



RESURGAM Webinar Cycle

Digital Platform Capabilities

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Agenda

- Our Overview
- Development of Fault Detection Procedure using Artificial Intelligence
- Industry 4.0 Compliant Data Integration Software
- Digital Tools for Agile Manufacturing and Communication
- Summary

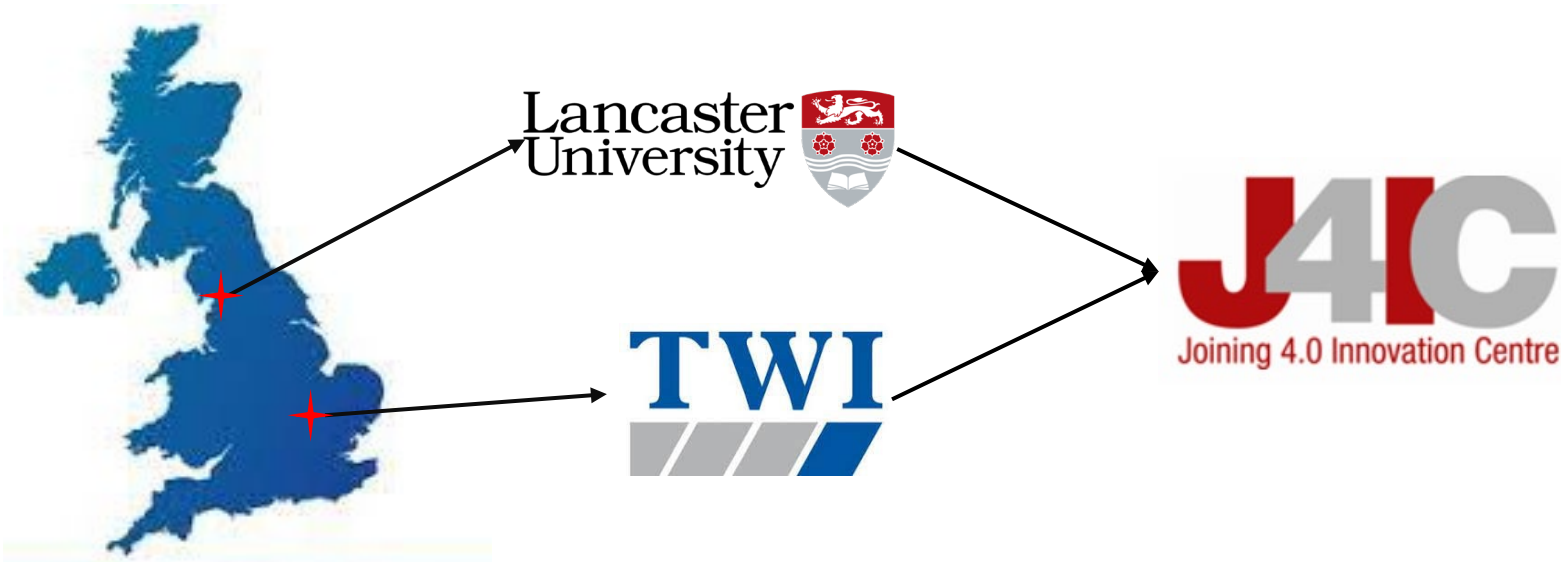


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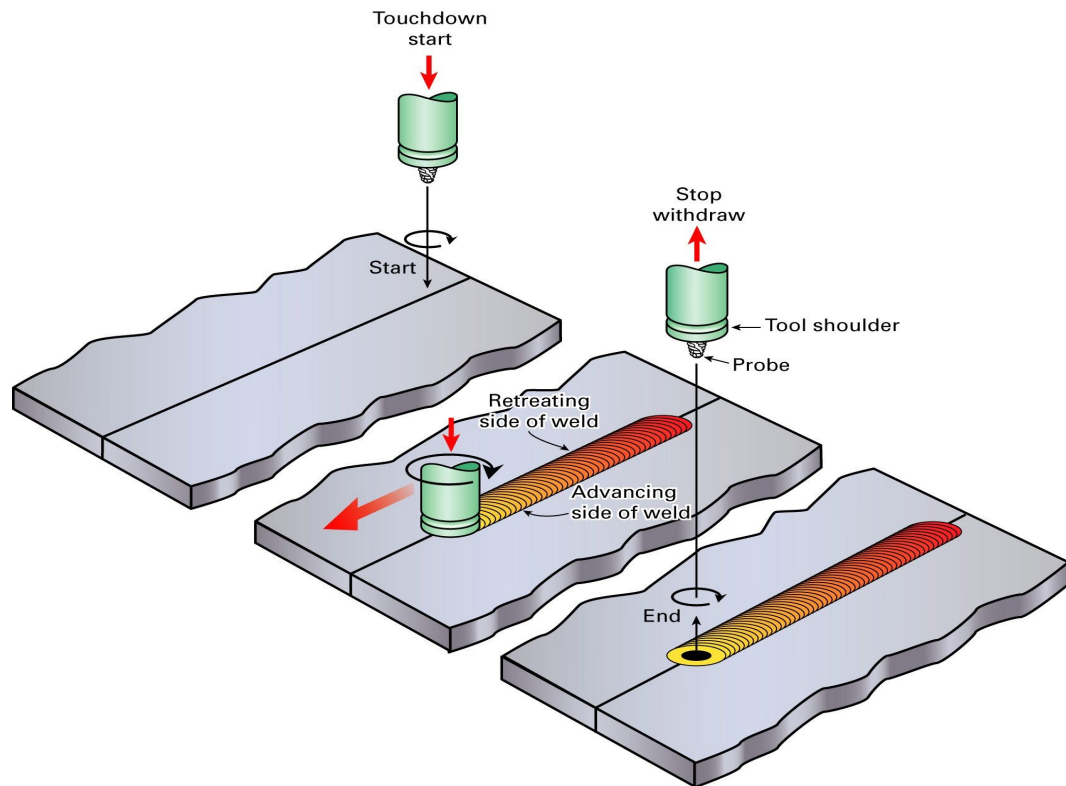
Our Overview



