in the size of the sensor head, making it both lighter and stiffer.



Temperature distribution within the head after 60minures operation

The LOWSTIR system now comprises of just one hardware and one software component excluding the FSW tool, with the wireless link designed to support two way communications for calibration and data collection.

BAE's Experience

Andy Wescott of BAE's Advanced Technology Centre says one of the biggest problems with welding aluminium is distortion. However with the appropriate clamping in place and due to there being less heat generated by the process, this problem is largely overcome. A further benefit of using FSW is that high strength aluminium alloys can be welded, a process not possible using traditional techniques. Also recent trials have demonstrated FSW can be used to repair localised damage to large panels. Rather than replacing a large area with a single sheet of material at the existing weld or join, just the damaged area is repaired with a slug of new metal which is welded 'in-situ' leaving no step or change in the contour of the original material. This saves time and money compared to larger repairs requiring more specialised equipment or a return of equipment to workshops.

Another advantage of the stir welding technique is that no consumerables are used and as there is no arc drawn, there is no radiation, fume or spatter present. Additionally as it uses vastly less energy in the process, all told it is a very 'green' technique.

The ability to 'go wireless' is a huge leap over the previous technology says Andy. Not having to worry about trailing cables to the laptop reduces set up time and makes measurements during welding very straightforward. The Bluetooth 'switch' is a simple jack-plug arrangement, pull out the plug and the Lowstir device will 'search' for the laptop. Once finished, simply replace the plug – that's all there is to it. Also as the power supply is now built-in using a rechargeable battery, it makes it a very versatile system. What was once a highly specialised measurement using equipment costing many hundreds of thousands of pounds, is now a relatively inexpensive process using equipment available in most engineering workshops, all driven by easy to use software.

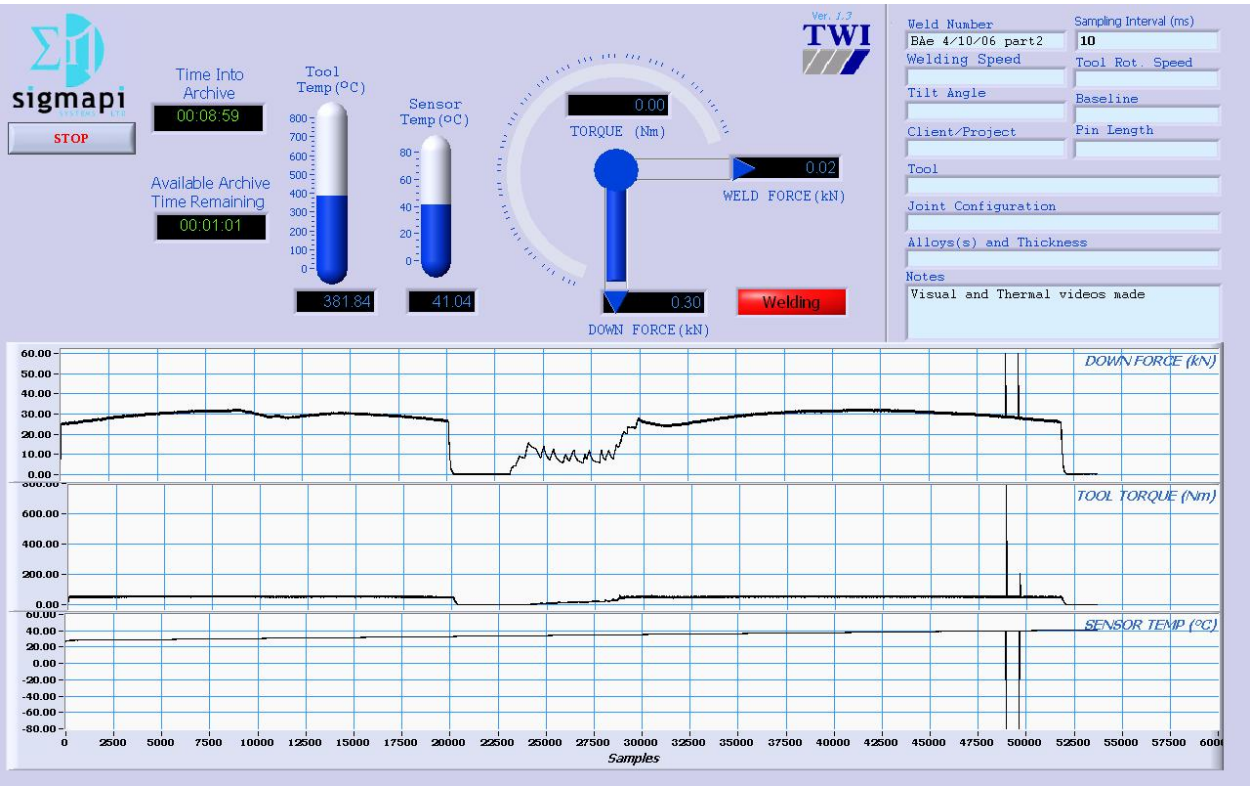
Weld Monitoring System

A weld monitoring system has been developed to accurately measure the vertical and horizontal forces and torque on the tool. The sensor is machined from one piece of high grade stainless steel, heat treated for maximum strength and stability. The sensor design allows for various taper sizes to be attached to accommodate the requirements of the user. The data gathered can be directly linked to the acceptance or otherwise of the weld. In addition, the device has the capability to monitor two user defined temperatures via thermocouples, one to be attached to the FSW tool, the second will serve as a safety cut out to protect the integral telemetry circuit, monitoring the temperature at the interface between the tool holder and the weld monitoring system.

Control and Logging system

The information gathered by the LOWSTIR device is displayed to the operator using a notebook PC running NI Labview. The instrument panel displays real time numerical values of forces, torque, the temperature adjacent to the system electronics and (if desired) the tool temperature. The system also has the capability to add real-time event markers to allow correlation between process conditions/stages and the recorded data. The main display screen has buttons to start and stop recording of data. Alternatively an automatic trigger facility exists for initiating the recording of data.

The display also shows the current captured data values for the weld in progress and indicates whether they are within the acceptable range for satisfactory welding. The display also has a multi-graph facility where the user can select which sensor values are displayed.



Specifications:

- Down force (Fz) to 50 kN
- Lateral force (Fxy) to 25 kN
- Torque (Mz) to 100 Nm
- Temperature of the internal electronics (to warn of overheating)
- Optionally, the temperature of any moving part.
- Max rotational speed of 3000 rpm
- Software logging rate selectable from 1 to 100 Hz.

For more information contact:

David Johnson - Head of Business Development

Sigmapi Systems Ltd.

Tel +44 (0)1782 740134 / Mobile: +44 (0)7918 744718

Email: dj@sigmapisystems.com

and

Andy Wescott

BAE Systems - Advanced Technology Centre

Tel.+44 (0)117 368314

Email: andrew.wescott@baesystems.com