Integration of weldability in through-process modelling

Project overview:
Welding is a joining method which is extensively used in industrial application, e.g. automotive industry, aerospace and shipbuilding. Microstructure is essential for the mechanical property of welded components and is responsible for possible failures during and after welding, e.g. hot cracking, brittle fracture upon loading. Prediction of material response to welding through modelling is useful to better understand the underlying physics for welding and avoid welding associated failures.

FE models validated by experiments will be developed to obtain temperature and stress profiles during welding, which are then used as input for microstructure model. The influence of different plasticity models will be tested in the aspects of prediction accuracy and calculation time.

Currently, phase field (PF) modelling and cellular automata (CA) modelling are commonly used for microstructure simulation. PF models for welding have been well established. However, it is computationally extensive and the calculation time could be weeks. CA model is advantageous due to its computation efficiency.

In this project, a current existing through-process CA model will be extended and employed in prediction of microstructure evolution during welding. The non-equilibrium condition during welding will be considered in this process.

The results from CA model and phase field model for welding will be compared in the aspects of functionality and calculation time.

At final stage of this PHD project, mechanical property evaluation will be made through RVE method.

Research activities:
In the past three months, a literature review on thermal, mechanical and metallurgical modelling of welding has been finished.

FE model: T and Stress
Microstructural model: PF and CA models
Mechanical property evaluation: RVE

Figure 1 Overview of PHD project

Key publications 2018:
None

Other achievement:
Poster presented at M2I annual conference and Materials meeting, 2018.