Our Expertise

- Artificial Intelligence
- Cloud Computing
- Advance Control Engineering
- Software Engineering
- Manufacturing Technologies
- Big Data

Background: Friction Stir Welding



- FSW is a solid state welding process invented by TWI Ltd.
- It can be used to develop high strength, lightweight, fatigue resistant welded joint.
- It has wide application: spacecraft, trains, shipping and automotive components, electronics assemblies and consumer goods etc.
- Can be used to weld Aluminium magnesium, copper and recently steel.



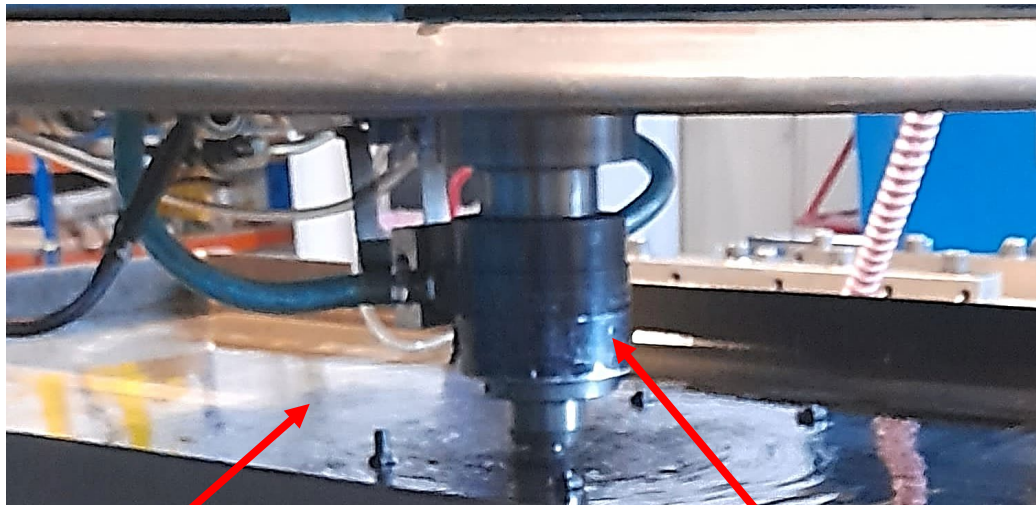
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Use Case

Revolutionise Shipping Industry



**Steel Submerged
Underwater**

Welding Tool

Remote Repair of Ship Hulls

- A recent discovery suggest steel structures submerged underwater can be welded using FSW.
- The damaged ship hulls can potentially be repaired without dry docking the ships.
- Can save significant time and cost



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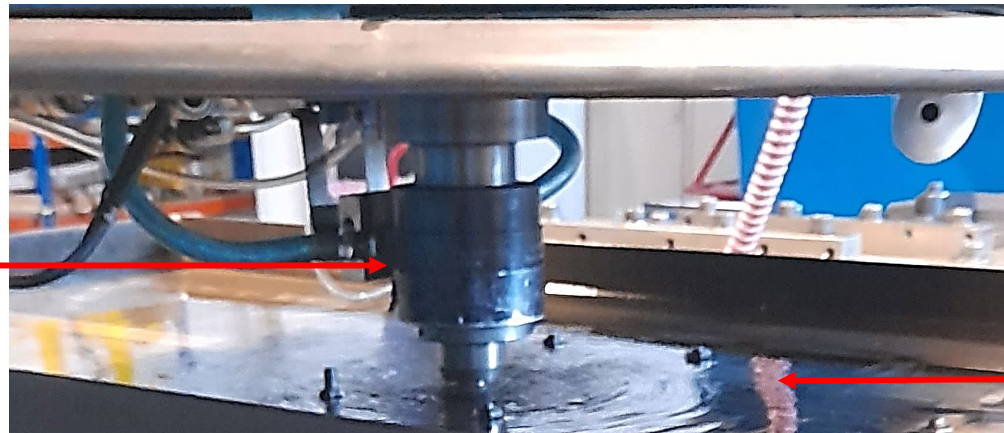
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Use Case

Revolutionise Shipping Industry

Welding Tool



Steel Submerged Underwater

Problem:

