Development and validation of on line monitoring and NDT Inspection of Laser welded thin sheet automotive components

Reporting

Project Information

OLIWAM

Grant agreement ID: 32240

Project closed

Start date
15 November 2006

End date
14 November 2008

Funded under
Horizontal research activities involving SMEs: Specific activities covering wider field of research under the Focusing and Integrating Community Research programme 2002-2006.

Total cost
€ 1 993 088,00

EU contribution
€ 1 032 688,00

Coordinated by
TWI LIMITED
United Kingdom

Final Report Summary - OLIWAM (Development and validation of on line monitoring and NDT Inspection of Laser welded thin sheet automotive components)

Because of the implications on the human and economic costs of the currently applied procedures, major vehicle manufacturers prefer to have an non-destructive (NDT) record for each weld, with the intention of performing testing in a fully-automatic way and online, which was the focus of the OLIWAM project. This pre-competitive project was aimed at developing a new, fast, monitoring and NDT inspection system, the OLIWAM system, to be used online, providing a 100 % inspection rate for thin-sheet laser welded automotive components. The system's software allows for online evaluation of the results, with remedial actions, if any, taken immediately, significantly reducing repair costs and scrap rates. Generic concepts for up to a further four NDT inspection systems were also developed to further facilitate fast, reliable on-line detection of weld imperfections.

Quality monitoring and inspection of the produced parts is essential to ensure good performance in service. Currently, three different techniques can be used for quality control of laser welds: process monitoring, optical weld bead inspection and non-destructive NDT inspection. Whereas the first monitors the laser process and/or the molten pool before it solidifies, the last two inspect the seam after solidification.

In their current forms, process monitoring is carried out, by definition, online or in real-time, i.e. as the welding is carried out, whereas most of the optical weld bead inspection and all of the NDT inspection is done off-line. This means that the inspection is conducted with the welded part removed from the production line, i.e. inspection constitutes an additional operation and adds cost to the product. Moreover, current NDT inspection and tear-down, in which a fully assembled car is put through a controlled crash, is only a sampling test. This means that not all produced parts or products can be inspected individually.

This project aimed to develop the OLIWAM system, i.e. automated equipment capable of online detection of the types of weld imperfections that are typically found in tailor-welded blanks (TWB) and body-in-white (BIW) assemblies. The OLIWAM system employs a series of NDT and process monitoring techniques, adapted to the materials and joint geometries of a selected TWB and BIW application, and the imperfections typically found for these welded parts. It analyses the received data at high speed and provide go/no go status for the welds produced.

At the onset of the project, the OLIWAM partners agreed on two automotive applications, representative of today's automotive production, to be used as benchmarks for assessing the performance of the OLIWAM prototype system. The first is a TWB that is part of the SEAT 3-door frame, comprising a butt joint between two zinc- coated steel sheets, 0.9 mm and 1.65 mm in thickness. The second is a BiW triple lap joint that is part of a VW door inner. The joint comprises two zinc-coated steel sheets, 0.7 mm and 1.5 mm in thickness, with a 2 mm thickness uncoated steel sheet in between.

For both applications, weld imperfections typically encountered in production were identified and ranked in order of their impact on the joint's integrity. The five most critical imperfections and their acceptance levels were selected for each of the applications, which would serve as the performance specification of the OLIWAM prototype system.

Based on the initial results of the monitoring and NDT inspection trials carried out at the various partners, the consortium agreed at the project mid-point, that the OLIWAM system prototype would include the plasma and temperature photodiode sensors, a coaxial CMOS camera, an MFL sensor array and an EC inspection probe.

In addition to the technologies to be included in the OLIWAM prototype, a generic design approach was also agreed at the project midpoint for both the system hardware and software. A modular principle was adopted for the hardware, to allow for the differences between the two selected applications, in terms of geometry and NDT inspection, and, for retrofitting additional sensors at a later stage, if required.

For the TWB butt joint application, it was demonstrated that the MFL, EC and DR techniques, as well as the plasma and temperature sensors and the CMOS camera, were all capable of detecting lack of fusion. The most critical of imperfections for the BiW triple lap joint configuration, according to end-user VW, is the lack of connection at the second interface, i.e. between the middle and bottom sheet. This imperfection can occur even though, visually, the top and bottom side of the weld appear to be acceptable. The only way of checking whether this imperfection has occurred, is using feeler gauges. This is done in practice, but is very labour-intensive (and expensive).

The OLIWAM work has demonstrated that both the DR technique and both the plasma and temperature sensor signals can be used to ascertain the presence of a weld (connection) at the second interface. There is also indication that the MFL technique is capable of detecting this type of imperfection, but further work is required to demonstrate the reliability and consistency of this technique. It is noteworthy, however, that none of these techniques can be used to determine the size the weld width at the second interface. However, this should be possible by (optical) visual inspection of the weld width at both the top and bottom side, and interpolating between measured values.

Implementation of the OLIWAM system, which provides 100 % weld inspection, is expected to reduce human casualties as a result of unexpected failure of safety critical structures. 100 % online weld inspection will also contribute to reduced manufacturing costs, by allowing repair to take place at the most appropriate point in the production line or prevent defective parts continuing along the production line.

Related documents

Final Report - OLIWAM (Development and validation of on line monitoring and NDT Inspection of Laser welded thin sheet automotive components)

Last update: 14 April 2011

Permalink: https://cordis.europa.eu/project/id/32240/reporting