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Conhecimento, tecnologia e inovação moldando o futuro da inspeção



TEMA: UNDERWATER INSPECTION

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Mechanical Engineer graduated in 2015/2 from the Federal University of Rio Grande do Sul (UFRGS), with a Master's and Doctorate from the Postgraduate Program in Mining, Metallurgical, and Materials Engineering at UFRGS.

He worked in the field of non-destructive testing from 2016 to 2022 at LAMEF-UFRGS, primarily participating in Research and Development Projects using ultrasonic techniques, with an emphasis on sensor development and signal processing.

Currently (as of 2023), he works as an Engineering Manager at Goldfine Serviços Tecnológicos do Brasil (an authorized distributor and consultant for JENTEK Sensors in Brazil).

INSPECTION OF BROKEN WIRES IN FLEXIBLE PIPES USING THE MWM-ARRAY TECHNIQUE

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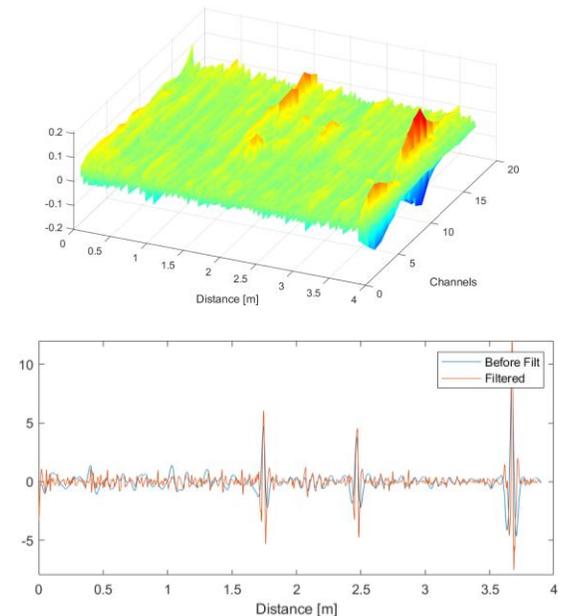
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MOTIVATION

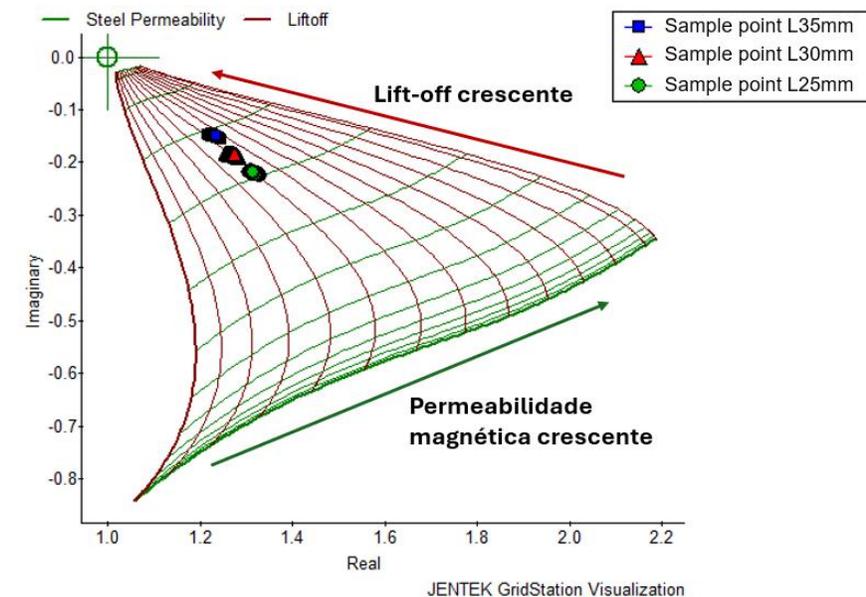
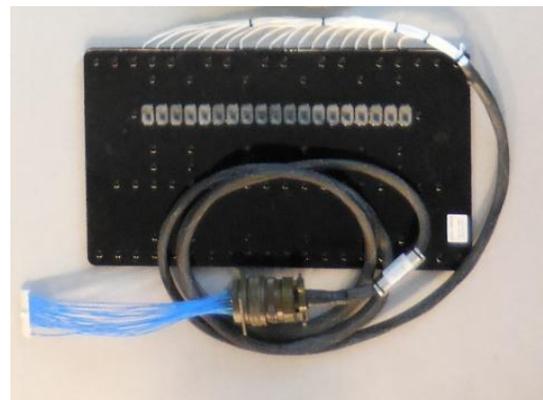
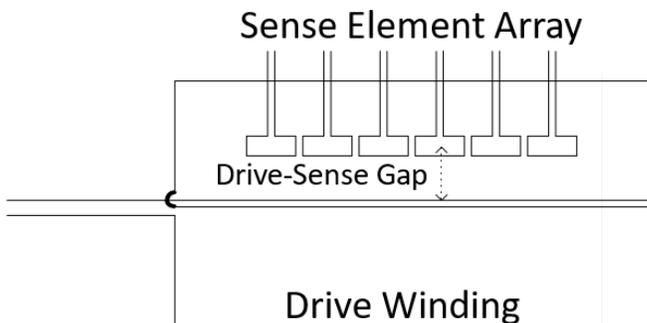
- High number of breaks in the tensile reinforcement wires of flexible pipes found in the field due to the effects of stress corrosion cracking (SCC)
- Need for a tool to inspect and scan long sections of pipes to identify breaks
- Need for technology to inspect tensile reinforcements under the external coating layers and thermal insulation layers of flexible pipes