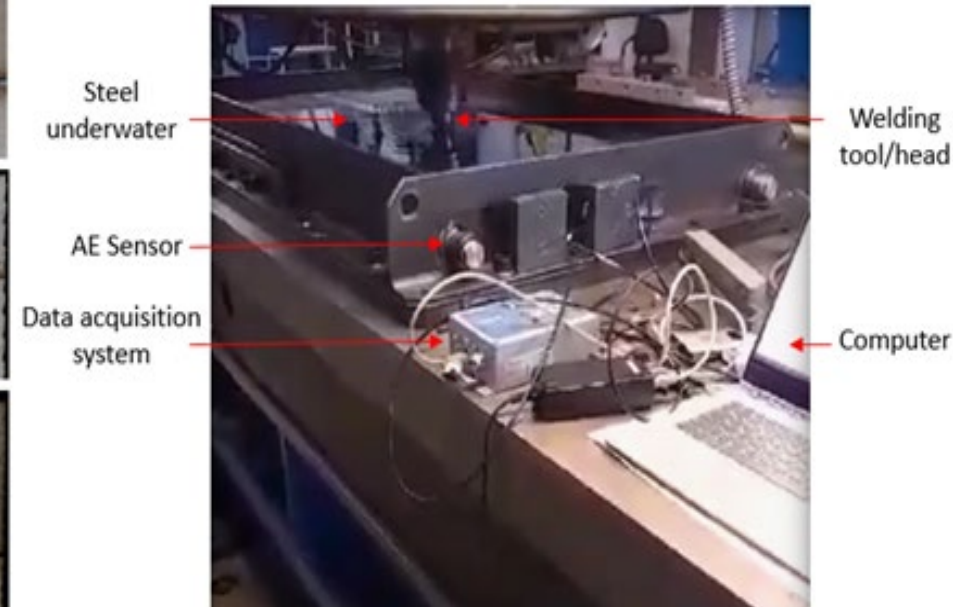
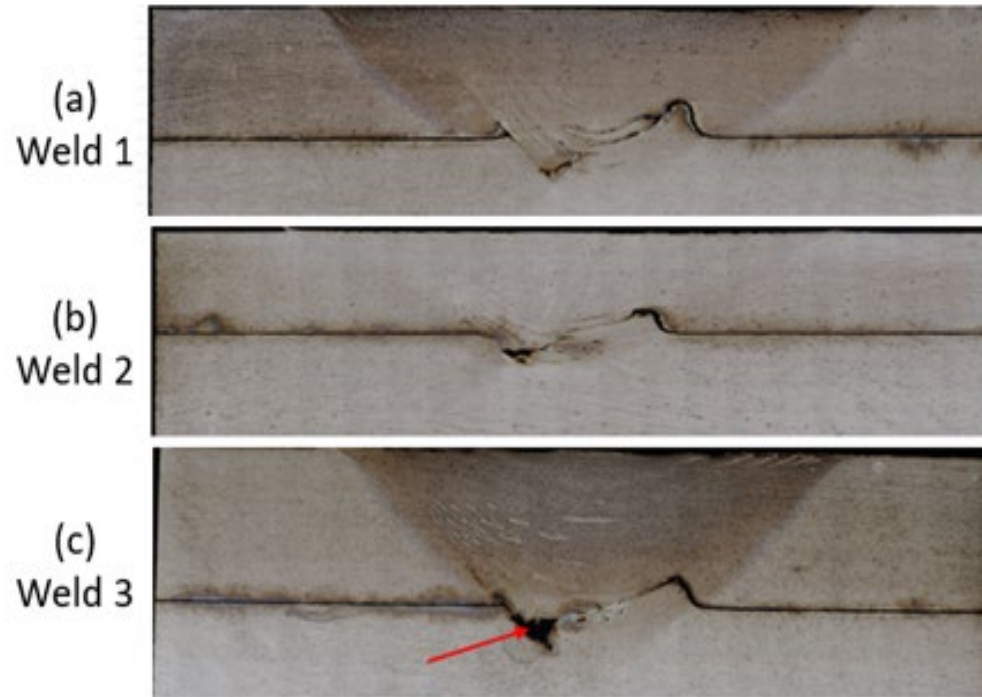
- Operators need to track the condition indicators regularly during the welding process to flag out defects and update the tools dynamics accordingly to avoid it.
- Requires experienced technicians to track the condition and manually tracking condition indicators are challenging

Approach:

- Automate the damage detection procedure
- Use a combination of two Machine Learning algorithms in series to suggest the presence of damages.
- Provides opportunity to the user to avoid the occurrence of damages.

Methodology

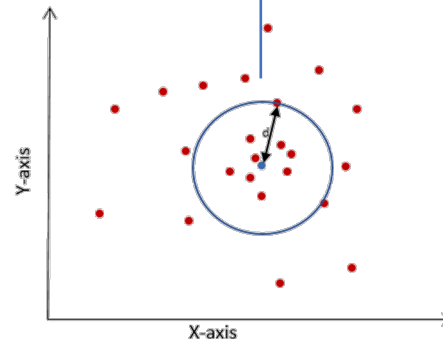
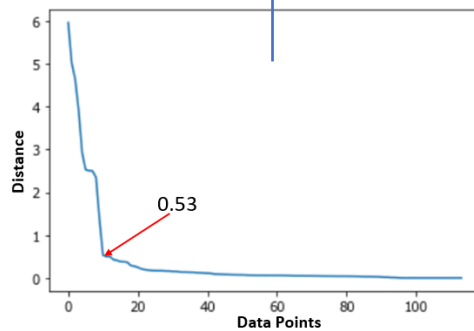
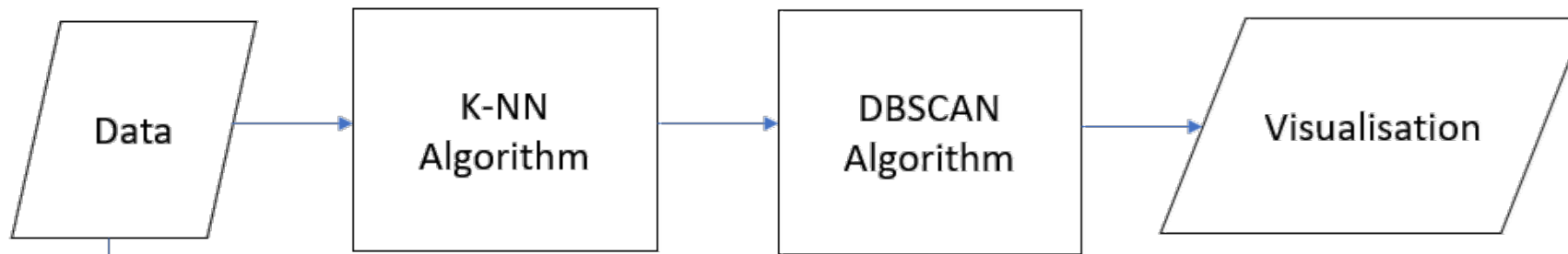
Data Collection



