THE MAGAZINE OF THE INSTITUTE OF MEASUREMENT AND CONTROL INSTMC.ORG

DOWN THE RABBIT HOLE: WHERE ART MEETS ENGINEERING

AI ETHICS AND MACHINE LEARNING

SOUTH WEST ENGLAND INNOVATORS COLLABORATE TO DEVELOP ENHANCED SOLUTIONS FOR SEAGRASS MONITORING

DYNAMIC THERMOMETRY AT NPL

PRECISION

MARCH 2023 ISSUE 27

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InstMC

INSTMC WELCOMES NEW PRESIDENT SHEILA SMITH

I am honoured to be taking over as President of the Institute of Measurement and Control and I would like to start by thanking the outgoing president, Martin Belshaw, for all his hard work and guidance particularly during the years of the pandemic.

He did a fantastic job and I hope to continue to build on the initiatives introduced over the past three years. Also, many thanks to Ian Craig the outgoing Honorary Treasurer and a welcome to our new Honorary Treasurer, Stewart McFarlane.

For those of you who do not know me I am an academic and have worked in Universities for over 30 years. I am Head of the Department of Applied Science at Glasgow Caledonian University and have been actively involved in chemical sensors and instrumentation research and teaching for many years. I am passionate about ensuring that we have an outstanding pipeline of talent to support industry and research and would like to work with members to ensure this continues to grow in the UK and worldwide. I have been actively involved in the Institute since joining, by being part of the Accreditation Committee and as the Chair of this committee for the past five years. I have now handed that baton over to Andy Augousti but will remain actively involved in accreditation.

Reflecting on current advancements, one of the main topics generating interest in emerging technologies is digitalisation, which can refer to the digitalisation of assets, and therefore processes, but can also refer to organisational strategy and knowledge and encompasses the whole socio-technical organisational system. Businesses are working towards a digital future at a rate appropriate to the organisation with the view to optimisation, efficiency of process and sustainability being a few of the major drivers. Indeed, associated with this area is the term 'Big Data' which has seen at least a 10-fold growth in scholarly articles in the past five years. It is therefore imperative that we are training the next generation of engineers with the skill sets to meet the industry challenges ahead.

Looking back at the history of the Institute, which when first formed was known as the Society of Instrument Technology, shows that its purpose was to advance instrument technology by "the dissemination and coordination of information relating to the design, application and maintenance of instruments". This statement is as true today as it was in 1944. There was also the recognition that the society was a learned society with the aim to promote technical education to those working in the industry or with the desire to do so. This is still the ethos of the Institute today. In 1988 Recognition by the Engineering Council allowed the InstMC to confer the titles of CEng, IEng, EngTech and EurIng to appropriately qualified members. Central to this is the requirement to be actively engaged in lifelong learning and registrants are required to provide evidence that they are engaging in CPD to maintain their registration.

Membership of the Institute has many benefits for all and I would encourage current members to continue or become actively involved in their Local Section, or why not become a member of one of the Special Interest Groups (SIGs)? Take some time to explore the InstMC website and see how the Institute can help and support you and how you can support the work of the Institute. Most of all please encourage all who have an interest in Measurement, Control and Automation to join and make the InstMC their PEI of choice.

Finally, I look forward to meeting many of you in the months to come and working with you to grow our Institute.

Sheila Smith President, Institute of Measurement and Control

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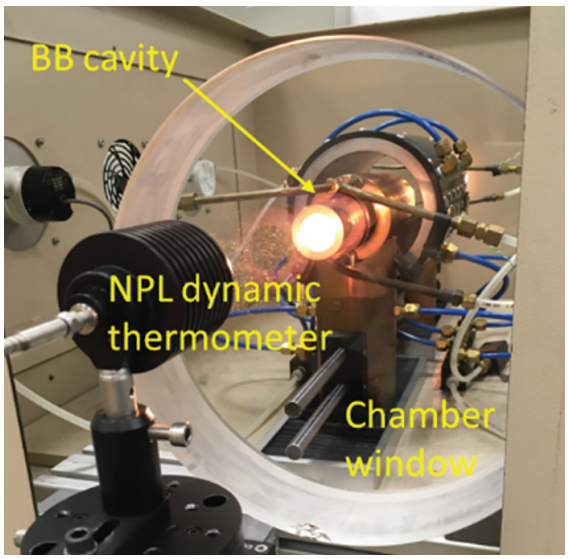
DYNAMIC THERMOMETRY AT NPL



The EMPIR DynPT project, under its full name of "Development of measurement and calibration techniques for dynamic pressures and temperatures", had the overall objective of improving the accuracy and reliability of pressure and temperature measurements in dynamically changing conditions.

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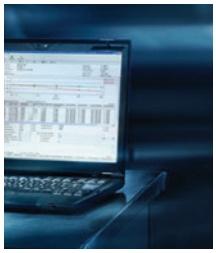

The InstMC Companion Company Scheme has been running since 1992, enabling companies to raise their profile amongst our membership of 3,000 professional engineers in the measurement, automation and control sectors.