OBJECTIVES

- Detection of broken wires in external tensile reinforcement layer of flexible pipe using the MWM-Array system
- Evaluation of the effectiveness of the system in different sample spacing configurations.

MWM-ARRAY TECHNOLOGY

- Electromagnetic sensors (Eddy Current) with parallel sensor elements
- Solution based on physical models representing the structure and response of the sensor
- Processing of signals acquired through GridStation software

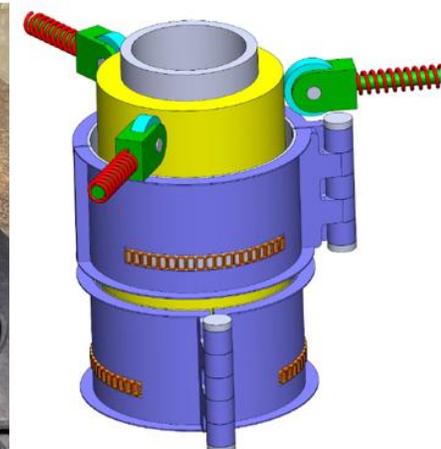
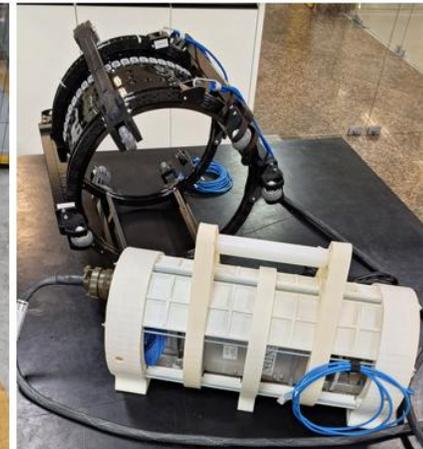


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TEST SETUP - EQUIPMENT

- External axial inspection of the pipe
- Multivariable and Multifrequency technique: Lift-off and Magnetic Permeability
- Instrument: GS9000 with 79channels
- MWM-Array® inductive 19ch sensors
- Air Calibration
- 100% parallel data acquisition with no multiplexing
- Data processing in GridStation Software

