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AINDT

INDUSTRIAL EYE

THE OFFICIAL JOURNAL OF THE AUSTRALIAN INSTITUTE FOR NON-DESTRUCTIVE TESTING

RADIOGRAPHY ▪ ULTRASONICS ▪ EDDY CURRENT ▪ PENETRANT ▪ MAGNETIC PARTICLE
VIBRATION ANALYSIS ▪ LUBRICATION ANALYSIS ▪ THERMOGRAPHY ▪ ACOUSTIC EMISSION

INNOVATION IN EQUIPMENT AND TECHNOLOGY

President's Message

Richard Stocker

The theme for this edition of the *Industrial Eye* is 'Innovation in Equipment and Technology' and we hope you enjoy reading through the content and technical papers held within it.

I challenge you to answer some of the below questions though and think to yourself, "Do end users and plant/asset owners really see genuine value in the advancement of Non-Destructive Testing technologies?" Finding microscopic defects that are smaller than those in which current and reliable technology is already highly capable of detecting and technicians are proficient, comfortable and confident using in the field?

...or do they see more value in their vendors and service companies showing a genuine, consistent and significant increase in productivity when carrying out Non-Destructive Testing on their assets, demonstrating proven and maximised on tool time from our technicians? Do they have the age old perception of seeing technicians spending far too much time in front of a laptop in the airconditioned office typing up mundane reports that few can understand or have the time and bandwidth to read through, when their time could be much better spent out on client assets carrying out more inspections? How do these aesthetics effect the rest of the workforce?

Would end user clients like to see further development in real time digital in field recording and reporting? Smarter and seamless interfaces with their ERP systems such as SAP or Oracle? Perhaps bespoke software that can directly link NDT reports completed digitally in the field with their asset hierarchy on various asset integrity management software's? Or even better, immediate transfer of information from our inspection equipment to their email of these software programs?

How far is far enough when it comes to developing technologies that can be used to find often irrelevant indications? Whilst understandably it's incredibly important to reach these high levels of sensitivity and certainty in some applications, is it really required for the day to day compliance testing and/or the bulk of regular inspections looking for more significant defects? Defects that can actually cause imminent failure, damage to property, the environment or in the worth case injury and worse to people.

Do we spend too much time demonstrating how intelligent and technical we are, whilst losing touch with the real reason why we carry out these inspections in the first place?

Do many of these clients and report readers need to see all the minor details contained in NDT reports? Or would this be best left with technical engineers and those who need to see we have met our requirements under bodies such as NATA? It's far more likely that senior leadership would prefer to see short and sharp reports that contain 3D images they can understand on the hop and make decisions in real time on whether to shut plants down, make repairs, limp through to outages?

Many clients simply want to know by exception as quickly and clearly as possible what the current state of their assets is so that they can make informed decisions and do not have to dig through enormous documents containing a host of technical data that they don't really need to see or actually care about. "Just tell me what you've found, so I know what to do about it".

We often get bogged down in the technical details and try to get the most in-depth information and show how good we are at finding the most minimal of defects and of course we are proud when we do so. But is that what our end users and client base really want? Perhaps we are good enough now to determine what they need to know; we just need to get better at getting the information to these clients in the most efficient and clear way possible. Get this information to them in a concise manner that they understand and suits their immediate needs.

As an industry made up of many professional service companies, we should be asking ourselves the above questions if we really want to drive successful growth within our businesses and also to ensure our clients get what they want and pay top dollar for. So ponder on this, how much time, effort and money do we really need to invest in new technology? Will it really drive the returns we are after? Will it make our clients overjoyed with our capacity to execute inspections on their assets?

Hopefully some interesting food for thought and this will drive some left field innovative thinking for you and your peers.

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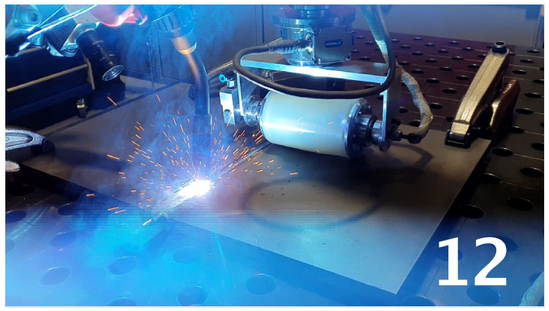

AINDT News

Industry News

Technical Article

Product & Services

Cover Image

GUL QSR® with the new SR Axial Scanner. The QSR® is GUL's quantitative short range (QSR) device, incorporating the latest guided wave technology
www.guided-ultrasonics.com

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Editorial Committee
Dr. Irene Pettigrew
Production Uma Sudhakar
Design Alarna O'Connell

AINDT
PO Box 52, Parkville Vic 3052
P: (03) 9328 8831
www.aindt.com.au
E: office@aindt.com.au

ADVERTISING
AINDT Federal Office
P: (03) 9328 8831
E: journal@aindt.com.au

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Manuscripts should be submitted in electronic form:
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2. typed with single spacing
3. with figures as tif or jpeg files at better than 300dpi

Manuscripts should include:
1. symbols and abbreviations conforming to recognised standards; metric units (SI)
2. references listed, after the text, in the order in which they occur in the paper
3. references indicated in the text by arabic numerals in square brackets
4. tables and figures numbered separately but consecutively with Arabic numerals and brief, descriptive titles
5. a reference in the text to all tables and figures
6. graphs and diagrams made with lines of sufficient thickness to reproduce well
7. titles and address of authors

Procedure for submission of manuscripts:
1. articles should be sent to: journal@aindt.com.au
2. manuscripts will be submitted to referees who will remain anonymous
3. reprints of each paper will be supplied free to the author

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CEO Message September/October 2023


Dr. Irene Pettigrew

It has been a couple of months now since I have embarked on my journey as the new CEO of the AINDT. Many may ponder on what does the CEO role involve for a majority volunteer-based not-for-profit organisation. The answer is that the role itself includes operations, finance, marketing, membership, administration, education, IT systems, HR, and, last but not least, national certification body management. There is no typical day in the life of a CEO as the role is expansive and diverse. The role has so far been insightful and has given me the opportunity to spend time with staff, volunteers, contractors, members, AQBs and kindred societies. The first stage has involved familiarisation and knowledge transfer by way of reviewing and auditing AINDT current processes and systems to enable priorities to be identified and areas of optimisation and improvement. This iterative process will lead to a development of the AINDT strategic plan for the coming years.

The AGM of the AINDT is fast approaching and it is the opportunity for all its members to participate in its policies and practices. In a large country, such as Australia, attendance in person by all members is not feasible, hence there is provision for proxy voting by those members unable to attend an AGM. This information is circulated to members by the AINDT Federal Office so do not pass up the opportunity to attend in person or cast your vote via proxy.

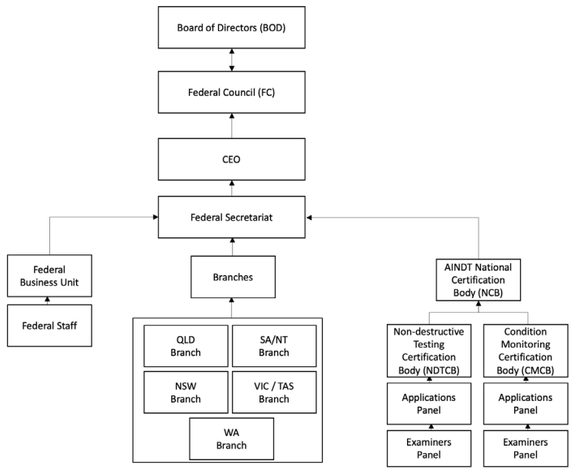
This is also the time of year where all the AINDT Federal Councillors, elected by their Branch Councils for a term of two years, meet annually. Federal Councillors have a duty to represent their Branch Council at Federal Council meetings and exercise due diligence when doing so. They are expected to contribute openly and honestly in the deliberations of Federal Council and to make decisions which are in the best interests of the AINDT. Federal Councillors are also therefore required to inform their relevant Branches of decisions made by Federal Council and to facilitate the decisions at Branch level, as being in the best interest of the AINDT.

Federal Councillors are responsible for the selection of nominees for the Board of Directors (BOD) positions annually. These nominees will be proposed to the entire AINDT ordinary membership, for voting/election, prior to the AGM.

In August 2023, following my appointment as CEO, the positions on the BOD transformed with Richard Stocker becoming Federal President, Justin Cavanagh as Vice-President, Damien Clarke taking up the treasurer role from non-voting Observer/Advisor, Nick Eleftheriou remaining as Immediate Past President and Richard Nowak as Federal Secretariat Liaison. This has left the Observer/Advisor position vacant until the Federal Council meeting in October. The non-voting board member (Observer/Advisor) is elected on their broad experience, management and business credentials, by the Federal Council to advise the board on the affairs of the AINDT. The Observer/Advisor is the mechanism by which, approved Federal Council recommendations are taken to the BOD.

I have included a flow chart to help understand how the AINDT organisational structure works constitutionally and to appreciate the degree of separation between the membership and certification services.

I am looking forward to meeting members at the upcoming AGM and on my travels around Australia. My door is always open so please do visit the Federal office (27a Stubbs Street, Kensington, Melbourne), reach out via email at office@aindt.com.au or call (+61) 0394869267.



Non-destructive Testing Certification Board (NDTCB) – Chairperson's Message


Barry Cooper

Innovation Equipment Technology is the theme of this month's Journal. AI Chip manufactures have been in the news lately due to sky-rocketing share prices. A quick Wikipedia search describes Artificial intelligence as: 'the ability of machines to perform tasks that are typically associated with human intelligence, such as learning and problem-solving'. Four Types of Artificial Intelligence have been identified: Reactive Machines, Limited Memory, Theory of Mind, and Self-Awareness being the highest level.

It is uncertain how quickly AI Technology will advance into NDE field. I believe human interaction will still be around in the near term. The next Generation of NDE Technicians will most likely require an evolving skill set that will probably include language processing, programming, statistics and mathematics as pre-requisites to enter this industry. Let's hope humans evolve with this new technology and aren't just displaced. I'm not quite ready for a Self-Aware Ultrasonic Flaw Detector yet.

Structured Credit System

The Structured Credit System is causing some angst among candidates that are at the Renewal Stage (1st 5-year period). If you are having trouble collecting the required points, then contact the AINDT early for advice. If you can't collect the required points then candidates have the option of completing the practical examination (minimum of 50% of exam specimens), as describe in Table C1 of the 'Guide'.

Referee Suitability

Again, another reminder of choosing a suitable Referee. Paragraph 3.7.4 of the 'Guide' discusses Referee requirements. There are different requirements for an initial certification and those candidates who are recertifying. 'For initial certification, referees must be in a position to direct and control the activities of the candidate.'

Whereas for renewal or recertification: 'the chosen referee need not meet the requirements for initial certification in terms of being in a position to direct and control the activities of the candidate.'

It is preferable if your Referee is certified in the same method the candidate is seeking experience verification for; but if they do not hold the relevant ISO9712 certification, they are still required to have suitable knowledge, skill, training and experience. Referee Resumes do not need to include their full working history back to High School, just the relevant NDE/Engineering experience is all that is required. A pre-approval process for referees is available if you are in doubt.

Please ensure your Referee is willing to be contacted by the AINDT Office Staff to verified what they have certified. A link to the Company Website, Personnel Listing, is not a suitable Resume and won't be accepted.

Barry Cooper
Chairperson – AINDT NDT Certification Board

Condition Monitoring Certification Board (CMCB) – Chairperson's Message

Shawn Moore

The Condition Monitoring Board from time to time get approached from training bodies to approve the training they offer as being acceptable for certification of their candidates.

Formal review is conducted by the CMCB board of these training organisations training materials for compliance with ISO 18436 and relevant parts being Vibration Analysis (ISO18436/2), Field Lubricant Analysis – (ISO18436/4) and Thermography (ISO18436/7).

In the past some training organisations have been requested to provide evidence of changes to training manuals to ensure compliance with the ISO Standards. As the training has not necessarily perfectly aligned with the requirements of the ISO Standard.

The CMCB does not directly offer training for certification purposes. The CMCB will not be directly involved in training but will approve training bodies (ATB's) that can provide proof that they are in compliance with ISO requirements of the specific methodology.

The CMCB will also authorise qualifying bodies (AQB's) to act on the board's behalf in the qualification and certification process. The CMCB will also approve examination centres (AEC's) providing they meet the standards for holding examinations on the CMCB's behalf.

It is important for the integrity of certification that these processes are regularly reviewed and documented. With the upcoming CMCB meetings in October review and documentation of these processes will be discussed to continue the improvement of the certification. Regular review of approved training organisations is viewed as important to ensure the quality of the training meets the minimum standards for ISO certification.

The transition to electronic examinations of candidates for certification is viewed by the board as a means of improvement and integrity of certification into the future. These elements being part of the overall QMS systems of the AINDT to make ongoing improvements to certification scheme.

Shawn Moore
Chairperson – AINDT CM Certification Board.

Membership Registrar's Message

Hi AINDT members,

As you, all may be aware AINDT has recently appointed Irene Pettigrew as our new CEO. Irene is an experienced business leader in the field of advanced NDT and has a PhD in Ultrasonic engineering. She has been heavily involved in AINDT since immigrating from the UK and is the current president until the upcoming AGM. This is a significant appointment for the future direction of the industry.

I would like to acknowledge Peter Milligan's efforts in supporting AINDT whilst this search was underway. Peter has been integral in the development and progression of the industry during his time as CEO. I would like to personally thank him for his efforts in support of AINDT.

AGM Importance, all branch AGM's are completed with good numbers attending. These meetings facilitate open communication between members and the Federal board. It is a chance to for two way dialogue accountability for actions raised over the past year to ensure decisions are made in the best interest of AINDT.

The AINDT AGM and Federal Council Meeting will be is held in Melbourne from the 13th to 15th October 2023 in Melbourne. Just a reminder that you can contact your local branch member for any questions which you want to be raised at the upcoming FC meeting. This is one of the main forums used to highlight feedback from our members.

AINDT membership renewals have been sent out and we encourage all members to submit their renewals forms in July. We are pleased to announce membership fees will remain the same as last year and offer the same great benefits.