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A documented laboratory management system, ISO/IEC 17025 style. Is it an unnecessary complication and time-wasting costly overhead? Or a simple way to ensure high quality consistently valid results in your measurement work?

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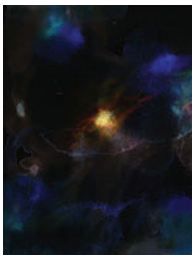

Cover Image Credit:
One Star Awake' by Diana Scarborough for the album 'Sunconscious' by the Sounds of Space Project (https://soundsofspaceproject.bandcamp.com/)

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DOWN THE RABBIT HOLE: WHERE ART MEETS ENGINEERING

As a featured subject in the '101 Jobs that Changed the World' campaign run by UK Research & Innovation, Artist-Engineer Diana Scarborough explains how she successfully fuses art and science to create multimedia artworks.

Taking the truth of data and the imagination of the artist has led to successful collaborations with organisations including British Antarctic Survey, University of Cambridge (Department of Chemical Engineering and Biotechnology), the School of Music at the Australian National University and the Royal Central School of Speech and Drama.

Diana is an ideas-led artist with a passion for cross discipline art and engineering engagement. Working with a multimedia palette, whether paint, print, sculpture, sound, film dance or installation, allows her the freedom to hone her ideas for a range of audiences and spaces. She believes her role as an artist is to take art out of the gallery and be a catalyst for cross discipline conversations while continuing to build fresh connections between art and science.

After moving to Australia in childhood, Diana trained as a technical officer at a naval dockyard in Sydney, refurbishing and calibrating radio, RADAR and SONAR equipment from ships and submarines. This 4-year programme emphasised hands-on- training which has been fundamental in her success as an engineer and an artist. She was one of the very few women in the programme and on completion moved back to the UK, accepting an R&D role at electronics company Cossor, who specialised in RADAR and IFF design. Working on special projects and designing circuits, particularly in leading-edge microwave technology, she also completed an Electronic Engineering degree at York University, continuing to work as an engineer with them during breaks.

During her final year, as part of an archaeology-electronics project, Diana devised a 'magic wand' that could be placed anywhere in a dig to give 3D positioning information down to the centimetre. The superfast technology required to realise the accuracy didn't exist on a commercial level, so she re-engineered it using sound transmission instead. On completion of her degree, she was offered a position as an instrumentation engineer specialising in HMI design for control and safety systems on an oil platform design team. This experience, and the consultancy work that followed, led to her being recruited for an overseas engineering position in the US; as a telecommunications/control systems lead engineer on numerous international oil and gas projects

Diana's project and systems career as an engineer has been key in formulating her art-meets-technology approach to creation. A running theme being the visual communication aspect. Whether through design or process, it sowed the seeds for her later incarnation as artist.

After a 7-year career in the U.S, Diana moved to the Netherlands. After applying for what she thought was a short Saturday morning art class, was selected by a panel for a part-time art degree course at the Royal Academy of Art in The Hague. Not only embarking on a life changing discipline, she had to adapt to learning in an environment where she didn't speak the language! Here she was forced to 'put everything out there' and be 'her own client' but feels the language barrier and her life experience helped bring out her inner creativity.

Diana says: "My work is informed by everything I've done as an engineer and I think that's why my art practice is collaborative, multi-media and project-based. Engineering is creative, not just science and maths. Like art, it is making something new that previously didn't exist. Prototyping, experimentation, budget, schedule and a public launch is the same for art as it is for engineering."

Wanting to continue creating as an artist, Diana completed a part-time MA in Printmaking at Anglia Ruskin University in Cambridge while teaching 3D art and design and digital art. Fascinated with visualising science and data, as an independent artist, she develops projects and builds teams allowing her to create immersive installations. She utilises the latest projection and software technologies, to bring scientific concepts to the public.

MA Printing analogue wave

Visitor triggering a soundscape response

SENSORS to trigger the radio stations

Radio Dials (2016) – Interactive Art Installation using Real Time Location System (RTLS) -

Radio Dials was an art installation recalling the beauty and loss of analogue radios as soundscape and digital print. Inspired by Diana's affection for valve and transistor technology and the transfer of analogue radio transmission to digital, it was a commentary on the personal impact of this loss. It highlighted places on the radio dials that would no longer exist, particularly their iconic fonts, and visitors could enjoy the crackle of tuning into a station, morse code and radio stories. The use of a radar base RTLS system, where visitors activated the soundscapes, simulated the sounds of 'tuning in' to find a radio station. This was a unique use of technology created by Ubisense, a Cambridge-based company. Diana's ability to inspire cross-disciplinary participation, through her passion, knowledge and communication skills is a key characteristic of all her projects.

Diana Scarborough (far right) with Dr Nigel Meredith and dancers, Becky Byers & Felix Denton

Sounds of Space Project – An Art Science Collaboration (2017 to current)

Sounds of Space Project is a multidisciplinary collaboration bringing new meaning to space through events, films, publications, performances, artworks, albums and even as wearable sound art!