Scanner and Hardware setup for measurement



TEST SETUP

Lift-Off configurations



17mm

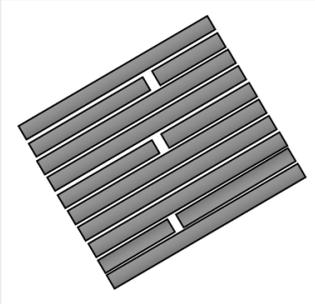
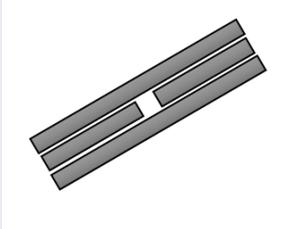
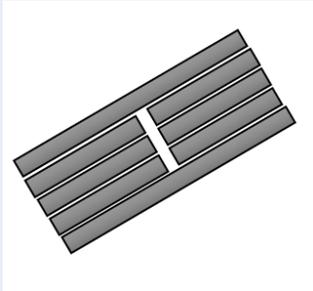


30 mm

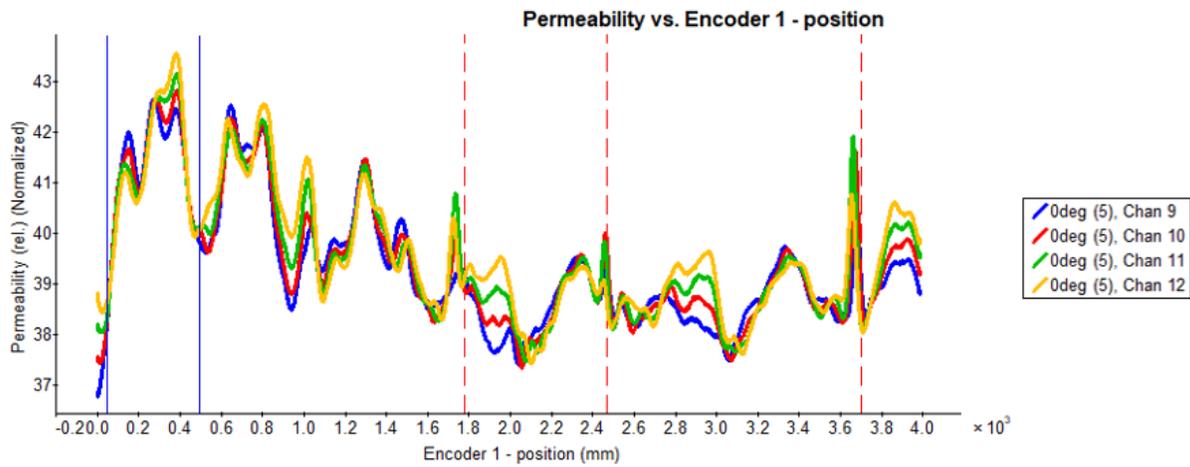


42 mm

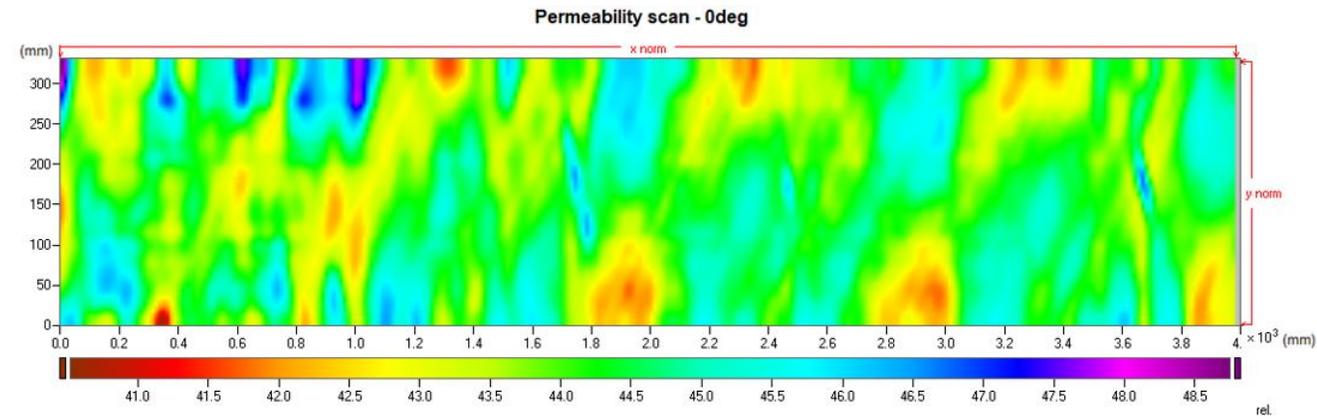