Weld data & identification		
Quality	Configuration	Medium
Good	Lap	Under water
Moderate	Lap	Under water
Bad	Lap	Under water

Methodology

Algorithms



Note:

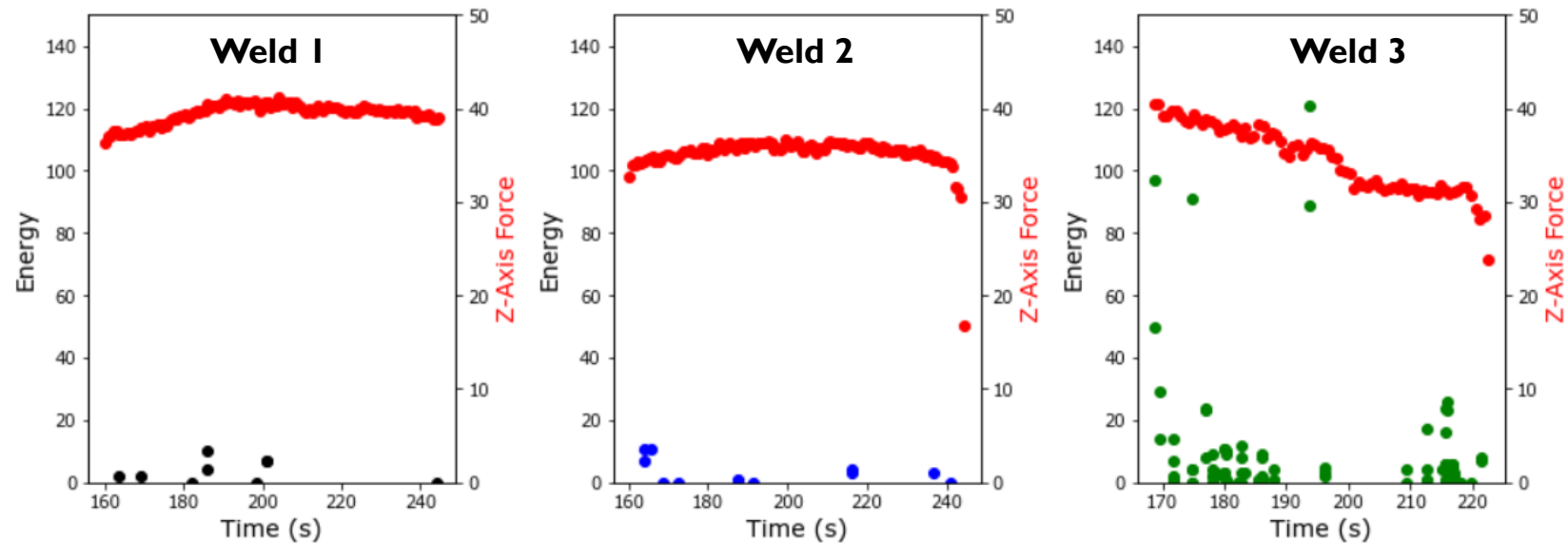
- Hyper-parameter MinPoints for DBSCAN is chosen to be 2 times the dimensions of the dataset
- Hyper-parameter Epsilon for DBSCAN is derived from K-NN Algorithm



Results

Sensitivity Analysis

The **higher AE energy activity in weld 3** compared to weld 1 and 2 corresponds to a **faulty weld**