Diana began working with Nigel Meredith, a research scientist with British Antarctic Survey (BAS) in 2017, later inviting composer Kim Cunio to join the group. Her first film used the footage of the Aurora Australis, taken by a BAS scientist, manipulated on the beat with space weather radio data converted as sound. Nigel had not worked with an artist before but was motivated to work with an artist -engineer as she offered a unique and exciting perspective on the scientific data he produced. On later projects, different space sounds from our solar system and beyond were used; including pulsars, which sound like drum beats, and black holes colliding.

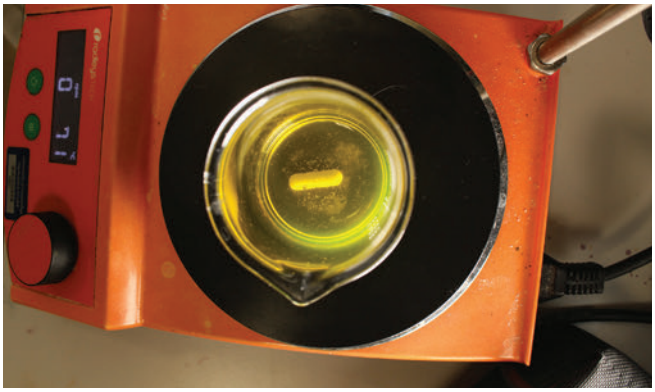
An album 'Celestial Incantations' became that sonic and visual journey from Earth to beyond the galaxy as well as a multimedia performance with dance. 'Aurora Musicalis' , an album and film combines a day of Earth 'sounds' derived from the VLF receiver at Halley Research Station with piano played at the range of the human heartbeat.

Sounds of Space Project has been included in festivals, conferences and exhibitions including the prestigious Venice Biennale, a world leading arts festival, and Bluedot, a science-music Festival at Jodrell Bank.

Sounds of Space album covers

Down a Rabbit Hole (2023)

Diana's current project is an art film created in response to an international call out for art-science inspired works for an online exhibition with a theme GUI/GOOEY (GUI is Graphic User Interface intersecting with the sticky world of biology). Alluding to the world of AI, HMI interfaces and Alice in Wonderland, the film is a playful take on the exhibition theme. Drawing on her engineering fascination with data, technology and using footage from a nano-science experiment as source material, Diana has created an art film where her cross-discipline career is evident, as she looks to recreate the wonder, beauty and creativity of both disciplines.



Source footage: Nanoscience experiment
Credit A. Melekhova

Animated final image from the video

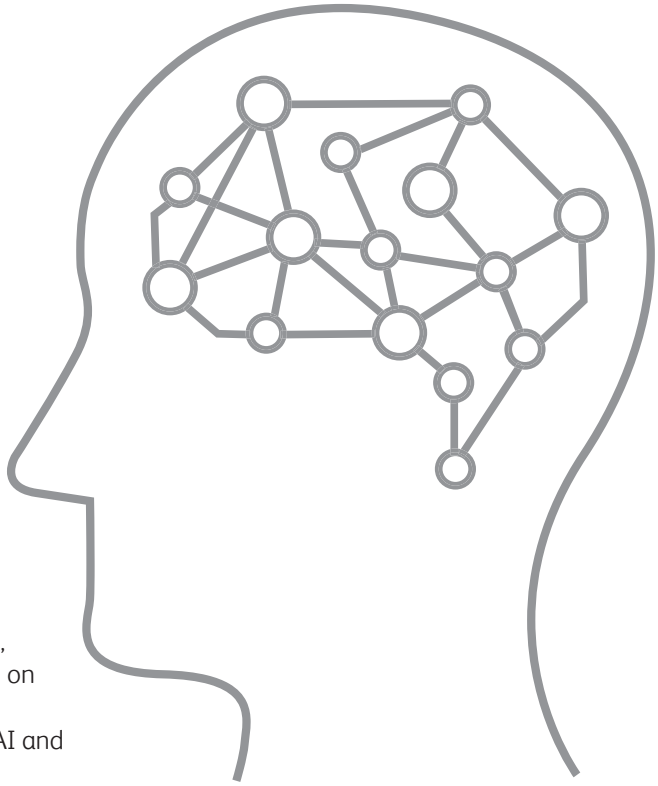
For more information on the work of Diana Scarborough (Johnston) visit https://dianascarborough.co.uk/

Plexus projects: GUI/GOOEY online exhibition will be available for public viewing from the end of February 2023. https://www.plexusprojects.org/

Visit https://www.bas.ac.uk/project/sounds-of-space/ to find out more about the Sounds of Space collaboration with British Antarctic Survey.

> Engineering is creative, not just science and maths. Like art, it is making something new that previously didn't exist

AI ETHICS AND MACHINE LEARNING



BY MAYA CARLYLE, PRINCIPAL ENTERPRISE ARCHITECT, NATIONAL PHYSICAL LABORATORY

How is our understanding of ethical AI evolving?