TEST SETUP – WIRE RUPTURES MEASURED

Position	Region 1 – 1.8m	Region 2 – 2.5m	Region 3 – 3.7m
Description	3 spaced defects with 5mm gap	1 defect with 10mm gap	3 adjacent defects with 5mm gap
Setup			
Image			

RESULTS – MAGNETIC PERMEABILITY

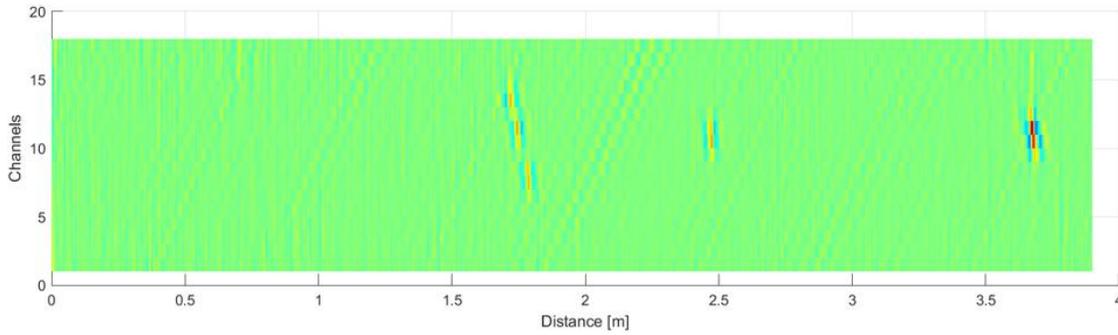


Magnetic permeability for 17mm Lift-Off (Channels 9 to 12)