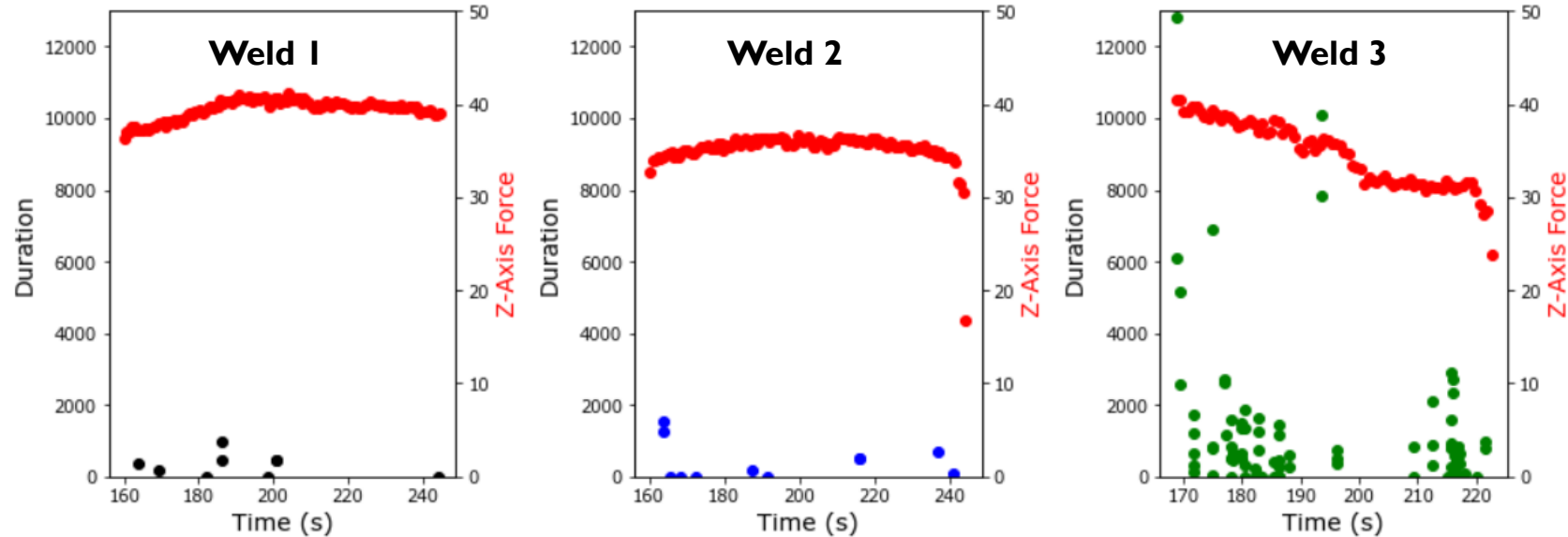




Results

Sensitivity Analysis

The **higher Duration** activity in **weld 3** compared to weld 1 and 2 corresponds to a **faulty weld**