As Artificial Intelligence (AI) technology becomes more advanced, researchers and practitioners are increasingly recognising the need to consider ethical issues related to its development and use. This includes issues such as fairness, transparency, accountability, and the potential negative impacts of AI on society. There is also a growing awareness of the need to involve diverse perspectives in the design and governance of AI systems, including those of marginalised communities. Additionally, there is ongoing research and development in the field of "Explainable AI" (XAI) which aims to make AI systems more transparent and understandable to human users, in order to promote trust and accountability.

Who is currently researching ethical AI?

At the National Physical Laboratory (NPL) where we focus on metrology (how to measure) and uncertainty (our confidence in our measurement), I am currently looking from the perspective of ethical AI with a focus on bias in data sets that are used to train Machine Learning (ML) models. There are many different centres around the world also looking at ethical AI, including:

- The AI Ethics Lab at the University of Cambridge, which conducts research on the ethical, legal, and societal implications of AI and machine learning.
- The AI Ethics and Governance Research Lab at IBM Research, which focuses on the responsible development and deployment of AI.
- The Partnership on AI, a non-profit organisation founded by tech companies such as Google, Facebook, and Amazon, which conducts research and engages in public education and policy advocacy on the ethical use of AI.
- The AI Ethics Lab at Stanford University, which conducts research on how to design AI systems that are robust, fair, and aligned with human values.
- The Center for Human-Compatible AI at the University of California, Berkeley, which focuses on the long-term alignment of AI with human values and interests.
- The Alan Turing Institute, which is the UK's national institute for data science and artificial intelligence, which conducts research on responsible AI, explainable AI, and AI governance.
- The AI Ethics Lab of the AI Now Institute at New York University, which conducts interdisciplinary research on the social implications of AI.

How are they measuring ethical AI?

Research over the globe is still tackling how to approach measuring AI Ethics and there is no general census yet. However, there is ongoing research to develop and refine these methods, some of which include:

- Fairness metrics are used to evaluate the fairness of AI systems with respect to different groups of users. For example, a fair machine learning model should not discriminate against certain groups based on their race, gender, or other protected characteristics. Some examples of fairness metrics include demographic parity, equal opportunity, and equal accuracy.
- Explainability metrics are used to evaluate the transparency and interpretability of AI systems. For example, an explainable AI system should be able to provide clear and understandable explanations for its decisions and predictions. Some examples

of explainability metrics include feature importance, decision tree visualisation, and LIME (Local Interpretable Model Agnostic Explanations).

- Human-centred metrics are used to evaluate how well AI systems align with human values and preferences. For example, a human-centred AI system should be designed to maximise human well-being and autonomy. Some examples of human-centred metrics include user satisfaction, trust, and preference alignment.
- Impact assessment aims to evaluate the potential positive and negative impact of an AI system on society. It is usually done by analysing the system's potential consequences on different groups of people, and the environment, and the assessment should take into account the economic, social, political, and environmental factors.

How does uncertainty and metrology factor into the world of ethical AI?

Overall, applying uncertainty and metrology to ethical AI can help to improve the transparency, reliability, and accountability of AI systems. By providing more information about the level of uncertainty in the AI's predictions and decisions, and by relating the AI's measurements to reference standards, it can increase the trust and confidence that users and decision-makers have in the AI system.

- Uncertainty quantification: the process of estimating the level of uncertainty in the predictions or decisions made by AI systems. It can be used to identify situations where the AI system is less reliable or less confident in its predictions, and to inform users or decision-makers about the level of uncertainty associated with the AI's output. This can be useful in situations where the AI system's predictions or decisions have significant consequences, such as in healthcare, finance, or criminal justice.
- Metrological traceability: the process of relating the measurements made by an AI system to a reference standard, in order to ensure their accuracy and comparability. This can be useful in situations where the AI system's measurements are used to make important decisions, such as in autonomous vehicles, industrial control systems, or scientific experiments.
- Uncertainty-aware decision making: the process of considering uncertainty in the predictions or decisions made by AI systems and how it can affect the outcome of the decision. This can be useful in situations where the AI system's predictions or decisions have significant consequences, such as in healthcare, finance, or criminal justice.
- Explainable AI: the process of making AI systems more transparent and interpretable, so that the decisions and predictions made by the system can be understood and justified. This can be useful in situations where the AI system's predictions or decisions have significant consequences, such as in healthcare, finance, or criminal justice.

Are humans biased?

Humans have a narrow view of the world and deeply defend that view. We use bias as a tool to gain social advantages, from aligning with a political party or building alliances, which helps in tasks such as getting our children into the best schools and improving the propagation of our DNA.

Figure: Image generated by the author on Dall-E AI image generation tool, showing a child in a slum crying when told off by a robot.

It is often when we travel and experience other cultures that we can then reflect on the constraints we identify in contrast to our own culture and begin to question them for correctness. Societies build up culture over a long period of time, these then move into beliefs which then impact how our societies operate and differentiate themselves.

