Title: Process control, optimization and parameter characterization of mild steel single and multi-layer deposits using Wire + Arc Additive Manufacturing

Harley Stinson, Richard Ward, Nicholas Opiyo, Justin Quinn, Cormac McGarrigle

[1]Center of Engineering and Renewable Energy (CERE), Ulster University Magee Campus, Derry, Northern Ireland

Keywords: WAAM, Additive Manufacturing, Manufacturing, 3D printing, Robotics, Cold Metal Transfer

I. Abstract Body

Wire + Arc Additive Manufacturing (WAAM) is a promising technology for the manufacturing industry due its capacity to reduce material waste by up to 90% in certain applications whilst also providing a means of production for large-scale (<1m) metal structures with high deposition rates of up to 4kg/hr [1]. These comparatively higher rates of deposition and large build volumes allow WAAM to fulfil manufacturing roles which its counterpart technologies such as Powder Bed Fusion would struggle to perform in an economical manner [1], [2]. The Automotive and Aerospace sectors are looking into WAAM as a prospective solution to fabricate large scale, medium complexity components with additional time and cost savings when compared to current subtractive and formative manufacturing methods [3]. Due to the energy sources employed, WAAM suffers from similar defects observed in welding such as porosity, distortion, residual stresses, hot cracking etc. [4], [5]. This research will investigate the parameter settings and process controls (e.g. travel speeds and cooling rates) of WAAM Via Cold Metal Transfer (CMT) which can improve the mechanical properties, microstructure and geometrical quality of WAAM Mild Steel single and multilayer specimens whilst minimising the presence of aforementioned defects. Testing will evaluate the tensile and flexural strength of machined specimens, fatigue life and microhardness throughout the multilayer deposits to characterise the effects of varying heat, current and voltage inputs, deposition strategies, inter-layer cooling rates and travel speeds.

II. Image:



III. Reference:

[1] S. W. Williams, F. Martina, A. C. Addison, J. Ding, G. Pardal, and P. Colegrove, "Wire + Arc additive manufacturing," Mater. Sci. Technol. (United Kingdom), vol. 32, no. 7, pp. 641–647, 2016.

[2] D. S. Thomas and S. W. Gilbert, "Costs and cost effectiveness of additive manufacturing: A literature review and discussion," *Addit. Manuf. Costs, Cost Eff. Ind. Econ.*, no. October 2016, pp. 1–96, 2015.

[3] R. Ward, S. M. Fadden, and J. Quinn, "Developments in Large Scale Additive Manufacture – the Potential and Limitations of Wire Arc Additive Manufacture and Associated Technologies," vol. 2015, 2018.

[4] S. Thapliyal, "Challenges associated with the wire arc additive manufacturing (WAAM) of aluminum alloys," Mater. Res. Express, vol. 6, no. 11, p. 112006, 2019.

[5] B. Wu et al., "A review of the wire arc additive manufacturing of metals: properties, defects and quality improvement," Journal of Manufacturing Processes. 2018.

IV. Biography:

Harley Stinson is a PhD researcher with the University of Ulster CERE researching Wire Arc Additive Manufacturing via Cold Metal Transfer

V. Presenting author details



Full Name: Harley Stinson
Contact number: +44 7871039890
Twitter account: N/A
Linked In account: Harley Stinson
Session name/ number: Layer Manufacturing and Additive Fabrication
Category: (Oral presentation/ Poster presentation)
Passport Number: