**University of Leicester**

**Future 50 PhD Scholarship**

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**Section 2 – *Project Information***

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| **Project Title** | Intelligent welding through enhanced human/robot interaction using digital twins and computer vision |
| **Project Highlights:** | 1. | Spearheading work on intelligent welding will have impact on UK and global economy. |
| 2. | Multidisciplinary approach to a metallurgical project that will allow for engagement in experimental metallurgy, programming of computer vision algorithms and remote interaction via virtual and augmented reality. |
| 3. | Use of new technologies with the aim to develop a new way of carrying out long-established processes. |
| **Project Summary**  |
| This project will investigate human/robot interaction and A.I. training for complex welding processes. Interactive Digital Twins will be developed to be used for complex welding processes that are beneficial to high-mix low-volume manufacturing. UK government has already made £300 million (2020) available for the development of intelligent welding that will impact the UK economy. The work also aligns with the new UoL centres that focus in digital manufacturing, A.I., and materials. It also aligns with the schools’ main research areas on materials science and work carried out in Materials Innovation Centre. Equipment and work that has been carried out with TATA steel will also contribute to the project.Welding is one of the most important material joining methods used today. The process is complex and it is currently being carried out in three main ways. Manual welding, robotic welding, and hard automation welding. Robotic and hard automation welding is very reliable for processes that require stable parameters during welding.Despite the technological progress, complex welds still require highly skilled professional welders. This is because they can adjust to unpredicted disturbances and changes to the welding parameters. The issue that occurs from that, is that currently, highly skilled professionals are at a shortage globally. Additionally, welding is a process that exposes them to toxic fumes and gases from the welding environment.For that reason, it is deemed crucial to develop a framework that will allow industry that focuses on high-mix low-volume manufacturing to produce parts that are complex in shape and challenging to weld. This can happen by enhancing the human/robot collaboration so that professionals can perform tasks remotely in a safe manner, and train A.I. algorithms to perform demanding tasks unsupervised.Recent work has demonstrated that by utilising interactive digital twinning methods some control of welding processes can be achieved. However, for this type of application, the control of the metallurgical properties has not been extensively studied. In a digital twin environment of this type, incorporating information on temperature gradients, weld depth, seam tracking, and microstructure evolution is essential. |