Humans are inherently biased due to the way our brains process information and our past experiences. Biases can manifest in a variety of ways, such as cognitive biases, which are systematic errors in thinking that lead to particular judgments or decisions; implicit biases, which are unconscious associations that affect behaviour; and explicit biases, which are conscious beliefs or attitudes that influence behaviour.

Humans can also be biased in their decision making, which can lead to discrimination and other negative impacts on society. For example, research has shown that people may unconsciously discriminate against individuals based on race, gender, sexual orientation, and other factors. These biases can be reinforced and perpetuated by societal factors, such as stereotypes and systemic discrimination.

It's important to note that bias is not always negative and can also

Optical analysis for a greener future

Kevin Fernandes, Process Analytics Sales Engineer for Endress+Hauser Ltd, discusses applications for Raman spectroscopy in carbon capture and hydrogen analysis.

As the world looks to cut greenhouse gas emissions, carbon capture and the production of low-carbon hydrogen have critical roles to play. Carbon capture permanently removes CO_2 produced by industrial processes or burning fossil fuels from the atmosphere and stores it underground. Increased use of hydrogen as a fuel, on the other hand, prevents carbon emissions at the outset because hydrogen emits only water when burned or used in a fuel cell, although the production process can release carbon.

Carbon capture requires careful monitoring for process control and optimisation as well as reducing total costs of ownership and safety risks. Chemical absorption based on amine solvents is considered to be the most mature technology and commercially feasible method for carbon capture. Key to optimising this process is solvent management, including CO_2 loading and amine strength, and Raman technology from Endress+Hauser offers a fast and robust solution.

Process optimisation

Raman technology has numerous benefits for carbon capture. The first is replacing time-consuming off-line analysis such as titration (more than two hours for sample preparation and measurement) with in-line monitoring, which gives measurement results in less than one minute without human interference. As well as reliably predicting the total CO_2 and amine concentrations in changing process conditions, Raman monitors the variation of solvent quality and degradation, thus minimising solvent loss, and the performance of the absorber, desorber and other equipment. All this minimises downtime for the carbon capture plant and enables plant operators to optimise their processes.

Utilising Hydrogen

Hydrogen can be produced from natural gas or even coal with virtually no greenhouse gas emissions by trapping the resultant CO_2 underground. Even more environmentally friendly is so-called green hydrogen generated by electrolysis. This produces no carbon emissions but is an expensive process. Blending green hydrogen with natural gas is a way to generate heat and power with lower emissions than using natural gas alone. These blends can be used for on-site consumption or sent out into the existing gas grid.

However, hydrogen is highly combustible, and blending hydrogen with natural gas poses an increased risk of explosion. You also need approximately three times the volume of hydrogen compared to natural gas to get the same amount of energy. Therefore being able to accurately measure how much hydrogen has been mixed into the stream is vital.

Real-time measurement

Endress+Hauser's Raman Rxn5 analyser delivers real-time, reliable composition analysis of rapidly changing gas turbine fuels blended with hydrogen by taking simultaneous readings from up to four probes located in different parts of the process stream. Reliable, nearly instantaneous feedback about the integrity of the gas blend helps to prevent too much hydrogen being added, which could damage the combustion system.

With the potential for four-channel availability and fibreoptic lengths up to 150 metres, a Raman analyser can also monitor hydrogen composition over a long length of pipeline after being injected. This data can be used to monitor the mixing quality or to corroborate predictive models of how hydrogen will behave in the gas grid at scale.

When combining Raman spectroscopy with a comprehensive control strategy, companies can maximise the use of carbon capture and hydrogen without compromising safety or efficiency, ultimately reducing overall carbon emissions for a sustainable future.

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People for Process Automation

be positive. For example, a positive bias towards certain groups can also lead to discrimination and negative impacts on society.

It's also worth mentioning that recognising and acknowledging one's own biases is an important step towards overcoming them. Various tools and techniques have been developed to help individuals identify and mitigate their own biases, such as Implicit Association Tests (IAT) and other debiasing techniques. Additionally, organisations and institutions can also implement policies and procedures to minimise the impact of bias in their operations.

Why are Machine learning models biased?

Bias is introduced into AI models via several routes:

1. Modelling topic - AI is often used to model human activities and if humans are biased then the AI is going to model a biased hypothesis – e.g., evaluating parole for male and female offenders equally, based on "no shows" to court appearances; but without accounting for additional societal pressures on women to provide extended care to parents and children.
2. Biased data - Training data sets might not be representative of the population they are to model, e.g. Amazon AWS trained their internal recruitment system on existing employee resumes, but the existing employee demographic was heavily male biased unlike the external resource pool.
3. Hidden bias – There may be hidden biases within the data that correlate to give additional weight to one part of the population, e.g., a gender bias data type might include weights of products.
4. Incorporating emotion – providing algorithmic catch-alls via introduction of emotion as a decision-making tool introduces bias. See Reference 1. The Risks of Using AI to Interpret Human Emotions.
5. Incomplete data – data set may be representative but the sample size may be too small and give unfair weight to some data points.
6. Biased data sets – Some data contains hidden biased, e.g. training an AI to reproduce renaissance paintings will be biased towards white faces See Reference 2. When AI Training Fails.
7. Drift – what we train our models on today will encapsulate this moment in time of our understanding, but many environments are forever evolving. Over time our model may stop reflecting the world which it intends to model, we call this drift. This is also an area sometimes exploited to cause an AI to fail by deviant users. See Reference 3. Microsoft Shuts Down AI Chatbot.

