



Integrity issues in high productive hybrid welding processes for marine structures

Wai Jun Lai (wai-jun.lai@cranfield.ac.uk)

Supervisors: Dr. Supriyo Ganguly, Dr. Wojciech Suder

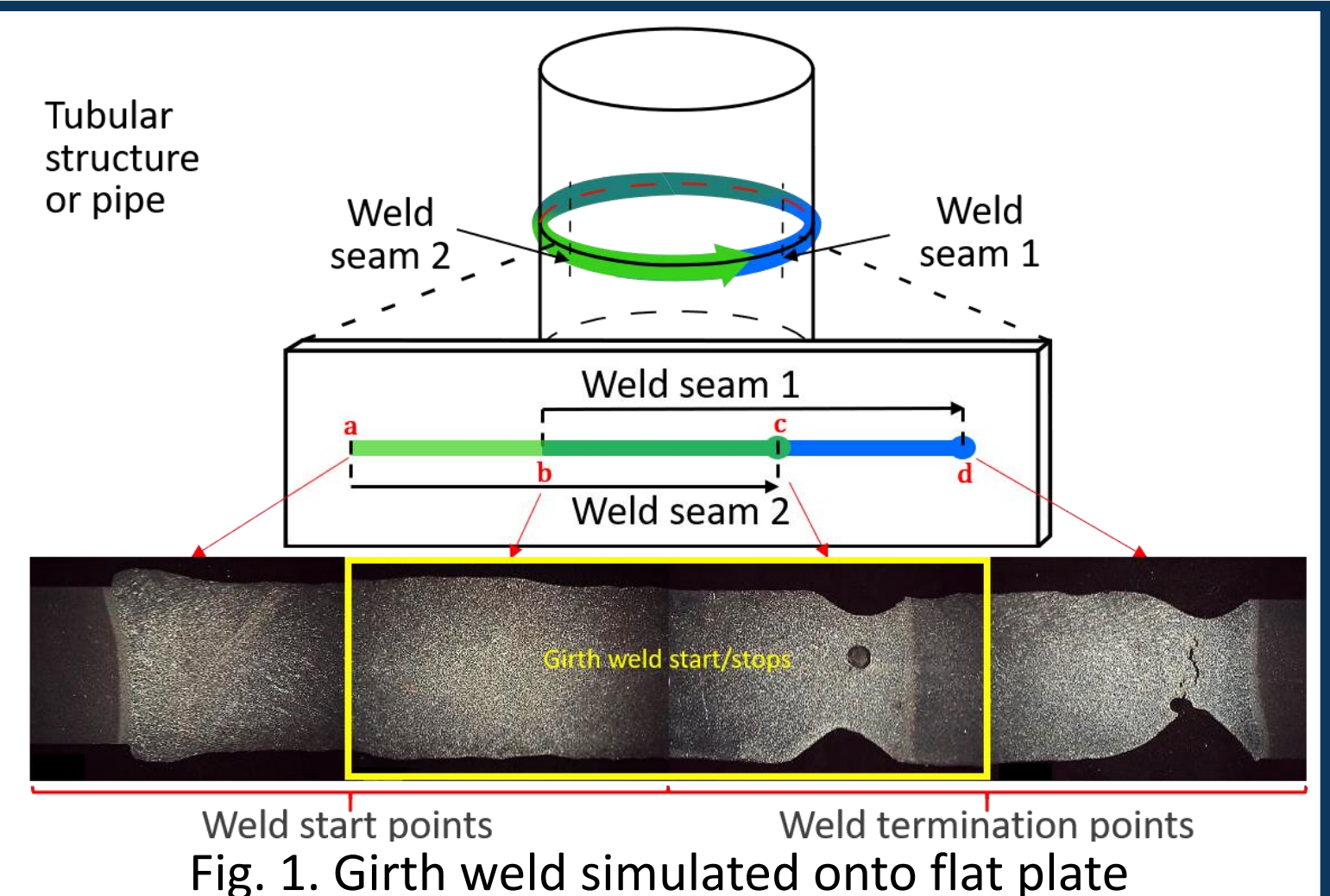
Introduction

The laser and hybrid laser-arc welding is an attractive option for the welding of thick section structural steels such as those used within the offshore industry due to the high productivity and low distortion weld capabilities when compared with conventional submerged arc welding. However for girth welding applications, defects associated with the start/stop of the welding process and termination of the laser keyhole remains a challenge.

Aim: To study the underpinning mechanisms of defect formation in the start/stop area of laser and hybrid laser arc assisted girth welds and propose process based robust solutions to eliminate such defects.

Methodology

- Girth welds simulated onto flat plates to study autogenous laser weld start/stops and laser keyhole termination as shown in Fig.1 using different laser weld termination regimes
- Evaluation of weld mechanical properties throughout start/stop location achieved using different laser weld termination regimes
- Incorporation of laser keyhole termination study within hybrid laser-arc welding process



Results and discussion

- Significant difference in weld profile throughout start/stop location and point of laser termination using different laser termination regimes