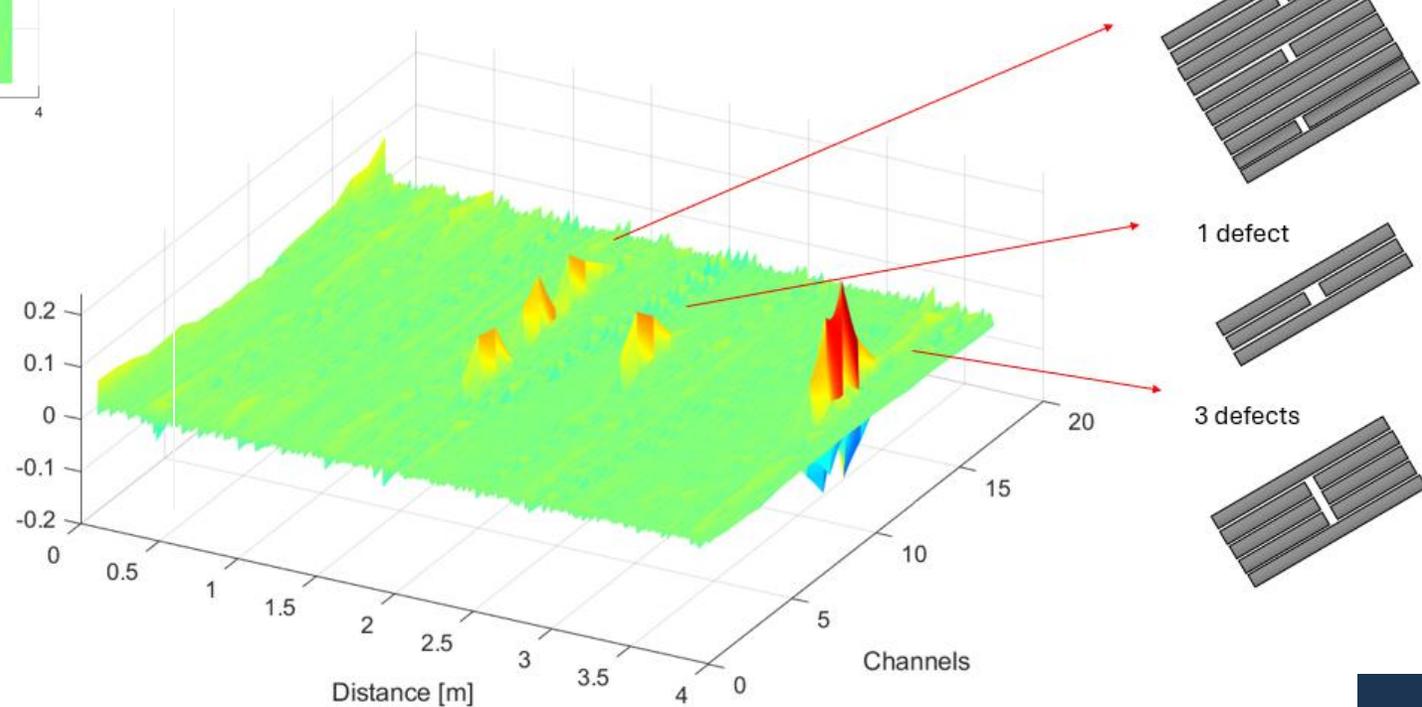


C-Scan Magnetic Permeability for 17mm Lift-Off

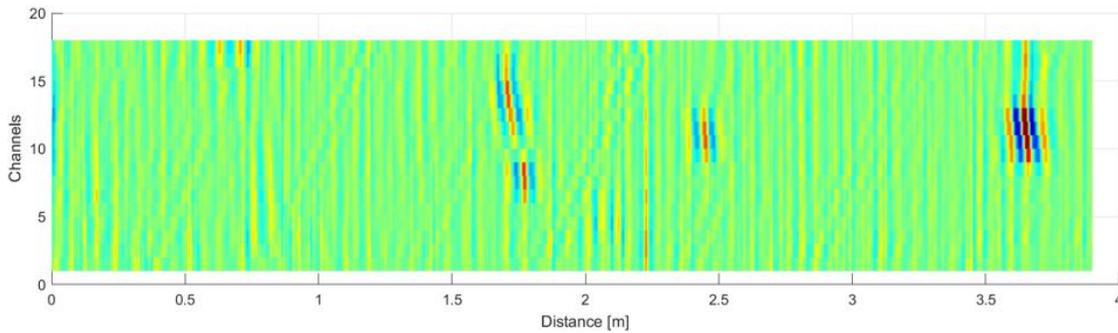
RESULTS – 17mm *Lift-off*