Why is it important to remove bias from Machine learning models if humans are biased?

AI is very similar to how a calculator augments our ability to do maths - you don't need to send your children to Kumon when you can give them a pocket calculator. In the same way AI is symbiotically entering many of our lives from Chinchilla and Chat-GPT3 writing our children's assignments to predicting climate changes from global warming.

AI Models are being used to enhance areas that were previously the domain of ordinary algorithms encapsulating human rules used to govern us. Like those supporting decision making by court room judges. The issue today is visibility and understanding of the way the AI Model makes its decisions, which can have devasting consequences when it comes to automating our legal decisions.

Identity is something that is very important to us all, but when a person attempts to sign into a computer system using face recognition, only to find that the system is confused by melatonin levels, it can lead to parts of our society feeling their identity has been erased.

Finally, we place our trust in large organisations and trust they will protect us from these AI biases. However even the leading companies get this wrong, as we can see in the image below generated by Nvidia where it used its opensource transfer learning libraries to paint three prominent black people in the style of renaissance art using transfer learning. Something that could be a public relation nightmare for a company trusting that this transfer learning machine learning model will be unbiased (Reference 2. When-ai-training-fails).

Figure: When AI fails catastrophically, in the example above, we see Nvidia's model repaint Barack Obama, Oprah Winfrey and Laverne Cox in a renaissance style using transfer learning.

References

1. The Risks of Using AI to Interpret Human Emotions (hbr.org)
2. When-ai-training-fails (www.digitalstrategyconsulting.com)
3. Microsoft shuts down AI chatbot (www.cbsnews.com)

See our research plans for the next 10 years at https://www.npl.co.uk/metrology-research-roadmap and find out how you can get involved.

Q&A

Anne Nortcliffe

Under the spotlight this issue is **Dr Anne Nortcliffe**, Head of School of Engineering, Technology and Design, Canterbury Christ Church University.

> I enjoyed working with engineers, and realised my actual future may not lie in chemistry but in control and measurement engineering.

What was the root of your interest in Engineering?

I am a third-generation engineer. Both my grandfathers were engineers who, before the second World War, studied at the Institute of Technology which is now Salford University. One was an electrical and electronics engineer and the other an optical engineer. My father originally studied physics at Liverpool University and then switched to metallurgy and gained a PhD in in researching manganese steel. My uncle's route to engineering was actually an apprenticeship with Unilever. My own route was non-direct, starting as a primary school student spending my Saturdays at Sheffield Polytechnic with my father in the materials testing labs. My interest in science grew in a school with very good facilities for technical drawing, woodwork and metalwork. I was one of four girls out of 60 boys who completed O level in metalwork and woodwork, and I chose to pursue a traditional science education of A levels in chemistry, physics and maths. I gained a place at University of Sheffield and completed a degree in chemistry, however, one of my summer vacations sparked my interest in metrology. I worked with a team of control and instrumentation engineers and chemists at Nuclear Electrics simulation research labs in Manchester, replicating the boiler systems that exist in nuclear reactors. We ran physical simulations of operations of the boilers, and the water chemistry. We monitored and measured the chemistry of the water in and out of the system and predicted when certain pipes, actuators or instrumentation would fail on these rigs. These physical simulations enabled the team to predict lifespan of the boiler and, how to create water chemistry that would extend the rig's lifespan. I identified that we needed to adjust two system variables to achieve one output, which could not be identified in 2D and needed a 3D map to identify optimum conditions. I developed a programme to generate a 3D graphical analysis solution so we could identify an optimum solution: a measurement and control problem. I enjoyed working with engineers, and realised my actual future may not lie in chemistry but in control and measurement engineering. I completed my chemistry degree and applied for a masters in control engineering and instrumentation at the University of Bradford, and was fortunate to receive a Welcome Plc scholarship that supported converting scientists to be control engineers.

After graduating I worked in industry developing an AI system for supporting distillation column operation start up, shut down and safe operation. The University of Huddersfield asked if I would be a sessional/associate lecturer so I took holiday from my day job to teach robotics and manufacturing. It was an incredible experience, which I enjoyed, and one that others recommended I pursue as an academic career route. To achieve this, I needed to go back to University to gain a PhD, which I completed at the University of Sheffield. I went on to an academic post at Sheffield Hallam University in 2000 and, in 2017 accepted the post of Director of Engineering at Canterbury Christ Church University. to create a brand-new inclusive engineering education facility and research facility. In 2018 I was made

the head of school of engineering, technology and design. The new school creation has been likened to a business start-up enterprise and the team I have created have worked out and solved numerous challenges. The team consists of 38% female academic staff, 58% black Asian academic staff, and the technical team is equally diverse. It is very important for the teaching team to mirror student diversity and, this year we recruited 21% female and 35% black and Asian students to our engineering courses.

What is your vision of Engineering in Britain for the next ten years?

We have to create a more sustainable future for the world, and that means no longer shipping goods around the world that can be produced locally with a reduced carbon footprint. Where we have to ship, we need to use sustainable fuels like hydrogen or electricity, so engineers need to consider different approaches to how we operate. Our current economy is based on a six-month economical model and this needs to change to consider long term future growth patterns and impact on the environment and society. At Canterbury Christ Church University, we are educating the next generation of engineers to come up with solutions that are fit for all of society. I'm quite positive that our graduates have the potential to solve problems and challenges we're dealing with at the moment with consideration to climate change and all of UNESCO sustainability goals. As engineers globally we need to reflect, educate, apply critique and consider all our solutions from aspects of economics, time, quality, sustainability and safety. It is more than the TQM triangle: it is a diamond model with inclusion at the heart. We have to engineer from all of those perspectives now and that's not just in Britain, that is across the world.

What should the UK government do to address the shortage of UK engineers?

We need to address the disparity of maths education across cities and counties. I published a paper at the Advance HE Conference in 2019, showing there is a significant disparity of access to 16 to 18 education in mathematics, physics and chemistry across Sheffield, and South Yorkshire - equally true in Kent and Medway. I do welcome the Prime Minister's recognition that we need to create an educational system that supports maths education to 18, but it needs to be mathematics that is contextualised and relevant to students' career aspirations. Engineers need applied mechanics, statistics, integration and calculus, but we are missing out on so much potential talent: students who could be engineers; bright articulate young people but do not have access to maths or physics A levels or good quality T level engineering education at a FE college. Now this isn't a quick fix. We cannot magic engineering, physics, computer science and maths teachers out of thin air. This is getting more serious, as all postgraduate teaching diploma courses in maths, physics and computer science are only 1/3rd full in 2022-23. If this continues it's not even a question of having sufficient maths teachers for A levels or other 16 to 18 mathematics education; we will not have enough teachers for GCSE mathematics.

We are maths confident as engineers. It is actually time to give back. We need to help educate the next generation in maths and to develop maths confidence in both teachers and students.

What do you do in your free time to relax?

Free time I wish! I run anything between 10 to 15k a day with my dogs. I sew and design clothes and I go hill walking.

Given one wish what would that be?

To be honest a sustainable efficient transport solution for travel long distance across the UK or abroad. If it was possible scientifically, safe and sustainable I would love the Star Trek teleporter! Although Zoom, Teams and Slack have enabled us to work differently, remotely, more efficiently and more sustainably, some things work much better face to face and hands-on. I now often need to be face to face in multiple places and travel takes up huge amount of my time.

SOUTH WEST ENGLAND INNOVATORS COLLABORATE TO DEVELOP ENHANCED SOLUTIONS FOR SEAGRASS MONITORING

A new, non-invasive method to measure and monitor seagrass biomass on the seabed around England's South West coast is being developed as part of an ongoing, collaborative project.

The innovative new technique is currently being trialled by local companies HydroSurv and Valeport, working with the University of Plymouth and Natural England, and supported by a grant of more than £266,000 from Innovate UK's Smart Grants programme.

It builds on the concept of the acoustic reflectivity of seagrass providing valuable information to characterise submerged aquatic vegetation. A full-stack solution consisting of a Valeport VA500 altimeter installed onto a HydroSurv REAV-28 Uncrewed Surface Vessel (USV), specifically developed for this project, provides a non-invasive, cost-effective platform to survey seagrass sites. A large, validated signal library and deep learning algorithm, developed by the University of Plymouth, deciphers the survey data to predict seagrass distribution. The data is visualised and interpreted within a cloud application created by HydroSurv.

The USV platform facilitates accurate repeat surveys that can be compared to monitor temporal changes in seagrass coverage for

the planning of protection and regeneration projects at biodiversity-rich worksites. The full solution, which was demonstrated successfully to project stakeholders last year, is set to change the way seagrass meadows are monitored in the future, complementing traditional diver surveys to cover much larger areas and enable rapid re-survey work as required.

Fiona Crouch, Natural England ReMEDIES Project Manager said: *"To effectively conserve and restore seagrass meadows we need innovative solutions to enable cost effective, repeatable surveys of established meadows, plus areas being restored through projects such as ReMEDIES, to monitor change. I'm really excited to see where this new technology will take us in supporting our seagrass conservation efforts."*

HydroSurv, Valeport and the University of Plymouth form part of a fast-emerging South West England maritime innovation cluster. The project partners are engaging with the Environment Agency and Natural England to develop the solution further, with a second phase of demonstrations planned for September.