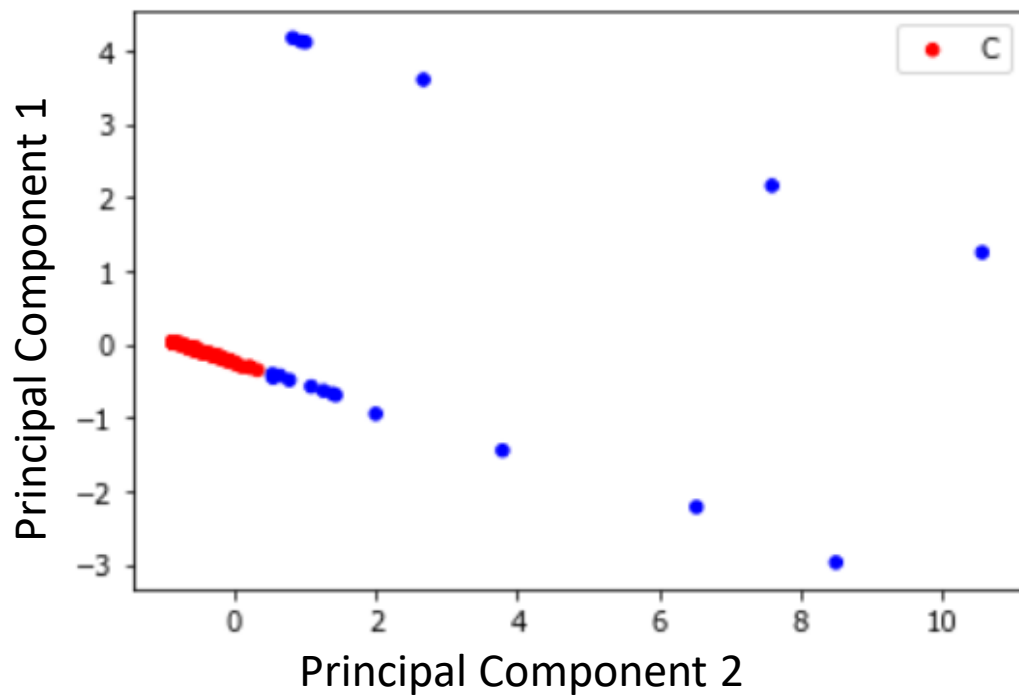




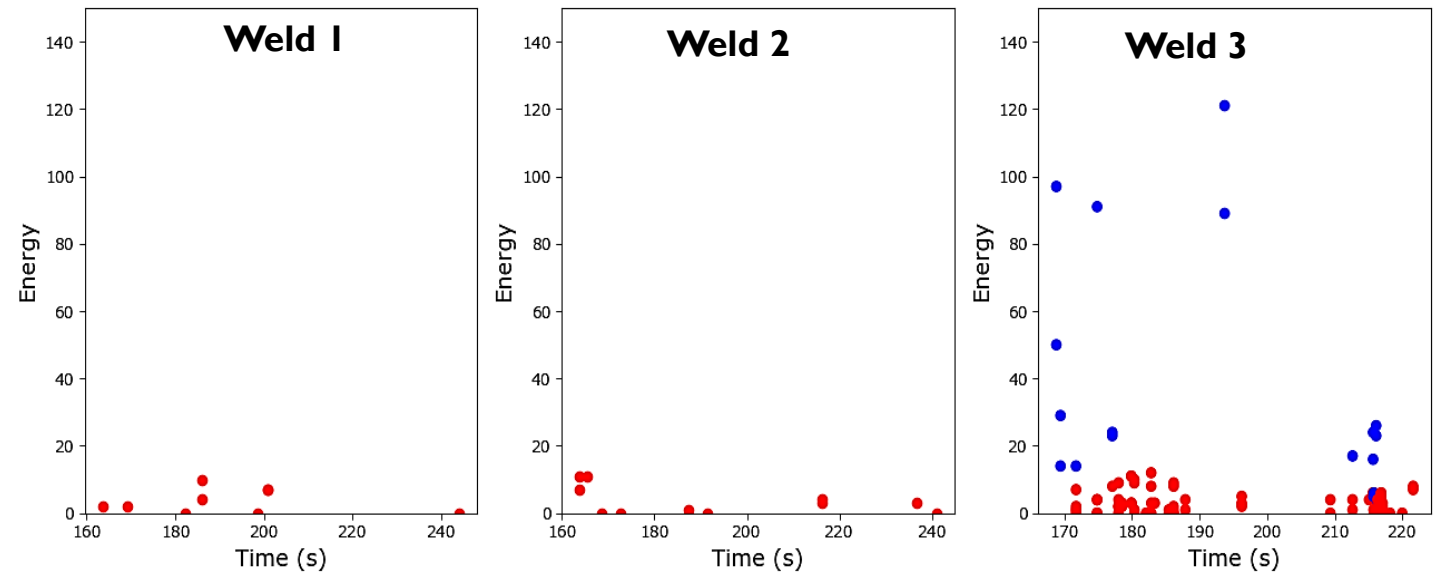
Results

Output from the algorithm

1 cluster with 96 points - **Red**
14 outlier points - **Blue**



1 cluster with 96 points – **Red**: Distributed in all welds
14 outlier points – **Blue**: Present only in weld 3





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Results

Deployment of the Algorithms

Algorithms are currently deployed in the Google AI Platform



Vertex AI

XGBoost



AI Platform

✓ V1

Description

Model WeldPredictor

Model location

Creation time Aug 31, 2023, 1:08:16 PM

Last use time Aug 31, 2023, 4:10:42 PM

Python version 3.7

Runtime version 2.11

Custom code and dependencies

Prediction class Predictor.WeldPredictor

Machine type Single core CPU



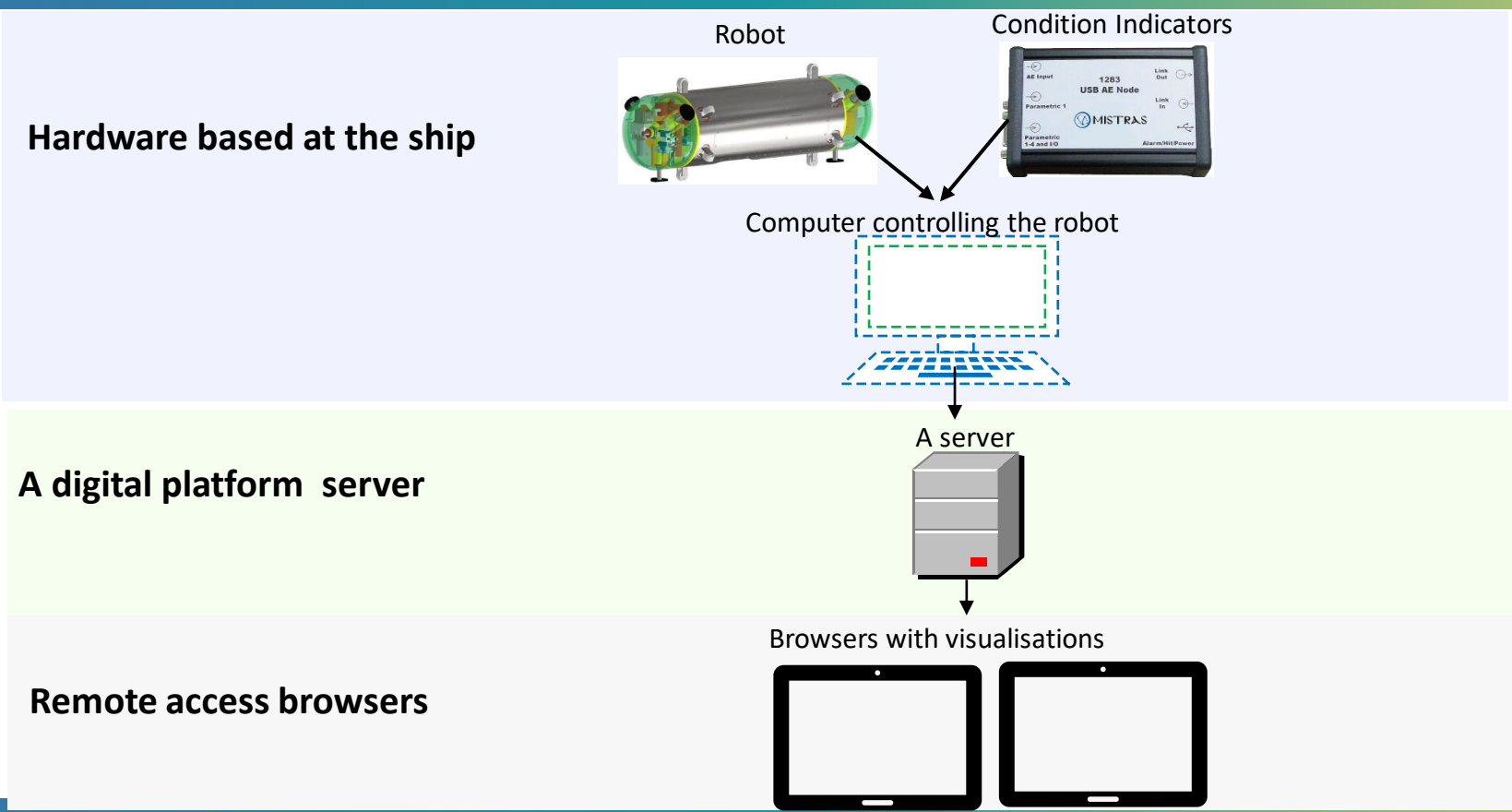
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Results