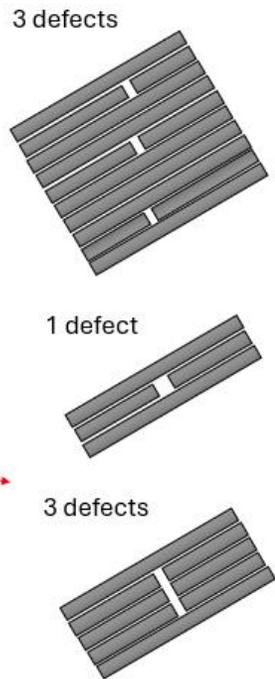
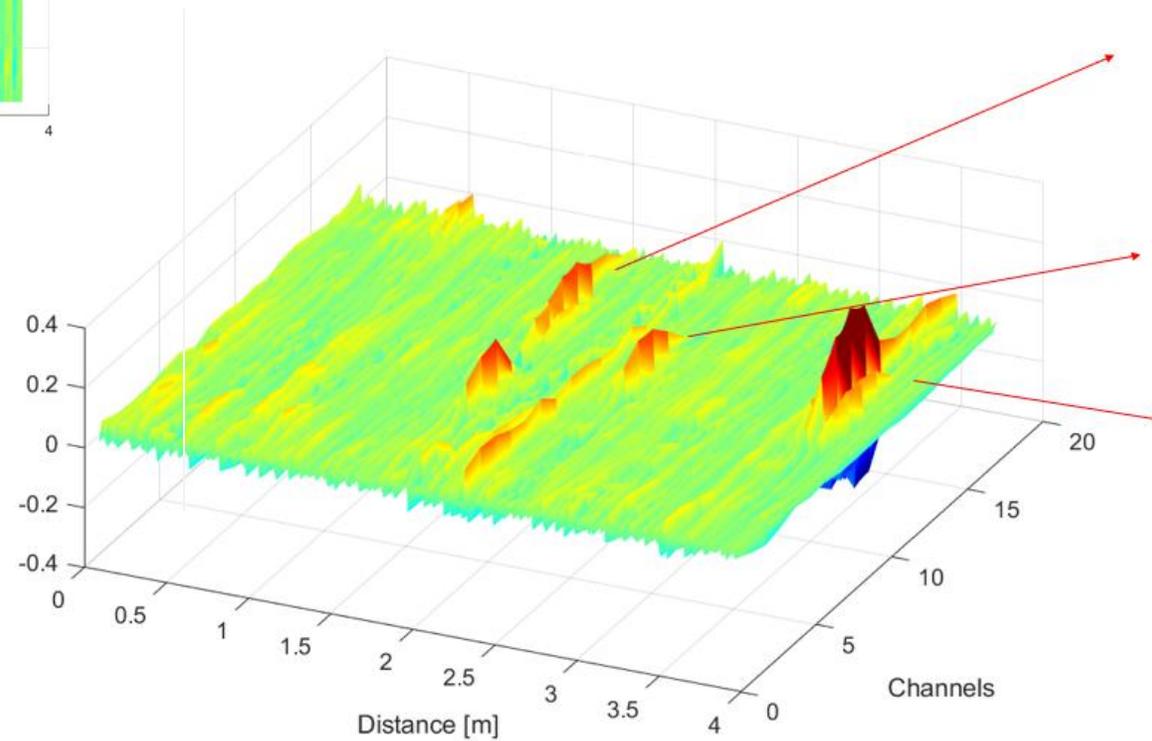
C-scan after processing of magnetic permeability signals



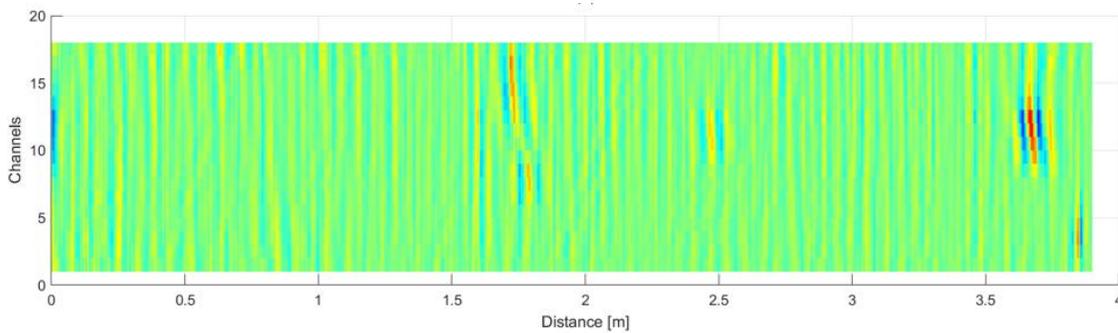
RESULTS – 30mm *Lift-off*



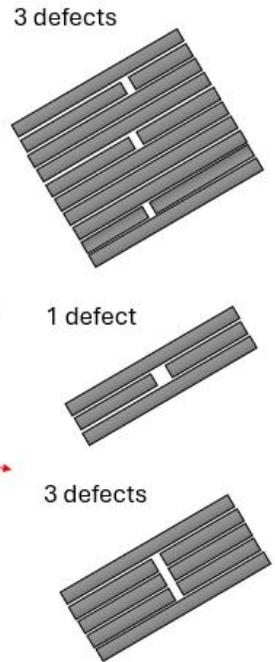
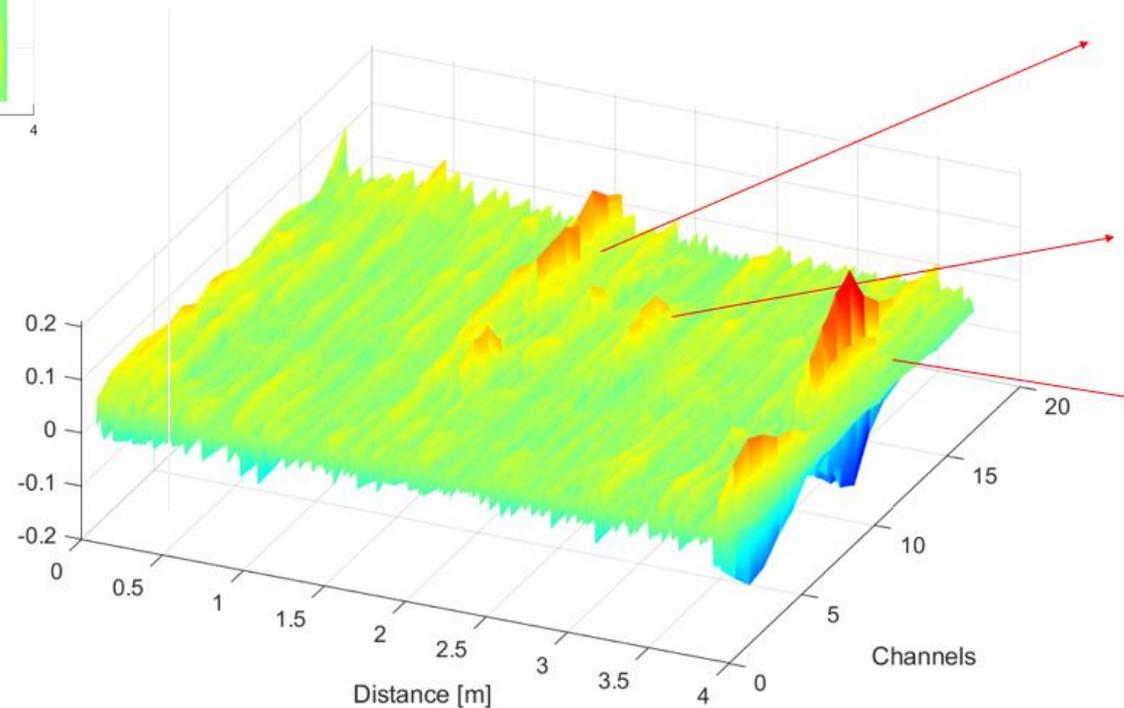
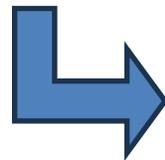
C-scan after processing of magnetic permeability signals



RESULTS – 42mm *Lift-off*



C-scan after processing of magnetic permeability signals



CONCLUSIONS

- MWM-Array technology showed correct positioning indications in 3 different sets of defects tested.
- MWM-Array sensors were able to identify areas with broken wires at lift-offs of 17mm, 30mm and 42mm.
- The technique proved promising for inspecting broken wires in flexible pipes with thermal insulation, as indicated in measurements up to 42mm of lift-off.

ACKNOWLEDGMENTS



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Obrigado!

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