The AINDT CEO, branch presidents and Membership Registrar will also be meeting shortly to review ongoing AINDT membership benefits.

Please continue to support AINDT.

Regards,
Craig Taylor

New AQB Alert – Protecs Global, Qld

When it comes to building a successful family business, it often begins with a passion that drives you, a journey that takes you across borders, and a vision that becomes a reality. This is the inspiring story of Protecs Global Pty Ltd, a new AINDT AQB founded by Hamed Madani and his wife, Keren Abarca, with a rich history that originated in Iran, extended to Asia and Malaysia, and finally found its home in Australia.

Protecs Global Pty Ltd stands as a testament to the incredible power of passion, relentless hard work, and unwavering integrity. Hamed Madani's remarkable journey in welding inspection and non-destructive testing (NDT) commenced when he was just 17 years old. His steadfast dedication to this field, fuelled by a profound passion, laid the foundation for his extraordinary career.

His early career in Iran provided him with the opportunity to refine his skills and expertise in welding inspection and NDT, all while nurturing his innate desire to teach and share knowledge. This passion became the driving force behind his journey as he worked tirelessly, paving the way for the future.

After years of tireless effort and commitment in Iran, Hamed Madani decided to broaden his horizons by taking his expertise to Asia and Malaysia. During his five-year tenure in these regions, he continued to refine his skills and deepen his knowledge in the field, laying the groundwork for what would ultimately become a thriving family business.

In 2014, Hamed and Keren made the courageous decision to relocate to Australia. This move marked a pivotal moment in their lives and business journey. Australia's diverse and vibrant industrial landscape provided the ideal backdrop for their entrepreneurial aspirations.

On January 1, 2023, Protecs Global Pty Ltd officially commenced its operations in Brisbane, offering CSWIP welding inspection training and examination services. Shortly thereafter, the company achieved another significant milestone by becoming an authorised qualifying body (AQB) approved by AINDT (Australian Institute for Non-Destructive Testing) to provide NDT training and examinations. The company specialises in training and certifying welding inspector personnel and delivering non-destructive testing training and examinations in strict compliance with ISO 9712 standards as set forth by AINDT.

Protecs Global Pty Ltd embodies the realisation of a lifelong dream, built on the pillars of passion, hard work, and integrity. The synergy of Hamed Madani's enduring passion for teaching and Keren Abarca's unwavering support has created a dynamic and prosperous enterprise. Their commitment to delivering high-quality training and examination services in the specialised fields of welding inspection and NDT is evident in the success and reputation they have achieved.

Hamed Mandani – MT using Bench Unit

Hamed, Keren and Seraphina Belle.

The journey from a young dreamer in Iran to the thriving business in Australia has been punctuated by challenges and opportunities, underscoring their remarkable resilience and dedication. Protecs Global Pty Ltd serves as an inspiring example for aspiring entrepreneurs and those who aspire to transform their youthful passions into thriving businesses.

Today, Protecs Global not only offers its exceptional training services in Brisbane but has expanded its reach to Gladstone and Mackay, with ambitious plans to extend its presence to other cities, remote and regional locations across Australia.

www.protecsglobal.com.au

Member List

October 2023

The AINDT is a national peak body that promotes the professional practices of non-destructive testing and condition monitoring personnel. Our mission is to provide members, industry and the community with an independent and professional level of service in relation to the science and practice of non-destructive testing.

Through the State Branches and Federal Office, the AINDT aims to be an efficient and effective technical society by operating as a recognised notification body and providing membership to individuals, companies and government bodies who wish to keep informed or have an interest in non-destructive testing, engineering, or materials and quality testing in general.

AINDT provides businesses with the opportunity to be recognised as a contributor of this professional Institute by becoming a Company, Corporate or Sustaining member. By holding such membership, companies can benefit from advertising opportunities, heightened support, staff certification control and much more.

We would like to thank the following companies for their valued support:

SUSTAINING MEMBERS

ATTAR
D R May Inspections
SRG Industrial Pty Ltd

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Azure NDT Quality Services Pty Ltd
Chemetall (Australasia) Pty Ltd
Evident Australia Pty Ltd
Hofco Oilfield Services
IRISNDT
OMS Engineering Pty Ltd
SafeRad SE Asia Pty Ltd
TR Pty Ltd

SUPPORTING MEMBERS

Chevron

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AXT Pty Ltd
Barry Evans Lifting World
Bluescope Steel (Port Kembla)
Hot Engineering
HVT Inspection Services
Magnetic Analysis Aust Pty Ltd
NDT Equipment Sales Pty Ltd
Nobel Engineering Services
Reliance Hexham
RPG Australia
Russell Fraser Sales Pty Ltd
Simplifi Nii P/L
Sonix NDT Pty Ltd
Thermal Imaging Services (AUS)

QLD

AXS Pty Ltd (Mackay)
Equipment Direct International Pty Ltd
International Tube Testing Pty Ltd
Lucas Drilling
Metal Testing Pty Ltd
M-Test Mackay
Queensland Alumina Limited
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ATCL
Defence Science and Techology Organisation (DSTO – Fishermans Bend)
Gippsland NDT Services Pty Ltd
iTest NDT
LMATS Pty Ltd (Williamstown)
NATA
OMS Software Pty Ltd
QENOS
Shantou Institute of Ultrasonic Instruments Co Ltd
Stocks and Partners Ltd

SA / NT

ASC Pty Ltd
Kuzer Technical
Red Earth NDT Pty Ltd

WA

Alliance Solutions Group
Applecross Electrical & Testing Service
Asset Reliability Inspections Pty Ltd
Assurity NDT & Consulting
Australian Institute of Maintenance Engineering
GoldFields NDT
Hofmann Engineering
ICM Training Solutions
Integrity Engineering Solutions
MJ Engineering Inspection Services (Welshpool)
NDT Instruments Pty Ltd
Vertech
Weld Integrity
Wood – Asset Performance Optimisation

NDT 2023 – BINDT 60th Annual Conference 12–14 September 2023, UK

The British Institute of Non-Destructive Testing (BINDT) kindly invited the AINDT to attend their 60th Annual British Conference on NDT (NDT 2023) which was co-located with the 19th International Conference on Condition Monitoring and Asset Management (CM 2023).

NDT 2023 consisted of three parallel technical sessions covering a broad range of NDT technologies and applications as well as the table-top exhibition with over 50 companies exhibiting a range of NDT- and CM-related products.

The open ceremony and MC for the conference was Professor Ian Cooper, BINDT President. The prestigious Roy Sharpe Prize (to recognise a significant contribution, over a period of at least 10–15 years, through research and development in any branch of NDT to the benefit of industry or society) lecture was delivered by NDT guru David Lines. David has brought us many advancements in phased array technologies in both the medical and NDT fields, but most will recognise what is now industry referred to as FMC capture and fun fact is he also supervised our CEO, Irene Pettigrew through her PhD almost 20 years ago. David presented 'Five decades of phased array ultrasound imaging: a personal view with the benefit of 20/20 hindsight' and it was interesting like most NDT practitioners, he fell into NDT by 'serendipity'; the luck some people have in finding or creating interesting or valuable things by chance.

CEO presenting AINDT gift to BINDT President

The Tuesday night evening function included a tour of Delapré Abbey, Northampton and the conference dinner was held at the Northampton Town Centre hotel. During the dinner, the BINDT was presented with a commemorative gift for reaching their 60th conference from the AINDT. This was a special handcrafted plate capturing the Australian Flinders Ranges from world-class glass blower Eamonn Veneker.

BINDT 60th conference – high tea.

On the last day, a new addition to celebrate the big milestone of the 60th anniversary conference, was a 'Showcase Day' focusing on NDT, CM and SHM technologies through the years. It was interesting to see the progression of NDT technology over the years, particularly with the original sizes and weights of UT equipment. We are all thankful for advancements in electronics and systems making these items more lightweight, easy to use and providing information in real-time.

Couch session hosted by CEO David Gilbert.

The Showcase Day was wrapped up by a couch conversation session led by BINDT CEO David Gilbert interviewing industry stalwarts on their most memorable experiences over the years, future prognosis of the industry and advice for future practitioners.

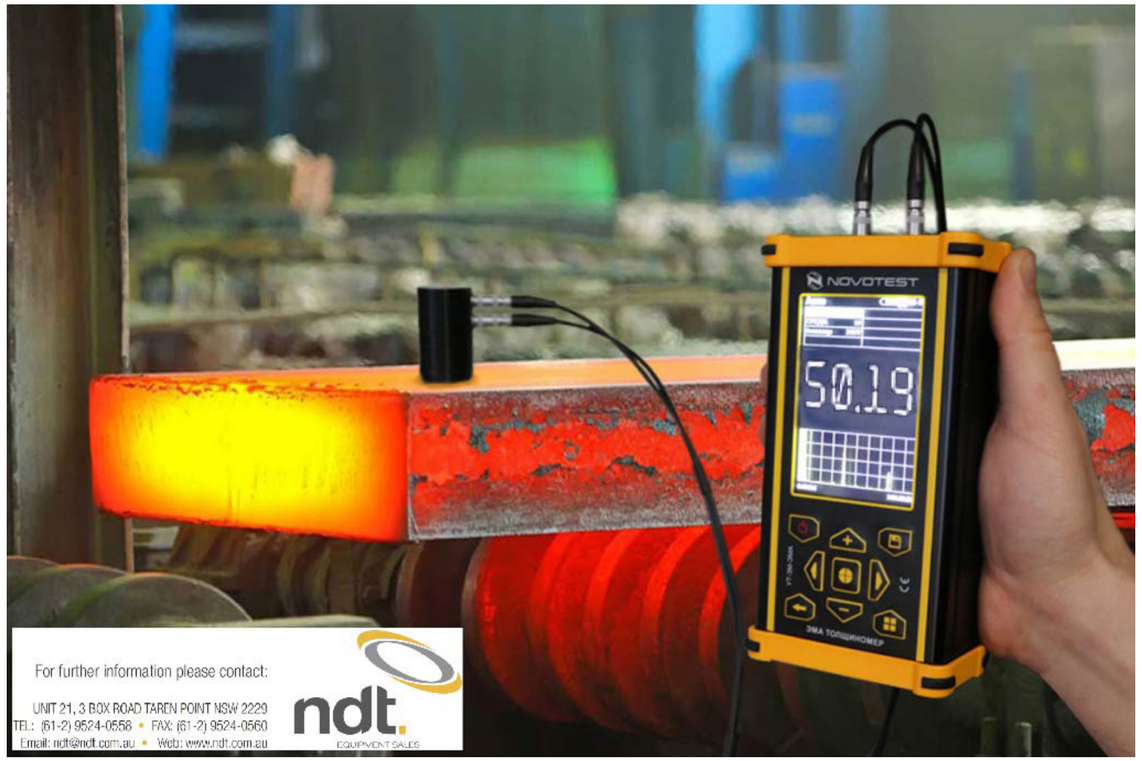
The AINDT would like to thank the BINDT for their warm hospitality during this special commemorative conference.

Historical UT sets.

David Lines delvering the Roy Sharpe Prize Lecture.

Tour of Delapré Abbey.

Pre-conference dinner networking.



Tours of Sensor Enabled Automation Robotics & Control Hub (SEARCH) and Technology & Innovation Centre (TIC), Strathclyde University, 19 September 2023, UK

Whilst in the UK attending the BINDT 60th annual conference, the AINDT had the privilege of a tours of SEARCH and TIC, two world-class cutting-edge research facilities, hosted by David Lines, Knowledge Exchange Fellow at the University of Strathclyde.

The visit included discussions with the research teams led by Professor Tony Gaghagan, Director of the Centre for Ultrasonic Engineering (CUE).

At SEARCH, the team demonstrated the state-of-the-art robotics used for welding and NDT. It was exciting to what's next for our industry by witnessing the use of NDT to inspect different weld runs in-situ during the manufacturing process whilst at elevated temperatures (>300 °C). The NDT technology is similar to the commercially available phased array RollerForm configuration but with the phased array probe at an angle working in pitch-catch configuration and without the necessity of any couplant between the roller probes and parent material to eliminate any contaminants entering the weld during manufacture.

The advantage of inspection in parallel with welding is early detection of welding issues and unacceptable anomalies particularly in heavy wall welds and/or critical welds that use expensive austenitic materials.

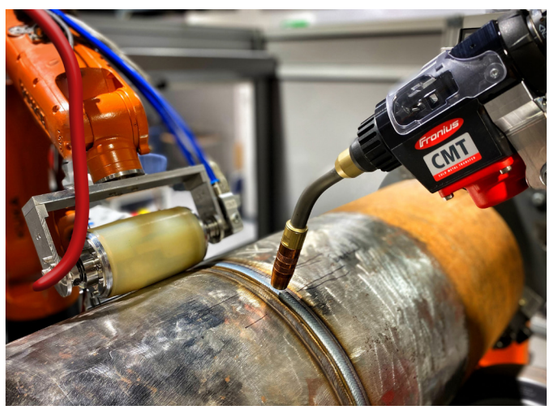
SEARCH facility.

For more information on research activities and inspection solutions that could benefit you visit:

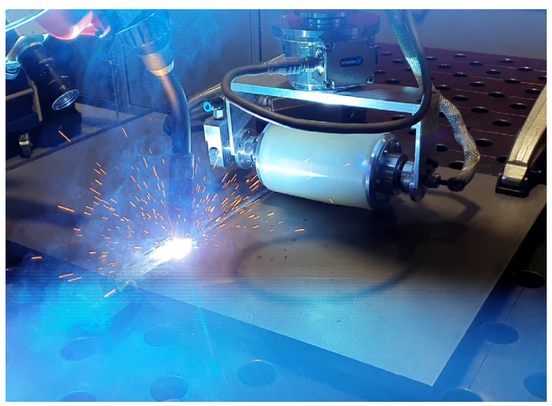
SEARCH: **search.eee.strath.ac.uk**

TIC: **www.strath.ac.uk/research/technologyandinnovationcentre**

CUE: **www.strath.ac.uk/research/subjects/electronicelectricalengineering/instituteforsensorssignalscommunications/centreforultrasonicengineering**



inProcess Pipe Weld Inspection.


inProcess Weld Plate Inspection.

