Real Time Evaluation of Weld Quality during Friction Stir Welding (Industry 4.0)

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Aim

To develop an in-process real time quality monitoring system for Friction Stir Welding to predict onset breakdown and re-establish good weld

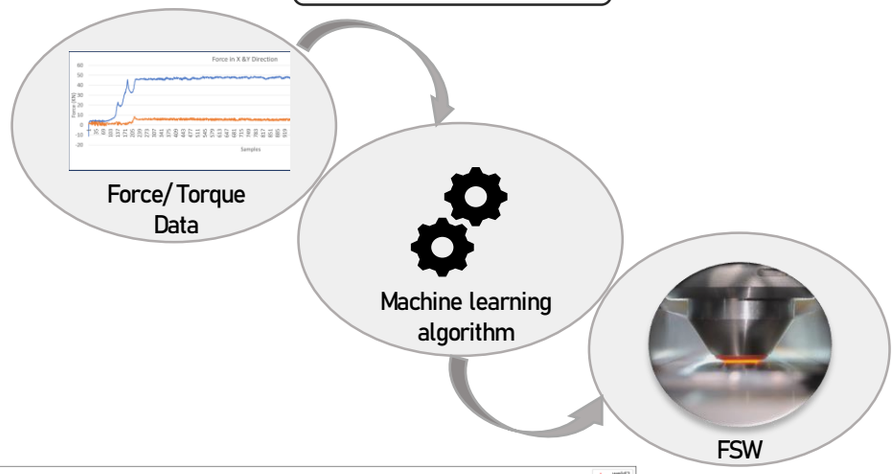
Background

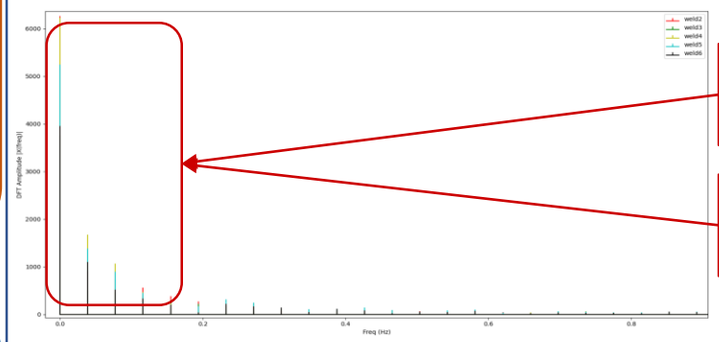
- Conventional welding techniques are prone to numerous defect like solidification cracks, porosity & hot cracking.
- FSW eliminates major causes of defects attracting manufacturers to replace conventional welding methods.
- The key parameters affecting the weld quality are axial force, temperature traverse speed and tool geometry.
- Weld quality evaluation for FSW is limited to offline methods, there is a need for an online weld quality evaluation system to save time and cost.

Methodology

- Present FSW machine are based on force and torque control methodologies and they have proven to be effective.
- Researchers have implemented machine learning for prediction of mechanical properties of the weld.
- Force and torque data show a trend when the defect is observed.
- By implementation of machine learning, the defects can be predicted by observing force, torque, acoustic & temperature signal for the weld.
- Weld quality can be can also be related to the Discreet Fourier Transform (DFT) of force data, it was observed that good welds had lower amplitudes at lower frequencies.
- Acoustic signals measurement has proven to be efficient for evaluating the weld quality.

Initial Approach



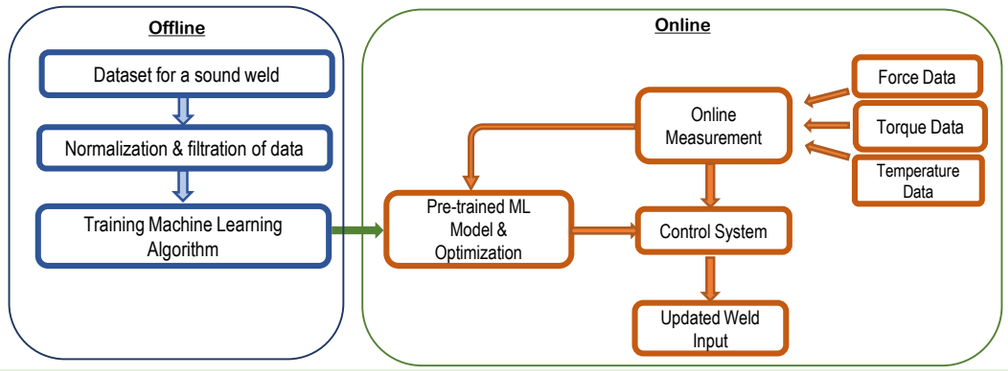


DFT analysis can be used to distinguish between the good and bad welds

Good welds have lower amplitude at lower frequency range

- The graph shows Discreet Fourier Transform for the resultant force in lateral plan of weld tool.
- By identification of the threshold frequency, the welds can be classified into bad and sound welds.

DFT Analysis of Planar Forces on FSW Tool



Block diagram for closed loop control

Project Objectives

- Assessing the important process variables and how they affect the process.
- Development of effective methodologies for measurement of variables and weld quality.
- Developing prediction models for the closed loop feedback system.
- Conduct experiments to validate the prediction models.
- Development of control methodologies based on prediction and online monitoring system.

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