I 4.0 Compliant Platform





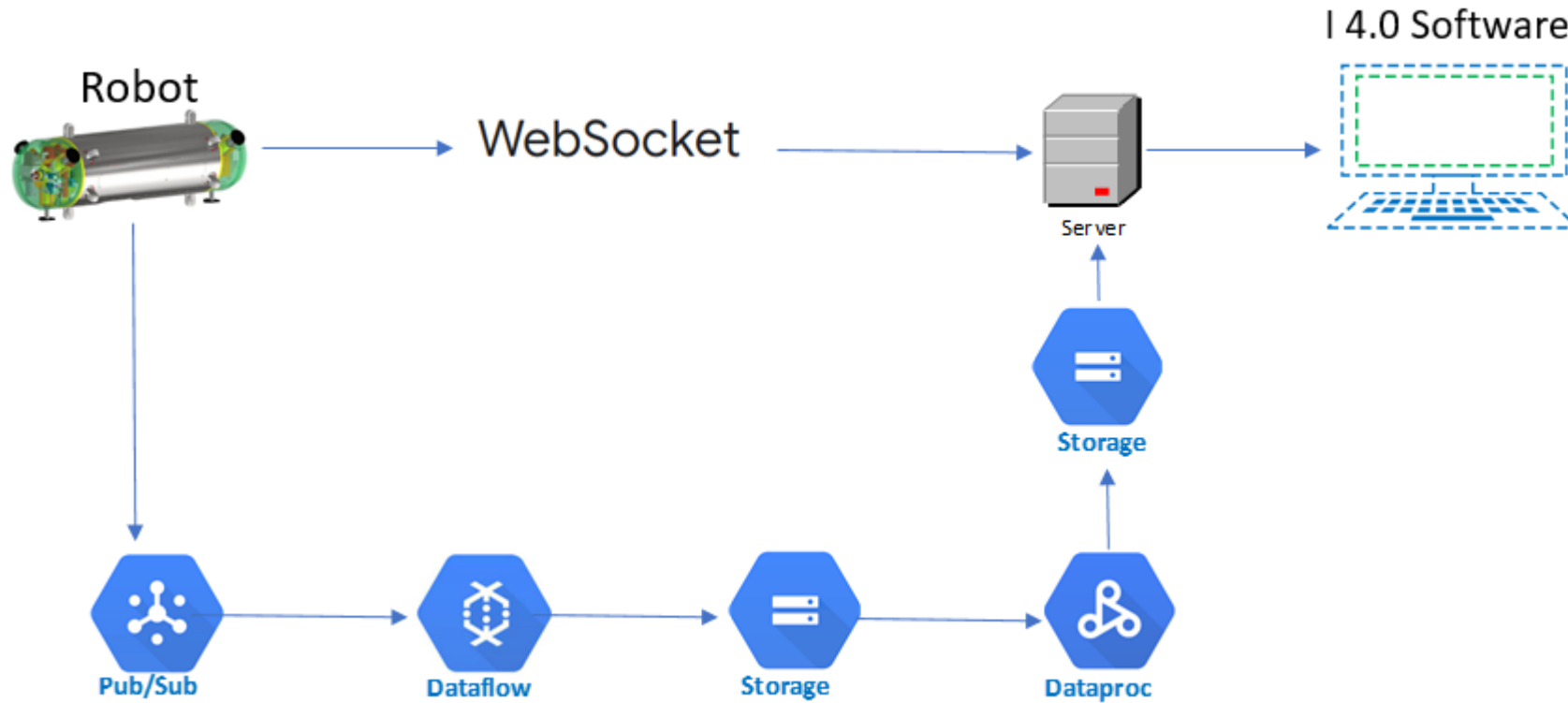
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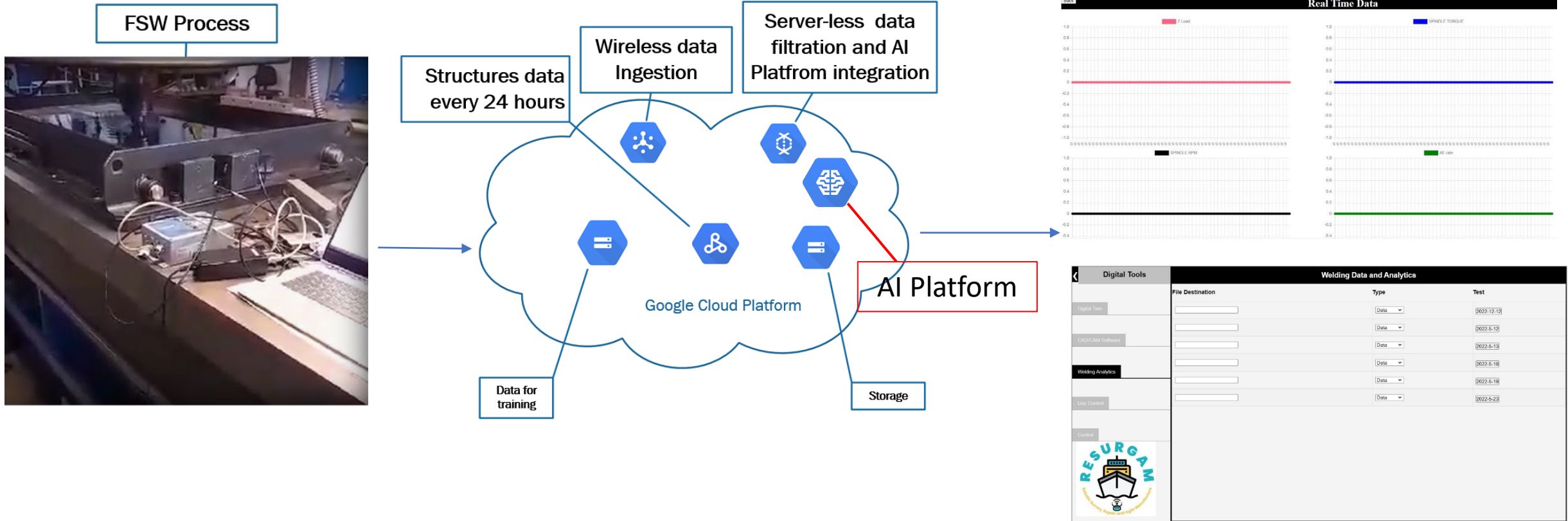
Results

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Results

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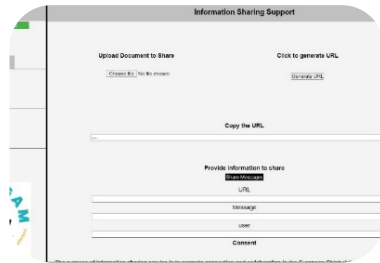
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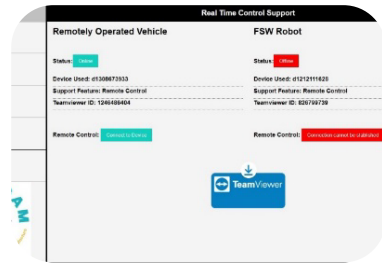


Results

I 4.0 Compliant Platform



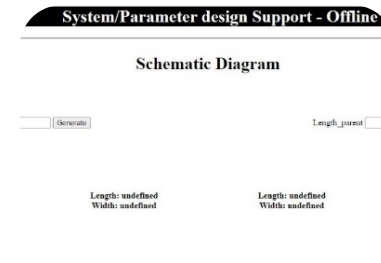
Communication and Data Share



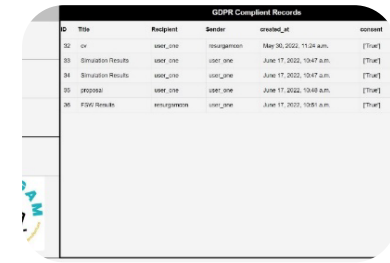
Live Control through TeamViewer API



CAD support



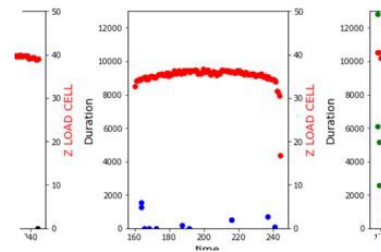
System and Parameters design



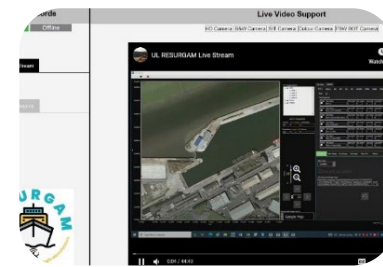
GDPR compliant monitoring



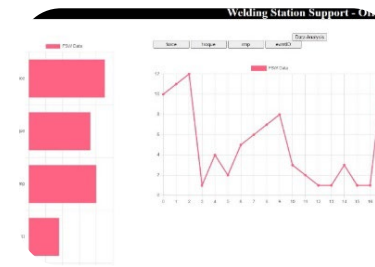
Security of the RDP



Digital Twin



Live Video Support



Data analysis



Summary

It is now possible to **weld steel structures under water** using an innovative FSW processes. This creates uncertainty of the effectiveness of the in-situ monitoring which is widely adopted in traditional welding. In this work, we have accomplished the following:

- Established the **confidence in AE** for monitoring the innovative **FSW process**. Identified the features sensitive to the damages.
- Developed an **approach** that uses a combination of two **machine learning algorithms** called KNN and DBSCAN. The approach can **successfully flag out** the presence of **defects** during **FSW of steel**.

As a part of this project an **Industry 4.0 compliant software** was developed that aims to connect the European shipbuilding and ship maintenance supply chain and value chain. Provide **digital tool for agile manufacturing**.

Any Questions?



Thank you.



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