Digitisation and Digital Signal Processing Methods in Industrial Metal Detection

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THE PROBLEM

Pulse Induction is a metal detection method that has good penetration through materials but bad discrimination capabilities

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Current analogue systems are not capable of keeping up with future customers demands and require digitisation to compete in the marketplace

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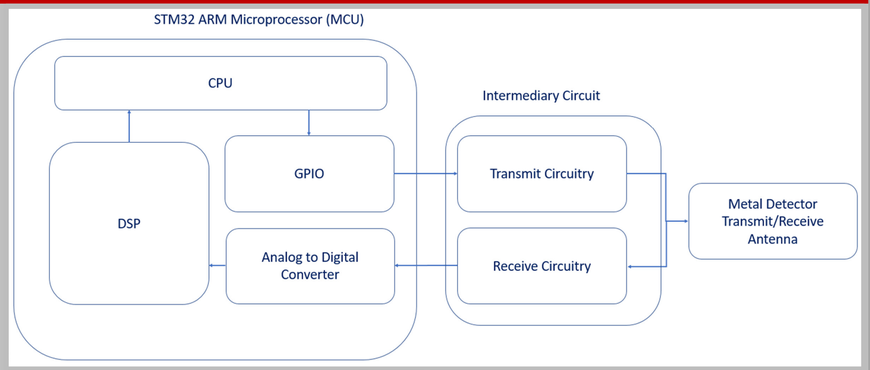
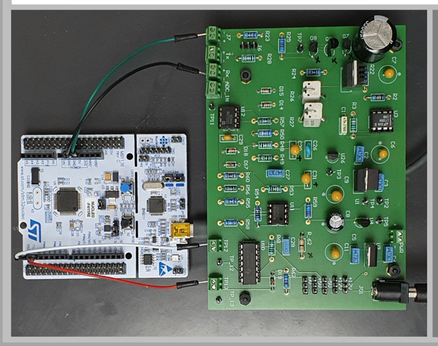
Detection sensitivity and reliability demands have increased significantly as metal detection becomes an increasingly essential part of the quality control process

BACKGROUND

- Cardiff University and Eriez Magnetics have an already established relationship, with Eriez Magnetics investing in a University spin-out Company Fault Current Ltd.
- With Eriez Magnetics recognising a need to update some of their metal detection products a KTP was determined as the best route for investment

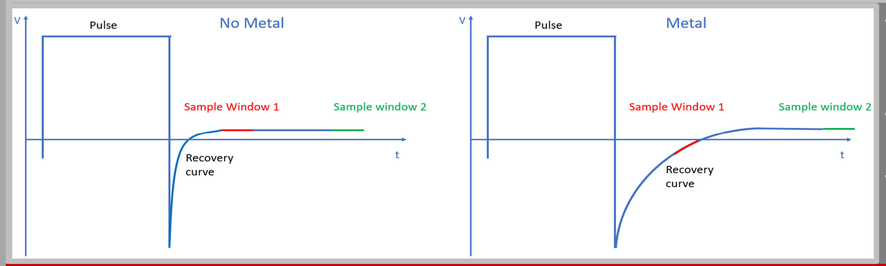
PROGRESS





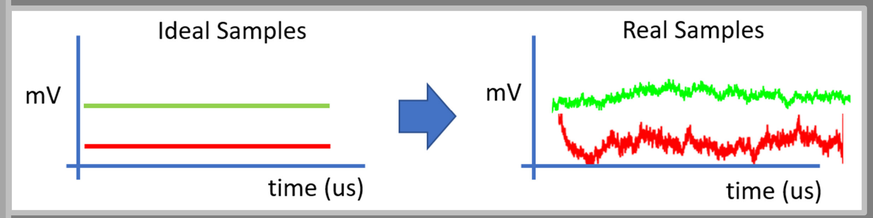
- The new digital metal detector must meet or exceed the analogue detection sensitivity specification
- Exceed the reliability of the analogue system
- Aim to discriminate between different metals using DSP
- The target platform for digitisation is a STM32F7 ARM cortex M7

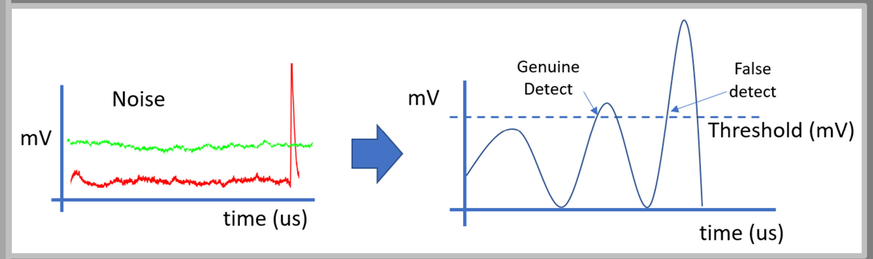
PULSE INDUCTION METAL DETECTION



- Pulse Induction (PI) injects a short burst of current into an antenna which generates a magnetic field, exciting the eddy currents present in the surfaces of materials
- This causes the materials to generate their own small magnetic fields that remain for a short time once the pulse is removed
- The magnetic fields in the environment cause a delay in the recovery back to ground with a below zero drop caused by back EMF in the antenna

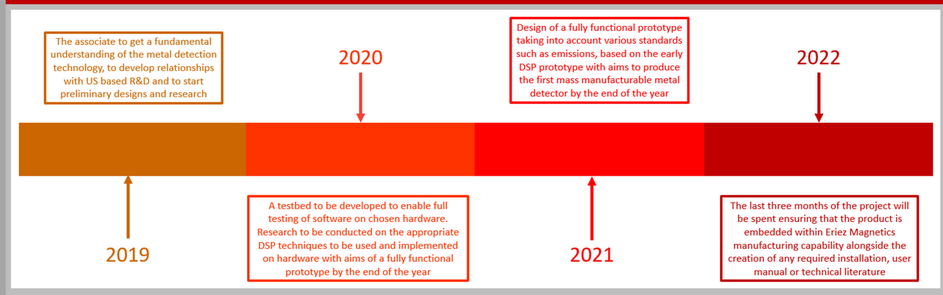
Processing the Signals





- A common method to process the signals compares a sample of the recovery curve against a second reference sample, far away from the pulse
- A comparison is made between the voltages of the two sample windows, with the difference between them being compared to a predetermined threshold.
- If the voltage difference between the two sample windows exceeds the threshold, metal is determined to be present
- External noise sources can greatly affect the magnitude of the voltages present in the metal detector circuitry.
- The simple threshold method outlined above does not take in to account sporadic pulses and noise that can cause false detections
- The threshold voltage range can be increased to compensate for a voltage spike but this comes at the cost of decreased detection sensitivity

TIMELINE



ERIEZ MAGNETICS

- The KTP aims to develop an advanced metal detection product that will keep Eriez Magnetics metal detection competitive in the global marketplace
- This KTP has been the recipient of a Welsh Government grant with the intention to closely involve the USA based R&D team and expand product sales to the currently untapped North American market
- Potential future developments include the expansion of an R&D team based in Caerphilly