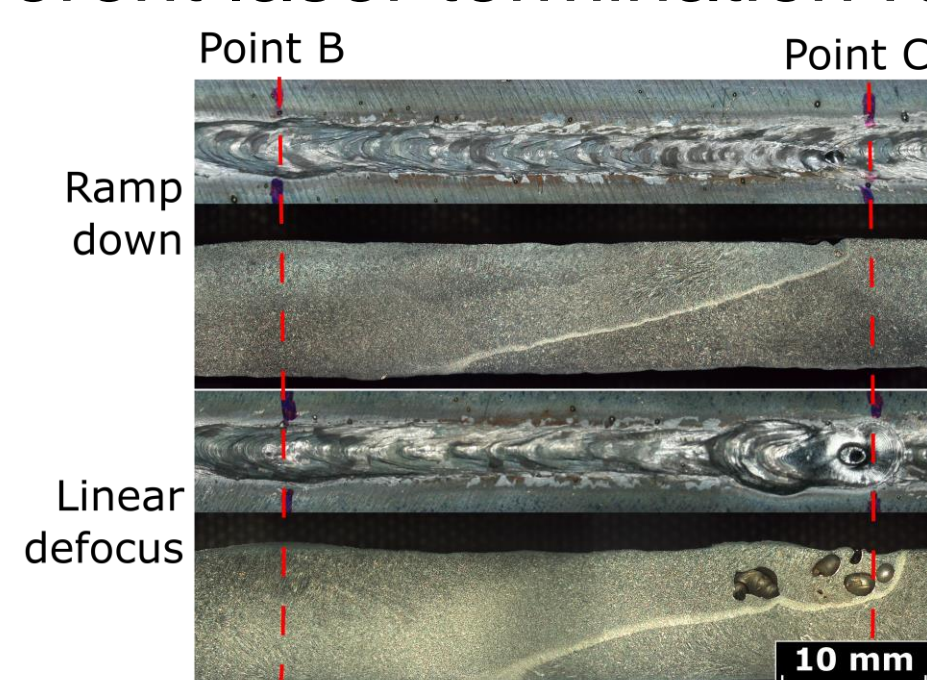


Fig. 2. Macrographs of different laser termination regimes

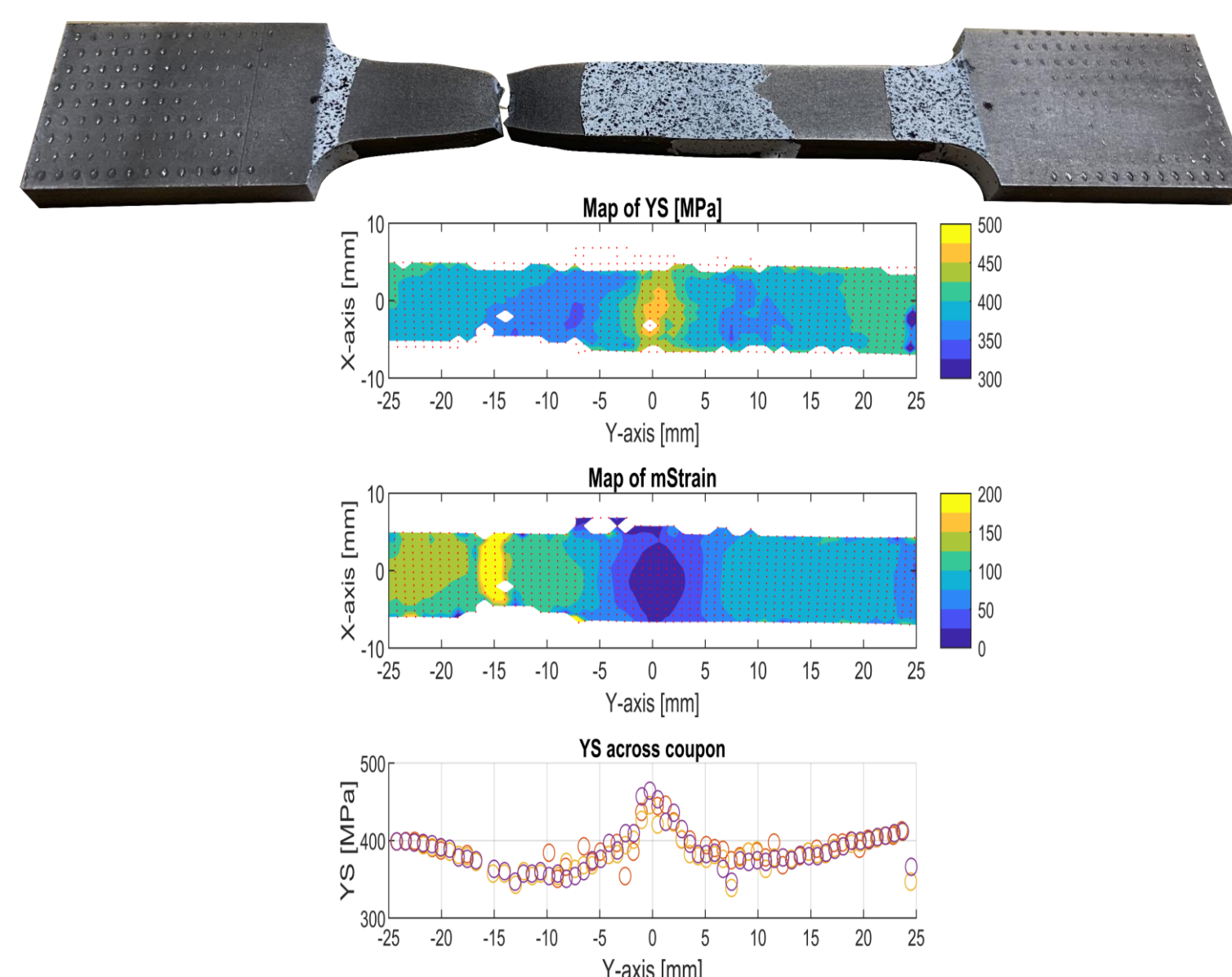


Fig. 3. Test coupon and tensile behaviour at laser termination point using laser power ramp down

- Tensile behavior at laser termination using laser ramp down termination regime shows high yield strength and minimal straining at weld zone

Ongoing work

- DIC mechanical tensile testing of autogenous laser weld start/stops using different termination regimes
- Hybrid laser-arc welding parameter study for development of penetration depth model
- Effect of arc source on laser keyhole termination in hybrid laser-arc welding