Western Australian Branch Technical Seminar – Introduction to Non-Destructive Testing

On Friday afternoon on the 11th of August 2023, the Western Australian Branch of the AINDT was proud to host and introduction to Non-Destructive Testing Session delivered by none other than Paul Grosser, Director of L3 NDT Pty Ltd at the Parmelia Hilton Hotel in the Perth Central Business District.

This was a great opportunity for individuals and companies wishing to enhance their staff's expertise and knowledge in Non-Destructive Testing. This free training session was specially tailored to provide QA professionals and non-technical personnel with a deeper understanding of this critical industry topic and covered the following elements:

- Basic surface and sub surface NDT techniques
- Advanced techniques including:
  - Time of Flight Diffraction (ToFD)
  - Phased Array Ultrasonic Testing (PAUT)
  - Digital and Computed Radiography
  - Acoustic Emission Testing
  - Thermography & other Condition Monitoring Techniques
- Australian and International Standards
- Qualification/Certification and Career Pathways
- General Q&A

With over 25 years' experience in NDT, Paul is a Chartered Engineer and multidiscipline Level 3 specialising in advanced techniques, which made him the perfect presenter for this session.

Alongside his technical capabilities, Paul was a long term (10 years) director of the AINDT and former Federal President and most recently ran the international prestigious Asia Pacific NDT Conference for 2023 in Melbourne.

Paul continues to represent NDT in the following roles:

- Voting Committee Member Standards Australia
- NATA NDT Accreditation Advisory Committee
- Technical Expert International Atomic Energy Agency (IAEA)
- Australian Representative NDT International Atomic Energy Agency (IAEA)
- Board of Directors Asia Pacific Federation for NDT (APFNDT)

The session was extremely well attended by professional from a vast array of roles, companies and industries with over 90 people in the room. Following the session, many of the attendee's attended the WA Branch AGM held at Helvetica, a short walk through the CBD, which was also well attended and continued to celebrate well into the evening

We look forward to hosting this event again in 2024 and beyond and thank Paul for kindly donating his time to present.

AINDT President Richard Stocker opening the session and introducing Paul Grosser to the attendees.

Paul Grosser delivering the Intro to NDT.

AINDT WA Branch AGM 2023

Following the hugely successful and well attended Intro to NDT event hosted by Paul Grosser, the AINDT WA Branch AGM was hosted on the evening of Friday 11th August. The event was hosted at the city centre location of Hadiqa and was attended by around 50 people.

There was a real good buzz around the event and a mix of members, non-members, and member companies all mingled, networked and enjoyed the delicious food on offer throughout the evening.

As part of the formalities of the evening, outgoing Branch President Paul Lavender conducted a review of the branch activities over the year and the Membership Report, Mike Needham provided the Treasurers Report and Richard Stocker, the incoming AINDT Federal President conducted a review of the Federal activities. The WA Branch also welcomed Nathan Lenane and Andrew Barry to the branch council, while also thanking Catherine Fleay who is leaving the council after 8 years of outstanding service.

Many thanks go to our sponsors for the evening, our Gold sponsors Vertech Group, and our silver sponsors ATTAR, Applus and Evident. The sponsors donated some very impressive raffle prizes with Iain Keen winning Concert Club tickets to see Culture Club at the RAC Arena, Beck Kinsella winning 2 tickets to iFly, Zoe Dunkerley winning a bottle of Japanese whiskey, and Josh Wilkinson receiving Gold Class cinema tickets.

The event closed out a very positive year for the WA Branch of AINDT, while also looking ahead to a positive year of engagement with our members.

Guests enjoying the WA Branch AGM.

Adam Alessandrino of Applus presenting Josh Wilkinson of Chevron with his raffle prize.

Ken Williamson of ATTAR presenting Beck Kinsella of Olympus with her raffle prize.

Craig Davies of Vertech Group presenting Iain Keen with his raffle prize.

QLD Branch News

G'day from the Sunshine state!

New Leadership and successful Catch-up Events Reinvigorate AINDT QLD Branch!

The AINDT QLD branch is pleased to welcome our new committee members who joined us to support our focus on community building and promoting educational opportunities. Our committee brings a wealth of diverse experience and vision. The branch looks forward to an exciting period of growth and collaborative work under this new leadership.

Our recent catch-up events in Brisbane, held one August 31st, was a resounding success. With participation from members across the spectrum of NDT community, including members from different branches, the event served as a vital platform for networking and knowledge exchange. Members engaged in spirited discussions, and the atmosphere was charges with enthusiasm for future collaborations and growth opportunities.

Upcoming Webinar: A Glimpse into the Future of Digital Radiography

QLD Branch is excited to announce a highly anticipated webinar, scheduled for Sep 13th, focusing on "A Practical Demonstration of X-Ray Inspection of Small-Bore Tubes using Digital Panels".

Join Johan Grauls, from Waygate Technologies, in a live demo using the advanced DXR75P & 100P digital panels, showcasing the practical aspects of X-ray inspection according to ISO 17636-2 standard.

PROTECS GLOBAL

Upcoming Technical Night: Mastering Ultrasonic Testing Calibration

QLD Branch is please to invite you to a hands-on session at Protecs Global in Sumner on October 26th. Hamed Madani, of Protecs Global, will show us how to build and use Distance Amplitude Correction (DAC) curve, Time-Corrected Gain (TCG) and some UT calibration tips.

Johan Grauls, from Waygate Technologies.

Stay tuned for more events!

Finally, we would like to extend our invitation to active involvement from our members in shaping the direction of our Branch. If you have any suggestions, ideas, or would like to contribute to our initiatives, please do not hesitate to reach out to us.

Regards,
QLD Branch Committee.

SA/NT Branch News

The SA/NT branch had their first post AGM meeting on the 28 August 2023. The meeting was attended by 12 members of council, either in person or via Teams. It was a pleasure to host the AINDT past president, Nick Eleftheriou, and new AINDT CEO, Irene Pettigrew, at the meeting.

As usual, the meeting was vibrant with participation from all who attended. Many ideas where tabled for technical meetings and guidance on different avenues for hosting technical presentations was offered by the CEO.

We hope to have fixed dates for some of the technical meetings/presentation, where members can earn points toward renewal/recertification, by the next council meeting.

Council would like to thank Irene for making the time to attend the meeting in person. It is always great to see commitment, enthusiasm and leadership from the top.

Looking forward to a busy second half of the year.

SA/NT President
Simon Wilding

SA Branch President Simon Wilding addressing the AGM meeting.

SA Branch Secretary David Suede Addressing the AGM.


Members at SA AGM.

Left to Right: Tyson Jenke SA Branch Vice President, David Suede Branch Secretary, Simon Wilding Branch President, Karl Saul, Past President.

Members at SA AGM.

Vale – Ron Cecil

22 November 1923 – 27 June 2023

AINDT is saddened to note the passing of Ron Cecil, a stalwart of the materials and testing industries in WA in his 100th year.

Ron's career included foundry, heat treatment, NDT, mechanical testing and materials engineering while working with, among others, Hoskins, Pope Engineering, Chamberlain Industries and Vaughan Castings.

It was during his time with Chamberlains that Ron participated in the establishment of the AINDT WA Branch (then NDTAA) in 1973 and served on the inaugural committee.

Throughout his senior career Ron employed many students as trainees and he is remembered for his help, wisdom and guidance willingly offered to everyone he worked with.

A quiet, unassuming gentleman, Ron was considered one of the best teachers and mentors any new graduate could hope for.

Many of his ex-students progressed to senior positions within industry and Ron remained very proud of these people and the successes they achieved.

Ron's legacy to industry continues with an annual "Ron Cecil Lecture" technical presentation hosted by Materials Australia.

On behalf of all members, AINDT extends sincere condolences to Ron's family and friends.

AQB Availability

AINDT examinations are available through a network of AINDT Authorised Qualifying Bodies (AQBs) as well as the two scheduled AINDT exam rounds.

AQB's are free to offer AINDT approved training and initial/recertification examinations in any Australian state at any time throughout the year. The scheduled AINDT examination rounds are conducted twice yearly (normally June and November) with dates being advertised in both the *The Industrial Eye* and the AINDT e-newsletter.

Whilst AINDT makes every effort to notify certificate holders of expiry of certification, it is the certificate holders responsibility to initiate the renewal & recertification process prior to expiry of certification (late fees apply to late certification applications).

Listed below are the AQB's for which AINDT has authorised to conduct AINDT examinations and the AINDT examination.

South Australia

Kuzer Technical

Contact: David Suede
Phone: 1300 199 086
Email: info@kuzer.com
Schedule: kuzer.com/schedule/

NDT Methods Levels Industry Sectors offered:

Ultrasonic Testing 1, General Engineering
Ultrasonic Testing 2, Welds
Radiographic Testing 1,2 Welds
Magnetic Particle Testing 1,2 Multisector
Penetrant Testing 1,2 Multisector
Visual/Optical Testing 2 Multisector
Phased Array Ultrasonic Testing 2 Multisector
Eddycurrent Testing 2 Multisector

Victoria

ATTAR – AQB – Advanced Technology Testing and Research

Contact: Mark Welland
Phone: 03 9574 6144
Fax: 03 9574 6133
Email: training@attar.com.au

NDT Methods Levels Industry Sectors offered:

Computed & Digital Radiography 2, 3
Ultrasonic Testing 1,2,3 Welds, Casting, Wrought, Aerospace, Thickness
Radiographic Testing 2,3 Welds, Casting, Aerospace
Magnetic Particle Testing 1,2,3 Multisector, Aerospace
Penetrant Testing 1,2,3 Multisector, Aerospace
Eddy Current Testing 2,3 Multisector, Aerospace
Magnetic Flux Leakage 2
Tank Bottom Testing
Phased Array levels 2 & 3 Ultrasonics 2 Multisector
Visual/Optical Testing 2 Multisector
Time of Flight Diffraction (TOFD) levels 2 & 3 Welds
Heat Treatment
ISO 9712 UT Level 2 Corrosion/Erosion – Detection and Mapping (CDM) Limited Certification

Western Australia

SRG Training Academy

Phone: 08 9232 0300
Email: trainingacademy@srgglobal.com

NDT Methods Levels Industry Sectors offered:

Ultrasonic Testing 1,2 Welds
Magnectic Particle Testing 1,2 Multisector
Penetrant Testing 1,2 Multisector
Phased Array Ultrasonic Testing 2 Multisector

ATTAR – Advanced Technology Testing and Research – Authorised Examination Centre

Contact: Mark Welland
Phone: 1300 139 155
Email: training@attar.com.au

NDT Methods Levels Industry Sectors offered:

Computed & Digital Radiography 2, 3
Ultrasonic Testing 1, 2,3 Welds, Casting, Wrought, Aerospace, Thickness
Radiographic Testing 2,3 Welds, Casting, Aerospace
Magnetic Particle Testing 1,2,3 Multisector, Aerospace
Penetrant Testing 1,2,3 Multisector, Aerospace
Eddy Current Testing 2,3 Multisector, Aerospace
Magnetic Flux Leakage 2
Tank Bottom Testing
Phased Array levels 2 & 3 Ultrasonics 2 Multisector
Visual/Optical Testing 2 Multisector
Time of Flight Diffraction (TOFD) levels 2 & 3 Welds
Heat Treatment
ISO 9712 UT Level 2 Corrosion/Erosion – Detection and Mapping (CDM) Limited Certification

Queensland

SRG Training Academy

Phone: 07 3816 5500

NDT Methods Levels Industry Sectors offered:

Ultrasonic Testing 1,2 Welds
Magnectic Particle Testing 1,2 Multisector
Penetrant Testing 1, 2 Multisector
Phased Array Ultrasonic Testing 2 Multisector

Protecs Global

Contact: Hamed Madani
Phone: 07 3492 9213
Email: Hamed.madani@protecsglobal.com.au

NDT Methods Levels Industry Sectors offered:
Magnetic Particle Testing Level 2 (Multisector)
Penetrant Testing Level 2 (Multisector)
Ultrasonic Testing Level 1 (General Engineering)
Ultrasonic Testing Level 2 (Welds)

Condition Monitoring Training Centres

The below training providers offer training in one or more Condition Monitoring methods, categories and industry sectors.

This training program has received approval from the AINDT as it aligns with the national syllabi as endorsed by the AINDT Certification Board.

To ensure comprehensive understanding, learners are advised to obtain a copy of the training module (syllabus) from either the training body, or by downloading from the AINDT website, when undertaking training in an CM method or industry sector module.

For Certification applicants, it is mandatory to successfully complete the training program and training hours as specified in ISO18436 to fulfil the corresponding CM Method, Category and Industry Sector.

All examinations are administered by the AINDT.
For examination dates and other pertinent information, please reach out to the federal office.

CM Training Centre Locations:

Victoria

University of Melbourne
Parkville
Victoria 3010
Phone: +61 3 9810 3348
Contact Email: claudine.evans@unimelb.edu.au

Industrial Precision Instruments
Unit 12, 634-644 Mitcham Rd Vermont
Victoria 3133
Phone: +1300781701
Email: training@ipi-inst.com.au

Wood - Asset Performance Optimisation
Level 3, 171 Collins Street
Melbourne, Victoria 3000
Phone: (08) 6314 2000 / (08) 6314 2280
Email: svt.bu.training@woodplc.com

Western Australia

SRG Training Academy
109 Bannister Road, Canning Vale
Western Australia 6155
Phone: 08 9232 0300
Email: trainingacademy@srgglobal.com

Wood - Asset Performance Optimisation
Level 1, 240 St Georges Terrace
Perth, Western Australia 6000
Phone: (08) 6314 2000 / (08) 6314 2280
Email: svt.bu.training@woodplc.com

Queensland

Advanced Infrared Resources Australia AIRA
PO Box 372 Hervey Bay
Queensland 4655
Phone: 0467 565 836
Email: jeff@irtau.com.au

SRG Training Academy
7 Brisbane Road Riverview
Queensland 4303
Phone: 07 3816 5500
Email: trainingacademy@srgglobal.net.au

Wood - Asset Performance Optimisation
Level 20, 127 Creek St
Brisbane, Queensland 4000
Phone: (08) 6314 2000 / (08) 6314 2280
Email: svt.bu.training@woodplc.com

Standards Report - Angelo Zaccari Chairperson MT007

The ISO Annual Meeting is being held in Brisbane 18th to 22nd September.

The main focus points will be on the following:

- Global trade: The importance of accountability in sustainable claims
- Building resilience in an uncertain world
- Preserving paradise: Climate adaptation for vulnerable islands

NANDTB informed MT007 that AS 3669-2006 which was superseded some time ago would not be seeking reinstatement of this Standard and accepts the adoption of EN 4179 to take place. A proposal was submitted by the MT007 Chairperson for the adoption of EN 4179.

The ISO Committee Chair of SC 7, Darcy Corcoran applied to continue his term and it is believed that this will receive a favourable vote. A ballot was taken during August with the results being known in the next Standards News.

With significant work being undertaken by ISO over the past months a significant amount of ballots and voting was undertaken by MT007 committee members.

Current edition ISO Standards that were accepted and being published include:

1. AS/NZS ISO 9712: Non-destructive testing — Qualification and certification of NDT personnel.
2. AS/NZS ISO 3452.2: Non-destructive testing — Penetrant testing, Part 2: Testing of penetrant materials. Prepare for publication.
3. AS/NZS ISO 3452.1: Non-destructive testing — Penetrant testing, Part 1: General principles. Prepare for publication.

Other ISO Committees that met which included draft documents being formed or revised that required voting by MT007 include.

1. Project: ISO/DIS 18081: Non-destructive testing — Acoustic emission testing (AT) — Leak detection by means of acoustic emission
2. ISO 19835:2018: Non-destructive testing — Acoustic emission testing — Steel structures of overhead travelling cranes and portal bridge cranes.

Standards Australia MT007 Committee Members have been notified that ISO Standards that continue to be developed are.

1. ISO/TC 135/SC 7 - Personnel qualification - Project: ISO/TS 11774:2011: Non-destructive testing. Performance based qualification.
2. ISO/DIS 24367: Non-destructive testing — Acoustic emission testing — Metallic pressure equipment.

ISO did not make available further information regarding previously presented Standards which included ISO/TS 18173:2005 General Terms & Definitions, ISO 10878:2013 Infrared Thermography Vocabulary & ISO 12716:2001 Acoustic Emission Inspection Vocabulary, therefore MT007 did not meet to discuss until all information was made available.

Please contact me using the details below if you have any questions or require further information and I will reply at the first opportunity.

Angelo Zaccari
MT007 Standards Chairperson
azaccari@aben-tech.com.au

4th National Manufacturing Summit 2023

On 2nd and 3rd August, the AINDT attended the 4th National Manufacturing Summit 2023 at Old Parliament House, Canberra with the theme focused on renewable energy.

The array of esteemed invited speakers from manufacturing industry, government, unions, and economics highlighted the enormity and key considerations of infrastructure, technology and skills sets required for electric vehicles (EVs), battery production and onshore and offshore wind turbines.

Charlie Joyce and Dr Jim Stanford, Centre for Future Work provided an overview of Australia's position in the global race for sustainable manufacturing describing Australia's weak starting point with the decline in and limited support for manufacturing despite the advantages of having unmatched primary renewable energy source and critical minerals such as lithium. Positive developments are new government initiatives (including Powering the Regions Fund, National Reconstruction Fund, Hydrogen Headstart and Capacity Investment Scheme), promising industrial planning looking at national strategies for batteries, EVs, and critical minerals, Net Zero Authority and Future Made in Australia as well as the international agreements. There is a need for action as new climate industrial policies in other countries have achieved a historic shift in economic strategy that are already having a dramatic impact on both the pace and the location of sustainable manufacturing activity. Australia needs to respond thoughtfully but quickly, and with an equivalent ambition.

Dr Jim Stanford, Centre for Future Work.

The impact of America's adoption of the Inflation Reduction Act (IRA) has triggered a need for Australia to consider their own political position, policies, and practices. Rather than just mine valuable minerals such as lithium (dig up the rocks as it was put by Ellen Fanning) and export, there is growing support and government endorsement for battery manufacturing in country. A lot of valuable ideas were shared on how we can work together to migrate to a future of green energy generation.

There is a big concern with the local supply chain unable to meet demand and cost effectiveness with the likelihood of the implementation of a hybrid solution using imported steels and components.

This sentiment was echoed in Dan McKinna's presentation dissecting the wind tower fabrication projects Keppel Prince Engineering have been part of since 2001. Wind tower fabrication within Australia is currently limited to Keppel Prince Engineering (VIC) and Haywards (TAS). Both manufacturers have small capacity (<8 sections per week) relative to overseas manufacturers and convoluted supply chains due to the location of the facilities.

Challenges faced with wind tower fabrication in Australia post the global financial crisis (2009) include rise of tower importation, reduction in international shipping costs, growth of onshore turbines and towers requiring upgrades, scale of components, the limitations of transporting large parts and each OEM having different specifications for fabrication, coatings, and internals. Size, complexity, and cost of transporting wind tower sections interstate places existing manufacturing capability at a significant competitive disadvantage in relation to landed overseas wind towers in NSW and QLD markets. Most of the cost of a wind tower is the steel plate and connection flanges (almost 60%) with 25% accounted towards the labour meaning that ~85% of the total coast can be sourced within Australia. Steel pricing is a key input to local manufacturing competitiveness.

Australia needs new wind tower purpose-built tower manufacturing facilities, utilising the latest tower manufacturing technology and processes with facility location(s) as far practicable by a wholistic approach to supply chain efficiency, logistics and cost.

With the global ramp up of offshore wind, Emily Scivitti discussed Oceanex's proposal to develop up to 4 offshore wind projects off the coast of NSW and WA with generation capacity exceeding 8,000 MW and up to 3 projects off the coast of New Zealand with a generation capacity exceeding 3,000 MW. Each project is strategically located close to a strong offshore wind resource within proximity industry and employment centres, key electricity load bases and key grid infrastructure with upcoming capacity and availability. The indicative steel requirements per tower are 1,000 tonnes with the floating substructure 4,000 – 5, 000 tonnes and each anchor (min. 3 per turbine) requiring 100–300 tonnes. For each project with 134 towers would require a staggering 750,400 tonnes of steel. For the NSW scenario, 200,000 tonnes fabricated per year would mean a fabrication period of 12–15 years with around 1000 fabrication roles created with start of 2028 on the proviso the commercial licenses are granted. The critical success factor is securing suppliers.

Of course, from an NDT perspective, a mass increase of renewable infrastructure means lots of employment opportunities, particularly with a huge demand for competent and certified NDT and CM personnel during compliance and in-service stages of the asset life cycle.

A presentation on Australian Manufacturing in the Renewable Energy Market was delivered by Simon Preston, Group General Manager, Precision Oxycut, Allthread Industries, First Forge. He described how renewable energy development is increasing due to the closing coal plants and in NSW alone, four out of five remaining coal plants (65% of NSW generation) will close in the next 15 years. Renewable energy is expected to increase significantly over the coming decades across all energy technology types (e.g., wind, solar, distributed PV) but repeating Oceanex's message, renewable energy projects require vast amounts of steel from 10, 000 tonnes for a large solar farm, 300 tonnes per wind tower and 50 tonnes for one monopole. Currently 16 W is being produced via wind and solar and this is expected to increase to around 141 GW by 2050. It is projected to require 2 – 3 million tonnes of steel for solar and 4–7 million tonnes of steel for wind. The key point is that all this manufacturing with require skilled personnel, manufacturing design, transportation, installation, and inspection. The NSW Government has an 11 GW target for renewable energy in dedicated Renewable Energy Zones requiring 600,000 tonnes of steel.

Despite producing almost 60% of the world's lithium, Australia retains less than 1% of its end use value. The global battery market alone will be worth $600 billion annually by 2030. Prime Minister Anthony Albanese address at the National Press Club, Feb 22, 2023, was communicated to the delegates where he stated "Lithium has an extraordinary capacity. We need to not just dig it up. I want to make sure we use the lithium and nickel and other products we have to make batteries here." Kirk McDonald, Supercharge Australia, used this and included the impact on climate as a pre-cursor for an overview of startups creating Australia's lithium battery value chain. A lithium battery value chain is lithium exploration and mining, ore processing and chemical making, cell and battery making, stationary energy storage, electric vehicles / mobility and second life / recycling. This will become circular as Australia progresses. Supercharge Australia grows startups to deliver innovation, progress policy and processes, materials, machines, and new business models. More information on Supercharge Australia can be found at **energylab.org.au/programs/supercharge-australia**

Lance McCallum, QLD Assistant Minister for Energy.

Welcome reception.

Thank you to Weld Australia for organising this event allowing like-minded organisations to forge partnerships for the tough journey ahead.

Rio Tinto – Asset health practitioners unite to solve common problems

On 23 August, the AINDT was invited to attend Rio Tinto's Asset Health Forum covering topics from technology, vendor partner offerings and long-term strategy alignment, at the DoubleTree Hotel in Perth CBD, WA.

This full day forum was a day of shared learning and connection, through presentations, discussions and focus groups, centred on all things condition monitoring, NDT and Asset Health. It was attended by a spread of technicians and engineers from across Rio Tinto's 16 sites and various ports in WA and invited guests, dedicated to communicating the vision of having a centralised asset reliability team for fixed plan (FXP) and heavy mobile equipment (HME).

Principal, Asset Health, Erik Lichter communicated the importance to establish a strong community of practice with our practitioners to enable sharing, learning and replication across Rio Tinto sites.

Erik said that "collaboration has previously happened in pockets, brought together Fixed Plant, HME and Perth-based practitioners. It was a fantastic opportunity for practitioners to connect with like-minded peers and open communication channels. Everyone is working through similar challenges, which provides an opportunity to and focus on priorities is far stronger than working in isolation."

It was refreshing to participate in a dedicated session on human factors and encouraging to know that Rio Tinto have several projects trying to improve the way they learn from failure and manage changes to improve safety.

The key takeaways from the human factors session that are prevalent across all industry sectors are:

- Humans will continue to fail; do we know when it matters and when it does not?
- The more error traps there are, the more likely you are to make a mistake.
- Those who are closest to the work know how to solve most of the problems if we ask them and make it safe to tell the truth.
- How can we make it easier to talk about failure?

The future technologies session focused on HME and provided some insight into a centralised data extraction platform to enable Rio Tinto to control data collection and storage rather than relying on different OEM hardware and software. The main reason for this was

Johann Petrick, Metlabs part of IRIS NDT.

Rio Tinto Asset Health Forum attended by 100 guests.

preventative maintenance to identify how failures work and for notifications before OEM thresholds are reached. This proof of concept is being rolled out later this year on 5 assets then will expand to 35 assets early 2024.

Pilots that will be implemented next year for condition monitoring include vibration analysis, belt thickness monitoring and online sensors for lubrication, temperature and vibration as well as electrical current reading with the emphasis of elimination of live work through use of sensor technologies.

The afternoon was split into FXP and HME dedicated sessions with AINDT attending the HME slot that involved an esteemed presentation with case studies on 'Fracture Analysis in Heavy Industry' from Johann Petrick, Metlabs part of IRIS NDT followed by a sneak peak into Rio Tinto's NDT improvement projects including a new HME NDT SharePoint, standards, engineering procedures, work instructions, competency framework and roadmap to compliance.

NDT & CM World Event Calendar 2023/2024

After considering numerous international NDT and CM Conferences taking place worldwide, we have narrowed down our selection to a handful of events.

September 27, 2023
AUSTPA
Leichhardt Room on level 1, Hotel Grand Chancellor, 23 Leichhardt St, Spring Hill Brisbane City, Brisbane, Queensland

The Australian Professional Thermography Association (AUSPTA) is excited to announce the next in-person program includes:

- Discussion on AS4836:2023 "Safe work on or near low-voltage and extra-low voltage electrical installations and equipment"
- Discussion on AS/ISO18434-2:2019 "Condition monitoring and diagnostics of machine systems – thermography – part 2: image interpretation and diagnostics"
- Service providers presenting on topics including UAVs and aerial thermography, practical case studies on thermal imaging and primary injection of electrical switchgear, equipment driven lubrication and technology, features, functionality, software and warranty on the new handheld infrared cameras
- Electrical, mechanical and civil industry user groups
- Open forum

October 23 – 26, 2023
ASNT 2023 Annual Conference
ASNT 2023 (eventsair.com)
Marriott Marquis & George R. Brown Convention Centre
Houston, Texas, USA

"EVOLUTION"

The NDT world is evolving at a rapid pace. From advances in technology, to artificial intelligence and machine learning, to an everchanging workforce, NDT continues to evolve. ASNT 2023: The Annual Conference reflects this evolution. Save the date and make plans to join us in Houston, Texas. Call for presentations is now open. Click here to present.

ASNT 2023 is the place to mingle with more than 2,000 NDT industry professionals and hear industry experts present high-quality, innovative content. The conference will feature exciting general sessions and time to connect with your peers, plus a vibrant exhibit hall with over 225 exhibitors. ASNT 2023 is the best opportunity to share your research/work, hear updates on the latest NDT advances, network with your colleagues and meet new ones.

27-31 May, 2024
The 20th World Conference on Non-Destructive Testing (20th WCNDT)
20th WCNDT
Songdo Convensia, Incheon, Korea

It is our great honour to invite you to attend the 20th World Conference on Non-Destructive Testing (20th WCNDT) hosted by the Korean Society for Non-destructive Testing (KSNT) to be held in Incheon, South Korea in May 2024 under the auspice of ICNDT.

The Organising Committee will offer a dynamic technical program that will be highly informative for every participant. The conference will be the place to interchange and integrate of professional colleagues from all around the world with an interest in this field. The venue, Songdo Convensia, Incheon, is a centre of trade and transportation built upon the advanced infrastructure of Incheon International Airport (IATA: ICN). Within an hour's distance from Seoul by public transportation, visitors will be given the opportunity to experience a mix of diverse cultures and world-class urban life.

Detection and measurement of pitting corrosion using short range guided wave scanning

Short range guided wave scanning is an inspection method enabling an indirect, quantitative measurement of remaining pipe wall thickness.

S. HORNE, E. LEINOV, T. PIALUCHA[1]
[1]GUIDED ULTRASONICS LIMITED, BRENTFORD, UNITED KINGDOM
INFO@GUIDED-ULTRASONICS.COM

It has seen widespread industrial use as an inspection solution for corrosion under pipe support (e.g. [1]). Pitting corrosion represents a significant challenge in industrial pipelines and its presence complicates short range guided wave scanning analysis as the wavelength used for inspection is larger than the diameter of small pitting-type defects. This work investigates the reflected signal from pitting corrosion, both in isolation and in the presence of larger corrosion patches, to improve the understanding of the complex signals received. This work provides the foundation and guidance for analysis techniques used in guided wave scanning. To achieve this a series of representative pitting defects with varying diameter and depth have been investigated using explicit finite element modelling.

It is shown that using currently established analysis techniques, the pit depth can be quantified for pitting with a diameter larger than approximately 13 mm. Smaller diameter pitting may only be qualitatively detected at this time due to mode conversion occurring at the defect, which obscure features that are used to provide quantitative analysis of the defect depth. Quantitative sizing of defects where pitting is present will require further investigation.

Keywords: Guided wave scanning, Inspection, Corrosion, Pitting.

Introduction

The assessment of pipeline condition at locations where corrosion attacks is crucial in the petrochemical and oil and gas industries. Corrosion under pipe support (CUPS) may develop at the contact area between the pipe and its support. Localised mechanical damage to the pipe coating at the support location, resulting from vibration or movement during normal operational conditions, along with moisture trapped at the location, may initiate corrosion. The growth of corrosion in an area that got affected may eventually extend well into the wall of the pipe, and create a large corrosion scab structure, which in-turn will obstruct direct access to determine the severity of the corrosion attack. Pitting corrosion may develop in pipelines at some cavities on the steel outer layer, where water and other corrosive materials can accumulate. This localised form of attack is of particular concern due to its unpredictability and may also develop at CUPS sites. Both CUPS and pitting corrosion pose a threat to the integrity of the pipe and may lead to loss of containment. Hence, the determination of the corrosion extent and depth are crucial to establishing the fitness of assets to continually be used in-service, e.g., in Fitness for Service (FFS) assessment calculations, and whether remediation activities such as sand blasting and lifting of the pipeline can proceed.

The detection of CUPS and other corrosion is often through visual inspection or screening technique such as long-range guided wave screening.

Then the defect size and depth are measured using an additional, quantitative method. While there have been many attempts to quantify the wall loss in CUPS applications without lifting the pipe to gain direct access to the corroded area, none have yielded satisfactory quantitative results [2] due to their amplitude-based analysis. Short range guided wave scanning is an inspection method enabling an indirect, measurement of pipe remaining wall thickness (RWT). The Guided Ultrasonics Limited (GUL) Quantitative Short Range (QSR) pipe scanning system is designed to scan short sections of pipe for the measurement of RWT. The measurement is obtained using a patented, frequency-based analysis, that is more tolerant of site conditions than methods that are amplitude or attenuation based, and requires only minimal pipe surface preparation [1].

The QSR1 system utilises Shear-Horizontal (SH) guided ultrasonic waves to quantitively measure the RWT at a given position along the pipe.

The system has two sensor configurations, defined by the propagation direction of the SH waves, circumferential and axial. In the circumferential configuration, SH waves are transmitted and received around the circumference at a series of sensor positions along the pipe axial direction. In positions where a defect is present, both transmission and reflection are received. In the axial configuration, SH waves are transmitted and received along the axial direction at a series of sensor positions around the pipe circumferential direction. In positions where a defect is present, only the reflection is received. The QSR1 circumferential configuration scope covers simple gravity supports, while the QSR Axial configuration enables inspection of various support types, as well as concrete wall penetrations and concrete anchors.

In both circumferential and axial configurations, the target defects of the QSR are corrosion scab type, where the scab size is greater than 25mm (1 inch) in the direction perpendicular to the direction of wave propagation. The presence of pitting corrosion complicates short range guided wave scanning analysis as the received signals are expected to be complex due to a combination of direct reflections and mode conversion from the pits. The presence of pitting clusters makes little difference to measurement of the majority of the remaining pipe wall thickness allowing accurate FFS calculations. In this paper we investigate the effect of individual pitting on the ability of the QSR Axial to detect and quantify corrosion defects. We use finite element simulated measurements of the QSR Axial setup and identical signal processing algorithm used by the QSR system.

1.1 The QSR Method

The QSR1 system uses non-contact electromagnetic acoustic transduction (EMAT) sensors to transmit and receive the guided waves over a wide range of frequencies; the sensors can sample through thin paint coatings, and the pipe preparation is minimised. The QSR1 enables quantifying the depth and the extent of corrosion so that FFS calculation can be more accurately carried out. The system currently has two sensor configurations, defined by the propagation direction of the SH waves, circumferential and axial. In both configurations, the system enables automated scanning process, where the sensors are displaced using a motorised framework to cover axial distance in the circumferential configuration, and cover circumferential extent in the axial configuration.

The QSR1 system, which was originally developed for sizing of CUPS, has a circumferential sensor configuration where the guided waves are transmitted and received around the circumference of the pipe at a series of sensor positions along a pre-defined axial length of the pipe.

The QSR1 circumferential configuration is presented in Figure 1.3a-b. The instrument comprises periodic permanent magnet EMAT sensors, ePod electronics controlling unit pod, pipe-size-specific frame and wheels and motor arrangement, allowing it to move axially along the scanned pipe at a predefined step size under its own power. The transducers excite and receive waves in both directions around the pipe, so that the first arrivals are via the short path across the top of the pipe followed by those along the long path over the bottom of the pipe. These arrivals are followed by a succession of waves that have travelled around the circumference of the pipe one or more times. The frequencies used are in the range of 100-500 kHz; within this range, the system uses the non-dispersive SH0 guided wave mode and the dispersive SH1 mode to measure the average thicknesses of the short and long paths, and the minimum RWT at the scan position. The wide frequency bandwidth used in the QSR1 is achieved by varying the magnet spacing between 6-12 mm using a motorised drive. The system automatically calibrates its sensors on the scanned pipe, adjusting the sensor configuration to match the scanned pipe nominal wall thickness, so that the frequency band will match the pipe wall thickness and a possible reduction due to wall loss. The reduction in remnant wall thickness at positions where corrosion defect is present will cause the long path SH1 mode to transmit only part of its higher frequency content and reflect the remaining low frequency content. The transition frequency, also called the split frequency, is directly linked to the minimum RWT and used to measure it [1]. The analysis is carried out in the frequency domain, by applying 2DFFT on the received signals; this enables separation of the different

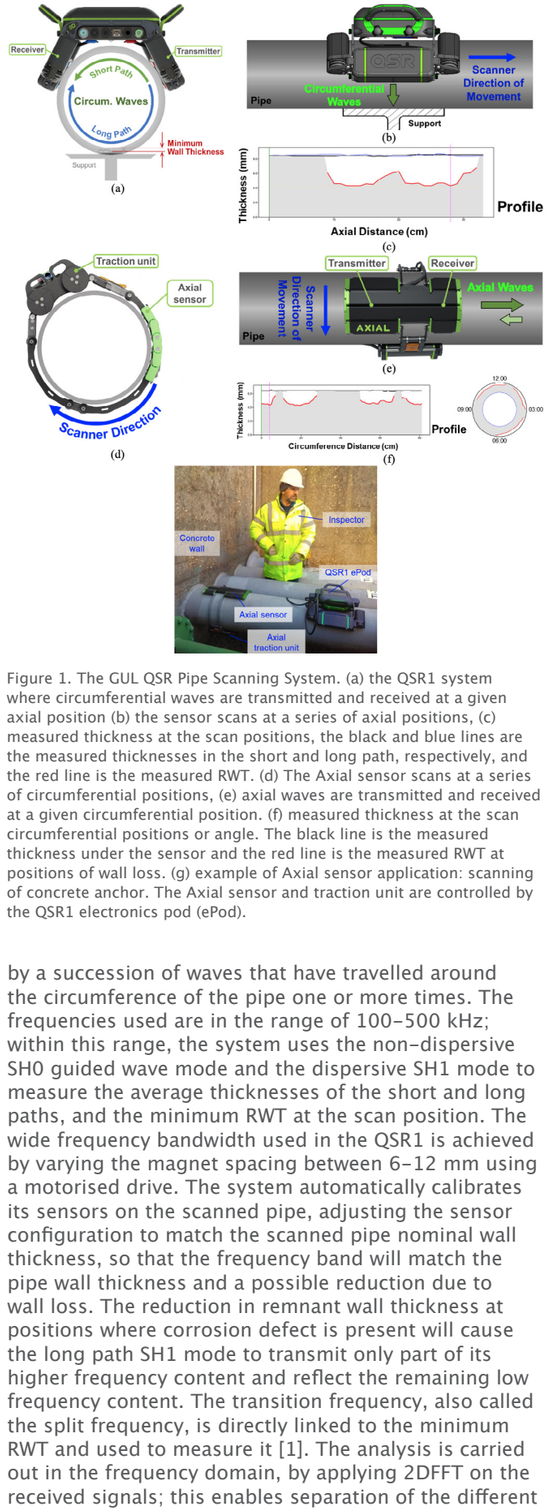


Figure 1. The GUL QSR Pipe Scanning System. (a) the QSR1 system where circumferential waves are transmitted and received at a given axial position (b) the sensor scans at a series of axial positions, (c) measured thickness at the scan positions, the black and blue lines are the measured thicknesses in the short and long path, respectively, and the red line is the measured RWT. (d) The Axial sensor scans at a series of circumferential positions, (e) axial waves are transmitted and received at a given circumferential position. (f) measured thickness at the scan circumferential positions or angle. The black line is the measured thickness under the sensor and the red line is the measured RWT at positions of wall loss. (g) example of Axial sensor application: scanning of concrete anchor. The Axial sensor and traction unit are controlled by the QSR1 electronics pod (ePod).

SH wave modes present in the pipe, matching dispersion curves and extracting the measurement. The scan results are used to build a profile of the section of pipe scanned, as shown in Figure 1.3c; it is a set of minimum RWT measurements obtained at each of the scan steps.

The recently developed QSR Axial sensor configuration which is used in the present study is presented in Figure 1.3d-e. In this system, the direction of wave propagation is inverted, where the waves are sent along the axial direction of the pipe at a given circumferential position of the sensor. The Axial sensor uses the same ePod controlling unit of the QSR1, a traction unit with wheels and motor, and a pipe-size-specific frame, to move circumferentially around the scanned pipe area at a predefined step size under its own power. The transducers excite and receive waves in the axial direction within the same frequency range, with the receiver closer to the area of interest, such that first arrivals are via a path under the sensor, followed by reflections from wall loss, if a defect is present, at the area of interest. In this arrangement, the base pipe wall under the sensor is measured along with the minimum RWT that caused the reflection at that circumferential position. The system then scans around the pipe to build up a circumferential profile of the pipe being inspected. The scan results are presented as thickness versus circumferential position or angle as shown in Figure 1.3f.

The transducer width for both the axial and circumferential sensors is about 50mm (2 inch). Defects much smaller than this width in the axial direction for the QSR1 and in the circumferential direction for the QSR Axial sensor, will have a non-specular reflection together with diffraction around it, so there is no sharp split in the signal transmitted. However, when a defect is not present there is no reflected signal, so a reflected signal sufficiently large amplitude at a particular split frequency is a reliable defect indicator and the split frequency gives an indication of its depth. The QSR method detects both internal and external corrosion, without distinction between the two.

2. The Finite Element Model

The presence of pitting corrosion complicates short range guided wave scanning analysis as the wavelength used for inspection is larger than the diameter of small pitting-type defects. We use finite element (FE) experiments to simulate the QSR Axial setup and operation to enable us to obtain insights into the governing parameters and improve our understanding of the observed results.

Explicit time domain FE three-dimensional simulations were performed using Pogo software [3]. Pogo enables high-speed FE simulations to be performed by utilising Graphical Processing Units (GPUs). The simulations were performed on a GPU workstation with 8 Nvidia Quadro RTX 8000 GPU cards. The modelled pipe section was a 10 inch (DN 250), Schedule-40 carbon steel pipe, 9.27 mm nominal wall thickness, 900 mm long, with the following material properties: density: 8,000kgm-3, shear velocity: 3,250 ms-1; longitudinal velocity: 5,960 ms-1. To allow the model to cover a frequency band of 100-500kHz, the model element size was 0.3 mm, enabling 31 nodes through the thickness. The FE model included approximately 800 million degrees of freedom (DoF). Excitation of the signal was obtained by prescribing tangential forces at a group of nodes at the outer surface of the pipe that represented the QSR Axial transmitter EMAT arrangement at the desired position; the excitation being a wide bandwidth tone burst. Signals were received at the location of a group of nodes that represented the QSR Axial receiver EMAT arrangement, which is of identical size as the transmitter. Excitation of the signals results in axial waves travelling along the axial direction of the pipe, in both directions away from the transmitter. Absorbing regions of the stiffness reduction method (SRM [4]) were added either on one or both domain boundaries to avoid signal reflections from them, when these were not desired. Defects were implemented in the pipe by removal of elements from a structured mesh along with some deformation of the remaining elements to match the desired profile. In the cases where defects were introduced, the simulations included a set of measurements around the circumference of the pipe, in 1/2-inch (12.7 mm) steps, to cover the circumferential extent. Results obtained as amplitude as a function of time are transformed into the frequency domain using 2DFFT and are presented as spectrograms.

3. Results

We initially investigate a case where no defect is present in the pipe and a flange at the end of the pipe acts as a reflector, to provide reference data set. Then we introduce a smooth defect to the pipe, of the type of scabs developed in touch point corrosion cases, and investigate the influence of the depth of the detect on the resulting signals. We also investigate a case where we introduce a series of pits of various sizes and depths to the pipe. Finally, we investigate a case where the smooth defect has the addition of pitting.

3.1 Clean pipe

To provide reference data, a clean pipe case with no defects has been set up with the QSR Axial sensor as depicted in Figure 2a, which operates in a pitch-catch configuration. The spectrogram collected for this case is depicted in Figure 2b where the received signals have been annotated according to their mode and source. The flange at the end of the pipe reflects all of the energy; the reflected SH1 mode experience additional dispersion due to distance travelled. The SH2 signal in the results presented in this report is clear due to the clean surface of the pipe. Outside of laboratory conditions the SH2 signal may not be seen as it is more susceptible to attenuation arising from features such as surface roughness. The cylindrical geometry of the model means that the same result will be obtained at any circumferential position. The colour scale in the spectrogram represent amplitude, with the gain set at 35dB in Figure 2b and in the following spectrograms presented hereafter.

3.2 Smooth corrosion patch

A smooth defect was introduced to the pipe to represent a generalised area of corrosion without any pitting. The

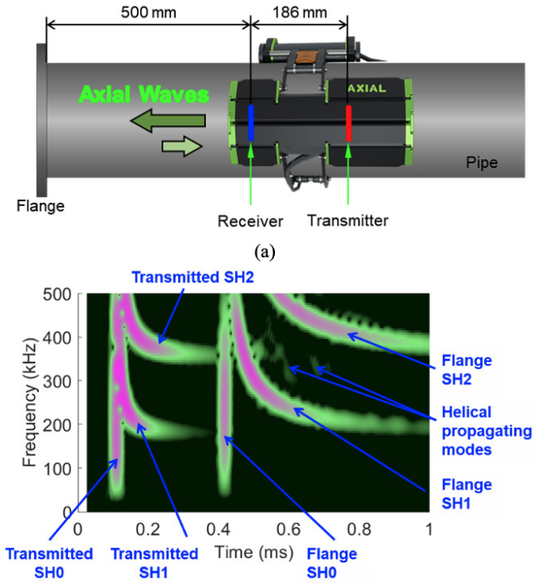


Figure 2. Simulated pipe: (a) Schematic view of the 10 inch, schedule 40 pipe used in the FE simulations. The QSR Axial sensor operates in a pitch-catch configuration, the transmitter (red line) and receiver (blue line) are at 686 mm and 500 mm away from the flange end of the pipe, respectively. (b) Spectrogram from the pipe with no defects shown in (a); The first signals arriving are the waves that travel directly between the transmitter and receiver of the QSR Axial sensor. This consists of three modes, SH0, SH1 and SH2. The second set of signals are due to the reflection from the flange end of the pipe and includes the same three modes. Further reflected signals that arrive later are seen that arise due to modes that have propagated helically around the pipe. The colour scale represent amplitude at 35dB gain.

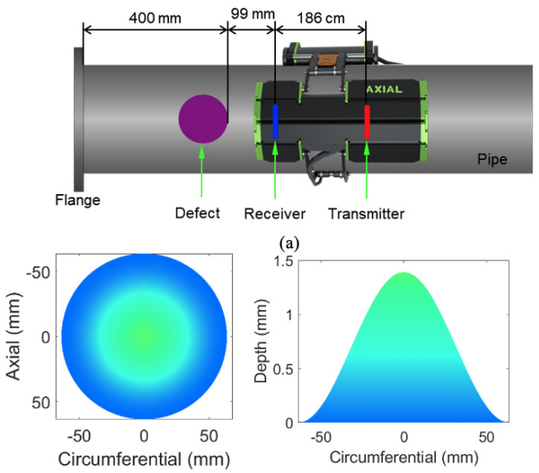


Figure 3. Pipe with smooth defect: (a) Schematic view of pipe with a defect (purple) introduced 99mm from the receiver of the QSR Axial sensor. (b) Smooth circular defect introduced to represent an area of wall loss due to corrosion. The defect has a diameter of 127 mm and, (c) the defect has a smooth profile to its maximum depth at the centre of the defect. The maximum depth was varied between 15% of the wall thickness shown here, to 50% of the wall thickness. The colour scale in (b) and (c) represents depth.

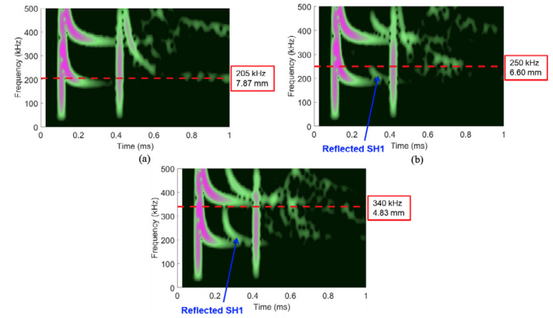


Figure 4. Spectrograms for a pipe with a smooth defect as depicted in Figure 3. Defect depth in percent of the pipe wall is: (a) 15%, (b) 30% and (c) 50%. The split frequency of the defect is marked with the horizontal red dashed line with the corresponding wall thickness given in a text box.

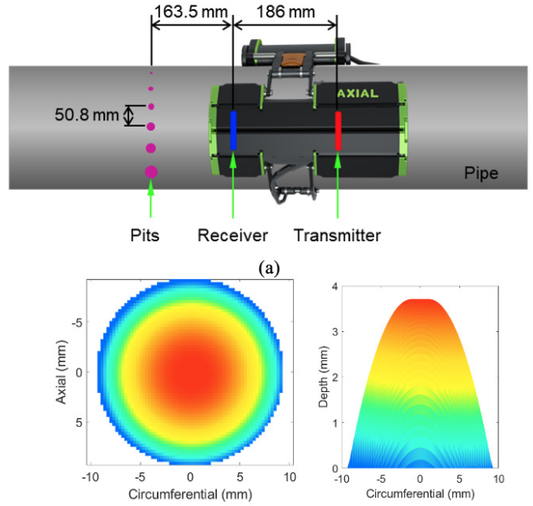


Figure 5. Pipe with pitting defect: (a) Schematic view of circumferential QSR Axial sensor scan of pitting defects. A series of pits with increasing diameter were introduced to the pipe surface separated by 50.8 mm circumferentially. The QSR Axial sensor scanned the pipe circumferentially across the pits with a 1/2-inch (12.7 mm) step. (b) Defect geometry for a 1/2" (12.7 mm) diameter pit. The diameter of the pit is measured where the wall loss is half of the maximum depth of the pit (c) The defect is 40% of the pipe wall thickness. Colour bars in (b) and (c) represents depth.

defect location and geometry are given in Figure 3a-c. The defect has a diameter of 127 mm and a series of maximum depths, varying between 15 and 50% of the wall thickness, were used.

The defect depth is measured in the same way it is carried out in the QSR Axial sensor results where the split frequency resulting from the defect presence is used to obtain the remaining wall thickness. Results for the smooth corrosion patch are presented in Figure 4. For shallower defects this will be seen primarily in an increase to the split frequency for the SH1 mode that is reflected from the flange end of the pipe. For pipes in the field the flange reflection may be complex and

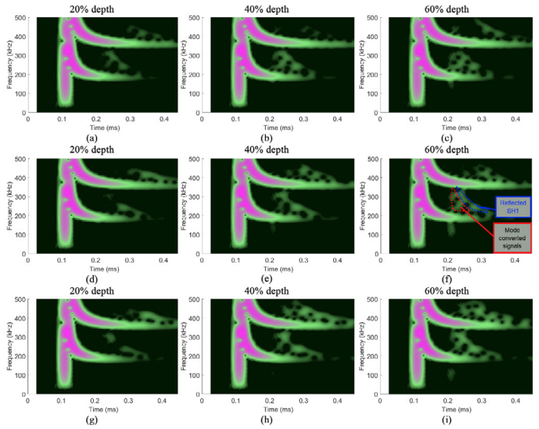


Figure 6. Spectrograms for a pipe with pitting as depicted in Figure 5. The QSR Axial sensor is circumferentially aligned with a pit of: (a-c) 1/8 inch (3.18 mm) diameter, (d-f) 1/4 inch (6.35 mm) diameter, and (g-i) 3/8 inch (9.52 mm) diameter. The maximum depth of the defect is given on the top of each spectrogram as a percentage of the wall thickness.

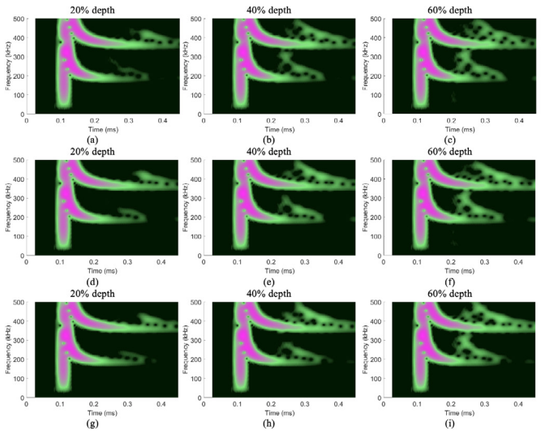


Figure 7. Spectrograms for a pipe with pitting as depicted in Figure 5. The QSR Axial sensor is circumferentially aligned with a pit of: (a-c) 1/2-inch (12.7 mm) diameter, (d-f) 5/8 inch (15.87 mm) diameter, and (g-i) 3/4 inch (19.05mm) diameter. The maximum depth of the defect is given on the top of each spectrogram as a percentage of the wall thickness.

varied and therefore unlikely to be reliably used for quantitative analysis. Figure 4 clearly shows the effect of the defect depth on the SH1 reflection. As the defect depth increases, the reflection of the SH1 mode from the defect becomes more prominent and the maximum frequency of this reflected energy corresponds to the split frequency resulting from the defect.

3.3 Pitting

The received signal from pitting defects for a series of pit diameters and depths have been investigated. The pit diameter was 1/8 inch (3.18 mm), 1/4 inch (6.35 mm), 3/8 inch (9.52 mm), 1/2 inch (12.7 mm), 5/8 inch (15.87 mm) and 3/4 inch (19.05mm) with three depths; 20, 40 and 60 percent of the nominal wall thickness

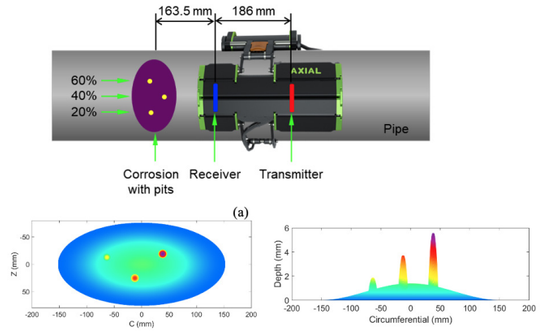


Figure 8. Pipe with corrosion patch and pitting defects: (a) Schematic view of circumferential QSR Axial sensor scan of a combined corrosion patch with pitting defects. A 305 mm by 152.5 mm smooth corrosion patch of 15% wall thickness was combined with three 1/2-inch (12.7 mm) pits (depth is labelled). The pits are separated by 50.8 mm circumferentially. (b) and (c) Defect geometry for combined pitting and corrosion as described in (a). Colour scale represents depth.

used for each pit. The pit geometry follows a steep parabolic profile with a flat bottom. This pit geometry was chosen to be more representative of pitting found in site conditions than a flat-bottomed hole. A schematic of the pipe is given in Figure 5a.

The results are presented for each pit diameter in Figures 6 and 7 for circumferential positions where the QSR Axial sensor is centred on the pit. For the largest pits the SH1 mode reflected from the defect shows an increase in its maximum frequency with pit depth similar to the smooth corrosion patch. As the pitting diameter is reduced, additional mode-converted signals from the pit are received and overlap with the reflected SH1 and complicate the analysis; These are labelled solely in Figure 6f; however, are present in all of the inserts in Figure 6 and 7. The proportion of mode conversion increases as the pit diameter is reduced and includes frequency content above that anticipated from the direct SH1 reflection and may therefore lead to an overestimation of the defect depth. Nevertheless, an indication the defect is present is received.

3.4 Combined Corrosion Patch and Pitting

The combination of pitting and general corrosion patch was investigated using a pipe as depicted in Figure 8a with a defect introduced as shown in Figure 8b-c. The QSR Axial sensor scanned at a 1/2-inch (12.7 mm) steps circumferentially across the defect.

The results are presented in Figure 9 for three circumferential positions which are aligned with each of the pitting defects. The combination of pitting with the smooth corrosion patch leads to a complex combination of received signals. The direct SH1 reflection from the corrosion patch, as seen in Figure 4, is masked by interference from the pitting defects. Therefore, estimation of the depth of the smooth corrosion patch is unlikely to be feasible when significant pitting defects are present. Furthermore, simple manual depth estimation for the pitting defects themselves is also likely to be more challenging due to this interference.

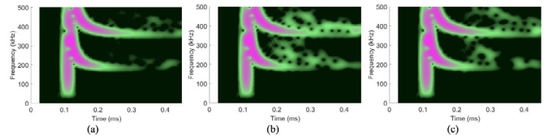


Figure 9. Spectrograms for a pipe with corrosion patch and pitting as depicted in Figure 8. The QSR Axial sensor is circumferentially aligned with the pit of: (a) 20% depth, (b) 40% depth, and (c) 60% depth.

4. Conclusions

The QSR Axial sensor provides sizing and depth measurements for corrosion patches with various profiles found in the industry. The presence of pitting clusters makes little difference to measurement of the majority of the remaining pipe wall thickness allowing accurate FFS calculations. Where pitting defects are present the received signals are complex due to a combination of direct reflections and mode conversion from the pits. However, the received signals serve as defect indicator and measurement of depth can be obtained.

The QSR Axial sensor is capable of detecting singular pitting corrosion of diameter as small as 1/8" (3.2 mm) with a depth of 20% wall thickness or deeper. The quantitative estimation of small pits is difficult since reflected SH1 signals are obscured by mode converted signals. This may result in overestimation of the pit depth.

Individual pits down to 1/2" (12.7 mm) can be quantitatively measured using standard GUL split frequency analysis. The presence of finer pitting indicated by the presence of mode converted signals. The presence of pitting corrosion of diameter as small as 1/8" (3.2 mm) with a depth of 20% wall thickness or deeper.

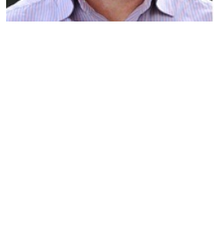
When pitting corrosion is embedded in a larger scale corrosion patch then the resulting interference between reflections from the pitting corrosion and the corrosion patch makes the resulting reflected field complex. In principle, the analysis can be performed in a similar manner to that as if the large-scale corrosion patch was not present.

Machine Learning developed for QSR1 (circumferential) improves analysis accuracy compared to human interpretation as signals become more complex and will be applied to axial interpretation.

5. References

1. Pialucha T, B Pavlakovic, D Alleyne and P Cawley, 2020, 'Quantitative measurement of the remnant thickness in corrosion under pipe supports.' Insight, Vol. 62(11), pp 642-648.
2. Khalili P and P Cawley, 2018, 'The choice of ultrasonic inspection method for the detection of corrosion at inaccessible locations.' NDT&E International, Vol. 99, pp 80-92.
3. Huthwaite P, 2014, 'Accelerated finite element elastodynamic simulations using the GPU', Journal of Computational Physics, Vol. 257, pp 687-707.
4. Pettit J, Walker A, Cawley P, Lowe M, 2014, A stiffness reduction method for efficient absorption of waves at boundaries for use in commercial finite element codes, Ultrasonics Vol. 54, pp. 1868-1879.

6. Author Details



Dr Sam Horne is consultant for numerical simulations at Guided Ultrasonics Ltd. He holds a PhD in Mechanical Engineering from Imperial College London, and MSc and BSc in physics from the University of Warwick. His PhD research was on guided wave inspection of creep damaged pipes.

Dr Eli Leinov is the head of GUL Training at Guided Ultrasonics Ltd. He joined GUL in 2018 following a Post-Doc at the NDE Group, Mechanical Engineering at Imperial College London, where his EPSRC-funded research was on guided ultrasonics wave testing of buried and embedded pipes and other applications. Eli holds a PhD, MSc and BSc in Mechanical Engineering from Ben-Gurion University, Israel.

Dr Tomasz Pialucha is a director of R&D at Guided Ultrasonics Ltd. He joined GUL in 2013. Tomasz holds a PhD and MSc in Mechanical Engineering from Imperial College London, where his research was on ultrasonic methods for testing adhesive joints. He was awarded a SERC Fellowship for scientific achievements.

Eddy Current corrosion detection on concrete power poles

Reinforced concrete power poles have been used in distribution networks from the 1950s and their usage has been growing ever since.

J. BAILEY[1], G. GOUWS[2], N. LONG[1]
[1] ROBINSON RESEARCH INSTITUTE, VICTORIA UNIVERSITY OF WELLINGTON, WELLINGTON, NEW ZEALAND
[2] SCHOOL OF ENGINEERING AND COMPUTER SCIENCE, VICTORIA UNIVERSITY OF WELLINGTON, WELLINGTON, NEW ZEALAND

Many older poles are still in use, for example, New Zealand has 320,000 poles over 60 years old out of a total installed population of 1.3 million. These poles have an expected life of 80 years so many older poles are due for replacement. Replacing all these poles is not financially feasible, so prioritisation of the most damaged poles for replacement is needed.

The current inspection methods used for concrete power poles are entirely visual involving a simple inspection to look at the amount of cracking, spalling and exposed rebar on a pole. This system has worked relatively well for the oldest style of concrete power poles where large steel rebar was used for mass-reinforcement. However, power pole design has moved to pre-stressed concrete power poles which have thinner rebar, making them more susceptible to failure from small amounts of corrosion. In addition, rather than deforming slowly like a mass-reinforced pole, it has been found that modern pre-stressed poles can fail suddenly and, in some cases, without any visual indication.

In this paper, a new eddy current testing technique that can detect corrosion in concrete power poles is presented. The technique uses a high-power coil placed around the pole with a dense array of thin film magnetic sensors. These sensors are orientated such that they are sensitive to disturbance in eddy currents in the rebar caused by corrosion. Simulation results explore the factors that determine when corrosion can be identified. Laboratory testing on mock power poles shows the potential effectiveness of the system, while results from a first field trial show the applicability of the techniques to the industry.

Keywords: Eddy current, Rebar, Corrosion, Power pole, Concrete.

1. Introduction

1.1 Concrete power poles

Electrical grids power our modern world. A critical infrastructure component of electrical grids is the power poles that hold up the wires that distribute power. Initially, these power poles were built out of timber. However, in the past 70 years, many concrete power poles have been used. For example, New Zealand has 1 million concrete power poles out of 1.3 million poles. This is growing as more poles are replaced, and new lines are built.

The expected life of these poles in New Zealand is 70-80 years which means the oldest poles are reaching the end of their predicted life. With close to 50,000 poles reaching an age of 70 in the next decade there is a significant expense looming for the owners of these assets, unless a test can be developed to show that their operational life can be extended beyond their original design life.

Several NDT testing techniques are used on timber power poles such as measuring the acoustic waves induced by an impact, ultrasonic scanning, and deflection characteristics when a pole is loaded.[1]. However, no NDT inspection method for concrete power poles is currently used in the industry. A typical assessment of a concrete power pole's health is a visual inspection looking for the level of cracking or exposed rebar.

The steel rebar in a concrete power pole provides structural strength and the typical pole failure is due to corrosion in the rebar, reducing the strength of the pole. Concrete power poles can be grouped into two broad categories: mass-reinforced and pre-stressed. Mass-reinforced poles use larger diameter rebar, resulting in a higher corrosion tolerance before failure. This more extensive corrosion before failure makes for easier identification through visual means. Pre-stressed poles, however, have thinner steel rebar or pre-stressing wires which compress the concrete. This compression allows the concrete to provide tensile strength to the pole. The thinner steel rebar means less corrosion can be tolerated before failure. This failure can occur suddenly when the steel yields, causing compression of the concrete to be lost, and the pole collapses immediately. Pre-stressed poles are now the predominant type, as they require less steel to achieve the same strength and this failure with little visual indication is becoming a significant concern for network owners.

Some NDT methods are available for inspecting rebar in concrete for other applications, such as GPR (ground penetration radar). These systems typically lack the resolution to identify the corroding rebar[2]. This paper will use ECT (eddy current testing) to identify corroding rebar inside concrete power poles.

1.2 Eddy current systems

ECT typically uses a system shown in Figure 1.

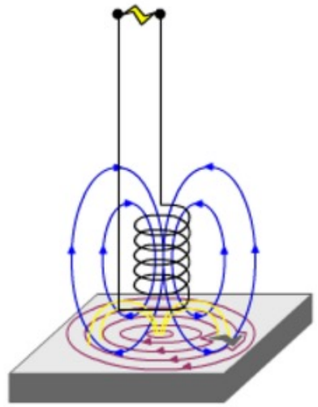


Figure 1 Eddy current testing principles. Blue line = magnetic field generated by the coil, red line = eddy current in the test object, yellow line = field generated by eddy currents [3]

The coil is placed with its axis perpendicular to the test object's surface. This induces eddy currents in the test object. The magnetic field from the eddy current is then measured with the same coil.

This paper will use a modified version of the typical ECT presented in [4] and [5]. The excitation coil is wrapped around the test object, and thin film sensors such as GMR (Giant Magneto-Resistance) or TMR (Tunneling Magneto-Resistance) sensors are used to measure the magnetic field strengths in 3 components: tangential, radial and axial to the excitation coil. This ECT configuration allows for a dense array of magnetic field measurements over the entire surface of the test object. This provides the resolution needed to identify corrosion in rebar. The ability to measure the radial magnetic field significantly improves sensitivity when the test object is uniform in the axial direction, as any change from zero fields indicates corrosion is present.

2. Simulation of Power Pole Inspection

FEM (finite element modelling) simulations were used to determine the effect of the rebar diameter and the impact of distance between the rebar and the sensor/excitation unit. The software package Opera[6] was used to complete the FEM simulations. A simplified power pole system with an excitation coil was modelled. The model contains a single copper loop with the excitation current and four rebars in a square pattern. Using symmetry, the model is further simplified to a single rebar and a quarter ring of copper. This reduces the number of elements in the model, reducing the time to solve. Once the simulation is completed, the magnetic field in the three cylindrical directions along a line of points in the centre of the copper ring is extracted.

The corrosion is simulated by reducing the diameter of the rebar over a 50 mm section. The movement of the coil and sensors is simulated by moving the area in 5 mm steps from the centre of the rebar length to 80 mm from the centre. This is an improved simulation technique compared to previous work in [5], where the excitation coil was moved over the corrosion area, which introduces distortion in the magnetic field due to the measurement location being closer to one axial boundary than the other.

To analyse the results of these simulations, contour plots of the magnetic field components over a cylindrical surface above the test object are plotted. An example of this is shown in Figure 2 for a 2 mm diameter reduction with 12 mm rebar. There is a characteristic shape for each component of the magnetic field with dual peaks for the radial field, a set of 4 peaks for the tangential field and a single peak for the axial field. To simplify the analyses and visualisation over a range of simulated defects and rebar configurations just the maximum value from each contour plot, except for the axial field, was extracted. In the case of the axial field the maximum change from the background field was used. For example, for the plots in Figure 2 this would be 0.422 mT for axial, 0.376 μT for radial and 0.131 μT for tangential.

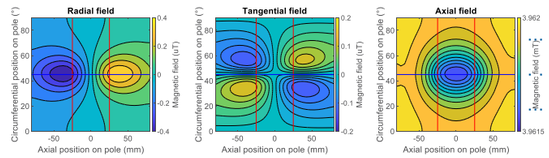


Figure 2 Magnetic contour plot of rebar with 4 mm diameter reduction. The blue line is the location of the rebar. Red lines are the edges of diameter reduction.

Previous work showed the effect of the depth of the simulated corrosion on the size of the peaks, with Figure 3 from [5] showing an approximately linear slope for the peak radial magnetic field with defect depth. This rate of 0.33 μT/mm gives a point of reference for comparison of the effect on the magnetic field from other parameters.

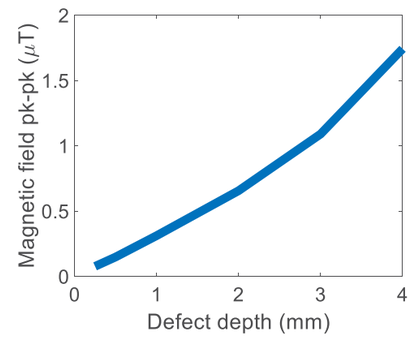


Figure 3 Effect of the depth of corrosion in rebar on the magnitude of the radial magnetic field distortions[5]

2.1 Effect of rebar diameter

The rebar in concrete power poles comes in a wide variety of sizes. The size is usually noted in the construction drawings but, in some cases, these details

are not available or reliable due to age and record keeping. For an effective NDT system, a measurement that can determine the rebar size and an independent measurement of the corrosion level would be beneficial. The first step to achieving this is to understand how the rebar diameter affects the measured magnetic fields using simulations.

A set of simulations were generated with the 4 bars of rebar on the corners of a 150 mm square with a coil diameter of 298 mm. The rebar diameter was reduced by 4 mm in a 50 mm section to simulate the corrosion. Then for each simulation the rebar diameter was changed, starting at 10 mm and going up to 28 mm. The peak magnetic field value generated by the defect for each magnetic field component from each simulation is plotted in Figure 4.

The simulation results show that the rebar diameter and the corrosion depth can be independently determined. The axial field shows a relatively linear increase of peak field with rebar diameter, which would allow the prediction of the rebar diameter if its location were known. There is some divergence at the extremes of rebar diameter above 24 mm and below 12 mm. This could be due to other competing effects changing the magnetic field at these extremes. At the large end, the steel is getting close to the sensors as the diameter increases which will increase the strength of the magnetic field in general as well as for any changes produced by corrosion. At the other end of the scale, the point when corrosion entirely consumes the steel is approached. The last data point represents a 65% reduction in cross-section. As a 100% reduction is reached, the eddy current in the steel must be distorted more until none of it can flow across the corroded section. This increased distortion in eddy current provides a source for increased magnetic field peaks resulting from the distorted eddy current.

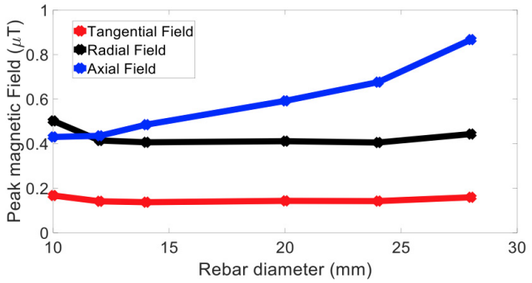


Figure 4 Effect of rebar diameter on the magnitude of magnetic field peaks generated by a 2 mm diameter reduction.

2.2 Effect of distance to rebar on the magnetic field

While the distance between the surface of the power pole and the sensor unit can be controlled, the amount of concrete cover on the rebar is a variable that can change with different pole designs as well as between different batches, depending on the quality of workmanship when they were manufactured. In some cases, when accurate documentation is available, this is a known value. In other cases, this may be an unknown variable that needs to be determined.

In the ideal case, when no corrosion is present, the rebar position will not affect the radial and tangential fields, which is borne out in a simulation with zero corrosion reporting a max field of 9 nT in the tangential and 22 nT in the radial directions. This non-zero field is due to mesh artefacts and boundaries in the simulation. However, when there is an area of corrosion distorting the magnetic field, then the expectation is that this distortion will be increased with decreasing distance between the rebar and sensor unit. This is due to magnetic field generated by the eddy current decaying less before it reaches the sensors. This effect is shown in Figure 5, which shows the strong dependence on distance from the rebar to the sensor unit. This means a different measure is needed to determine the distance to the rebar to correct the effect of changing the distance between the rebar and the sensor. If we look at an area of the rebar with no defect only the axial field is expected so the effect of the distance to the rebar should be observable in the axial field. Figure 6 plots the axial field far from the defect in the rebar. It shows that as the distance increases, the dip in the magnetic field caused by the rebar reduces. This indicates that a measurement of the axial field could be used to determine the distance between the sensor and rebar. However, this will have limited effectiveness as a high dynamic range will be needed on this measurement to resolve the slight change in the magnetic field. If the rebar is too far away, detecting this change would not be possible.

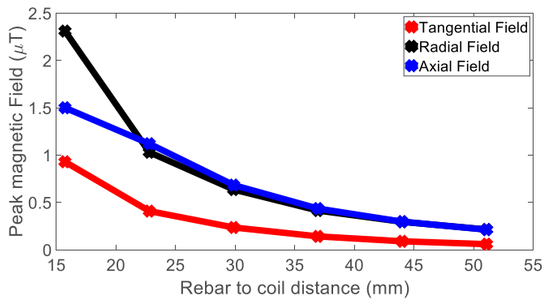


Figure 5 Effect of distance between rebar and sensor on the peak measure magnetic field in each direction

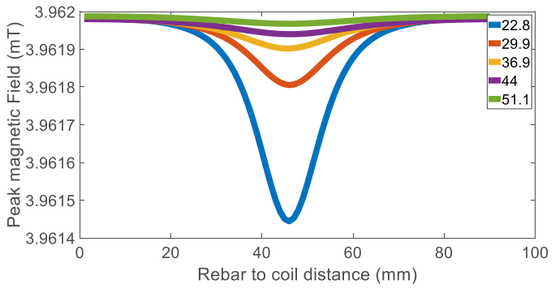


Figure 6 Effect of distance between rebar and sensor on the axial field above rebar

3. Field Prototype

A prototype system as shown in Figure 7 has been built to test this measurement technique in the field. This design has been introduced in [5] but no field testing was done at that stage. The prototype consists of 3 sub-systems; (1) the lifting system, (2) the sensor unit and (3) the power source. The lifting system clamps onto the power pole at a height of about 3 meters and has four winches used to move itself into place. Once clamped in place the winches are used to move the sensor unit up and down the pole controlled via a webpage interface. The power source contains a battery and power management equipment so the system can be used in the field for an 8-hr day. It also includes a power amplifier that generates the 160 Hz excitation current to feed into the transformer on the sensor unit. The sensor unit comprises four quarter-ring units connected by straight sections to allow size adjustment. Each quarter unit has 12 pairs of GMR sensors that measure the radial and tangential field at 5-degree intervals. An onboard FPGA has a high channel count digital lock-in amplifier implemented that simultaneously measures magnetic field amplitude at 160 Hz for all 96 sensors. The magnitude and position on the pole are sent back to a laptop for further data processing and contour map generation.

Figure 7 Prototype ECT device on in-service power pole during testing

3.1 Mock pole testing

In previous work, [5] a mock pre-stress power with a 7.5 mm diameter wire rope with seven strands was tested with the prototype. Two samples were tested, one with 80% of one strand removed and the other with 50% removed. This testing showed peaks appearing in the magnetic field at the defects' location as predicted by the simulations. The contour plots for the tangential field are shown in Figure 8 and Figure 9. These results gave the confidence for initial field trials with the system.

3.2 In-network pole testing

In collaboration with a New Zealand distribution company, the prototype system has been tested on four poles in their network. Two were mass-reinforced Figure 10, and two were pre-stressed Figure 11.

The testing procured involved the following ten steps:

1. Temporary anchor was attached at 3.5 m from the ground.
2. Lifting platform was attached around the pole.
3. Lifting platform lifted itself to the temporary anchor and is attached to the pole.
4. Sensor unit was placed around the power pole in the zero-degree position.
5. Sensor unit was lifted up the pole at a rate of approximately 2 mm/s with the magnetic field measured at one second intervals.
6. The sensor unit was then lowered at a higher speed, typically 10 mm/s.
7. The sensor unit was rotated from zero to the 45-degree position, and steps 5 and 6 are repeated.
8. The sensor unit was removed from the pole.
9. The lifting platform was lowered back down and removed from the pole.
10. The temporary anchor was removed from the pole.

The time to complete this process was approximately 90 mins. In addition, at each pole, we had to unpack and pack equipment which took 20 mins each side of testing. This gave an approximate testing time per pole of 130 mins. This testing time allowed for two poles to be tested per day. However, achieving a faster testing rate would be possible with a next-generation system. The limiting factor for testing is the scan speed set at 2 mm/s to get high-density data. With a streamlined attachment system, a pole test at this speed could be completed in 30 minutes, allowing for 16 poles in an 8 hr day.

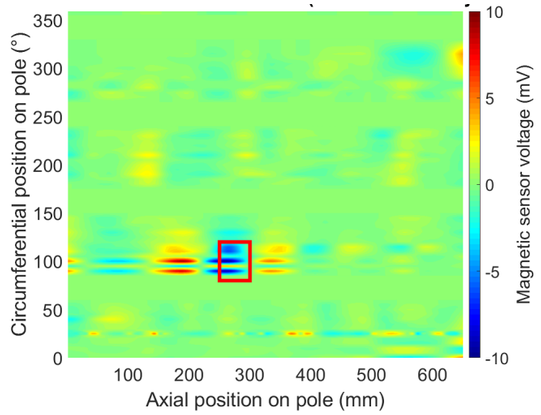


Figure 8 Tangential magnetic field over mock pre-stressed power pole with simulated corrosion location shown by the red box. 80% of one strand from 7 strand cable was removed[5]

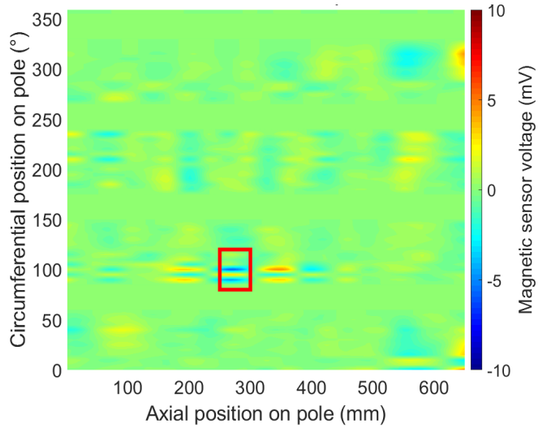


Figure 9 Tangential magnetic field over mock pre-stressed power pole with simulated corrosion location shown by the red box. 50% of one strand from 7 strands was removed[5]

Figure 10 Mass-reinforced power pole tested during the field trial

Figure 11 Pre-stressed power pole tested during the field trial

3.3 In-network testing results

The mass-reinforced style power poles gave the most unambiguous indication of corrosion, with a clear set of peaks observed in both the tangential and radial magnetic field over multiple scans. This is illustrated in Figure 12, where a cluster of peaks can be seen in the tangential field between 1100 mm and 1300 mm between sensors 37 and 48.

The testing on the pre-stressed pole encountered a few issues that reduced the quality of the data from testing on these poles. These issues resulted from the pole tilting 5 degrees from vertical and having a smaller-than-expected cross-section. This meant the clearance between the tool and the pole was approximately

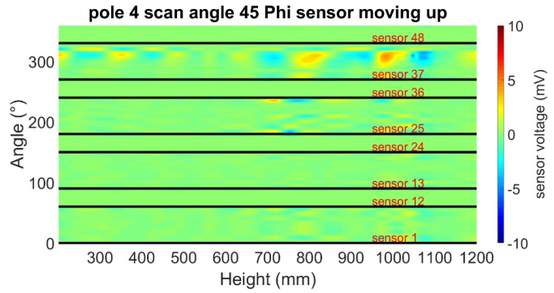


Figure 12 Contour plot of the tangential magnetic field over mass-reinforced power pole in field testing, showing likely corrosion between sensors 48 and 37 at 1200 mm.

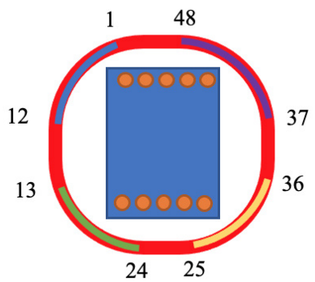


Figure 13 Relative position of sensors during testing of mass-reinforced power pole

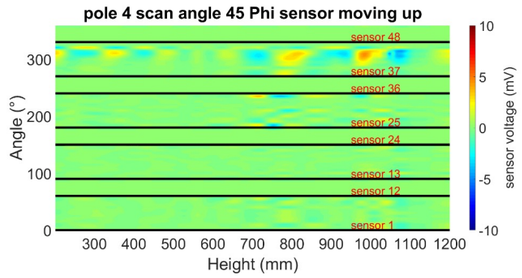


Figure 14 Contour plot of the tangential magnetic field over pre-stressed power pole in field testing

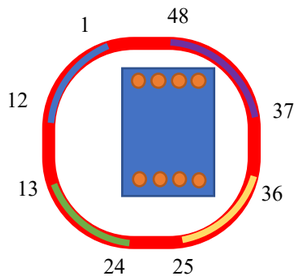


Figure 15 Relative position of sensors during testing of pre-stressed power pole

50 mm. The combined effect was that the mechanism to centre the tool was overwhelmed by the extra gravity load. This resulted in the segment with sensors 37-48 being close to the surface of the power pole while the other sensors were 50+ mm from the surface. From the simulation in section 2.2, the addition of this distance is expected to result in only the effect on the rebar under sensors 37-48 being observed. With this limitation in mind, Figure 14 shows the contour plot of the magnetic field for the tangential field with the expected more significant variations in the magnetic field appearing in the sensors closest to the power pole. There are some signs of corrosion with peaks in the magnetic field between 900 and 1000 mm in height. However, these peaks were less consistent across several tests than was seen in the mass-reinforced pole. This gives rise to uncertainty that it may be a false positive indication of corrosion.

4. Conclusions

The simulations have shown that simplified corrosion shapes can be identified independently of the rebar size, and a rebar size correction algorithm could be created if needed. The simulation has also shown that the distance to the rebar is an important parameter that affects the magnetic field strength.

The effect of the distance can be predicted via simulation so if the distance is known then a correct factor could be applied to determine the depth of corrosion. The testing with the prototype has shown that it is possible to detect reduced steel wire diameter in the lab, but it is approaching the limits of detection at 50% strand loss. To improve this limitation using a higher-sensitivity magnetic sensor, which is now available, would be possible. In tandem with this, it would be necessary to reduce the background variation which is likely due to jerky movement introducing variation in the magnetic field.

Testing the prototype showed the capability to detect corrosion in real-world situations with what appears to be corrosion detected on the mass-reinforced pole. However, the critical issue to resolve is a tool design that can make a smooth movement for the entire test length as close as possible to the surface of the pole.

5. Acknowledgments

This research has been funded by the MBIE endeavour fund under contract RTVU1811

6. References

[1] "Timber Pole Conditions Assessment Guide: Consultation open." https://www.eea.co.nz/site/publications/drafts-for-comment/drafts-for-comment-now-closed/timber-pole-conditions-assessment-guide.aspx (accessed Jan. 11, 2023).

[2] D. Eisenmann, F. Margetan, C.-P. T. Chiou, R. Roberts, and S. Wendt, "Ground penetrating radar applied to rebar corrosion inspection," presented at the REVIEW OF PROGRESS IN QUANTITATIVE NONDESTRUCTIVE EVALUATION: VOLUME 32, Denver, Colorado, USA, 2013, pp. 1341-1348. doi: 10.1063/1.4789198.

[3] "Basic Principles of ET." https://www.nde-ed.org/EducationResources/CommunityCollege/EddyCurrents/Introduction/IntroductiontoET.htm (accessed Jul. 08, 2020).

[4] J. Bailey, N. Long, and A. Hunze, "Eddy Current Testing with Giant Magnetoresistance (GMR) Sensors and a Pipe-Encircling Excitation for Evaluation of Corrosion under Insulation," Sensors, vol. 17, no. 10, p. 2229, Oct. 2017, doi: 10.3390/s17102229.

[5] J. Bailey, N. Long, and G. Gouws, "Detection of rebar corrosion in concrete power poles," presented at the EEA conference and exhibition 2021, wellington, Jul. 2021.

[6] "Opera | SIMULIA by Dassault Systèmes®." https://www.3ds.com/products-services/simulia/products/opera/ (accessed Jan. 24, 2023).

Author Details

Joseph Bailey received a B.E. (Hons) from Canterbury University in 2011 and an M.E from Victoria University of Wellington in 2015 and is currently studying towards a PhD.

He joined Industrial Research Limited as a junior engineer in 2011 and now works at Victoria University of Wellington as an Engineer. He works on instrumentation for super-conducting system in addition to current research interests including of thin film magnetic sensors in eddy current system for NDT across a number of applications.

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NOTICE OF THE 56TH ANNUAL GENERAL MEETING OF THE AINDT

The AINDT extends a warm invitation to all financial members for its 56th Annual General Meeting, scheduled to take place at the Rendezvous Hotel Melbourne.

Venue: **Rendezvous Hotel Melbourne**
Address: **328 Flinders St, Melbourne**
Date: **Friday, October 13, 2023**
Time: **5:00 PM AEDT**

The AGM serves as a significant occasion to commemorate achievements, reflect on past accomplishments, and set sights on the upcoming year. It also presents an excellent opportunity to connect and network with colleagues and peers in the industry.

All financial members of the AINDT are eligible to participate in the AGM. In the event that a member is unable to attend, they have the option to nominate another member as their proxy to represent them. To obtain a proxy form, interested members can request one by emailing: office@aindt.com.au.

Members who wish to include additional agenda items must submit their requests in writing no later than Thursday 15 September 2023.

Statements of Income and Expenditure for the period from 1 July 2022 to 30 June 2023, as well as Statements of Assets and Liabilities as of 30 June 2023, will be distributed during the AGM. In the lead-up to the event, these documents will be made available on the AINDT website, along with the draft minutes from the 2022 AINDT AGM.

AGENDA

1. Attendees / Apologies / Proxies
2. Disclosure of interest
3. Confirmation of the Minutes of the 54th AGM held at Rendezvous Hotel Melbourne 7 October 2022
4. Business arising from the Minutes
5. Receipt of the 55th Annual Report
6. Receipt and acceptance of the Statements of Income and Expenditure for the period1/7/22 to 30/6/23 and statements of assets and liabilities as at 30/6/23
7. Appointment of Auditor
8. a) Election of Office Bearers(Directors): for 2023-2024

   b) Ratification of Federal Councilors (Regional & Office Bearers) for 2023 – 2024
9. Close.

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