David Hull, Founder and CEO of HydroSurv said: *"Staying true to our values of ocean and environmental stewardship, the work being carried out within this collaborative project will directly translate into impact addressing UN Sustainable Development Goal 14, 'Life below water'. The ability to provide blended, non-invasive solutions that rapidly acquire, process and visualise the coverage and density of seagrass meadows is central to improving our understanding of these vital ecosystems and delivering regular and repeatable resurveys instride with the needs of coastal practitioners."*

The VA500 altimeter, which uses state of the art signal processing, was customised by the instrument manufacturer for this project.

Jim Gardiner, Research Scientist at Valeport said: *"The VA500 altimeter was developed to deliver reliable underwater range measurements in a compact, robust package. Working with University of Plymouth and HydroSurv, custom firmware was developed to deliver low noise, high quality, correlated acoustic profiles at up to 10Hz to enable deeper analysis, exploration, mapping and classification of the acoustic information gathered by the VA500."*

Dr Tim Scott, Associate Professor of Ocean Exploration at the University of Plymouth, said: *"As part of the project, the application of deep learning algorithms for the acoustic detection and characterisation of seagrass beds has introduced improved accuracy and efficiency over more traditional techniques. When combined with the advantages of lightweight autonomous survey platforms, this new combined survey solution introduces a step change in accurate and repeatable seagrass mapping."*

Seagrass meadows are a crucial part of the marine ecosystem and are increasingly being recognised for their essential carbon capture abilities. As well as being as effective at storing carbon as woodland, seagrass also provides vital habitat for young fish, seahorses and jellyfish. It additionally cleans surrounding seawater and helps to stabilise the seabed, thereby reducing coastal erosion.

The UK has lost around half of its seagrass since the mid-1930s due to factors ranging from seagrass wasting disease (SWD) and pollution to physical disturbance from the anchoring, launching and mooring of leisure boats. The £2.5 million LIFE Recreation ReMEDIES partnership 'Save Our Seabed', led by Natural England and funded by the EU LIFE Programme, was launched in July 2019 to protect and restore these sensitive habitats.

Article originally published by Ocean Robotics Planet https://oceanroboticsplanet.com/

HydroSurv REAV-28
Uncrewed Surface Vessel
Credit: Valeport

Valeport VA500 Altimeter
Credit: Valeport

> I'm really excited to see where this new technology will take us in supporting our seagrass conservation efforts.

Inst MC

CEng Chartered Engineer

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(CEng) develop solutions to engineering problems using new or existing technologies, through innovation, creativity and change. May be accountable for complex systems with significant levels of risk.

What is professional registration?

- **Recognition** through membership of a relevant Professional Engineering Institution (PEI), that an individual's knowledge, understanding and competence have been assessed and confirmed through Professional Review.
- **Verification** that they have attained the standard required for inclusion on the national register in the appropriate category of registration.
- **Commitment** by an individual to maintaining their competence through Continuing Professional Development (CPD), professional behaviour for the benefit of society and their commitment to the engineering profession.

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- Competent workforce.
- Competitive advantage.

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For further details and application forms, please visit our website or contact the Director of Membership & Registration on +44 (0) 20 7387 4949 Ext 3 or email: membership@instmc.org

Scan QR Code to apply for professional registration via InstMC

HOW NEXT GENERATION, NON-INVASIVE ULTRASONIC CLAMP-ON FLOWMETERS ARE HELPING OPERATORS AVOID TIME-CONSUMING MAINTENANCE CALLS

In the often harsh realities of the industrial environment, cutting edge clamp-on ultrasonic technology is proving its worth to chemical plant operators, offering a permanent, maintenance-free measurement solution that saves time and makes everyday work just that little bit easier.

Ultrasonic flowmeters use sound waves to measure the flow of liquid within the pipe. Alternating between transmitting and receiving pulses of ultrasound waves between two transducers, the flowmeter can accurately and reliably determine the flow rate, and because measurement is carried out safely from outside the pipe, there is no risk of contamination or leakage.

Answering the plea for a maintenance-free solution

Specialising in the production of nylon salt and its intermediates, which are needed for the production of polyamide 6-6, a major French chemical manufacturer was looking for an alternative and highly reliable flow measurement and verification of flow direction on a liquid MGN transfer line between the jetty and storage tank. They needed a solution to the headache of time-consuming maintenance calls due to failing existing transducers that were unprotected and exposed to the elements. The acoustic coupling already in place consisted only of grease, and the measurement often failed because the outdated ultrasound technology was no longer able to penetrate the line. The coupling grease was either washed away by rain or dried out in the heat, rendering the measurement completely unreliable.

Regularly having to intervene unexpectedly during a filling process to carry out maintenance, plant operators turned to FLEXIM to install brand new clamp-on ultrasonic technology, capable of being easily and permanently attached to the outside of the pipeline with no need for any preventative maintenance.

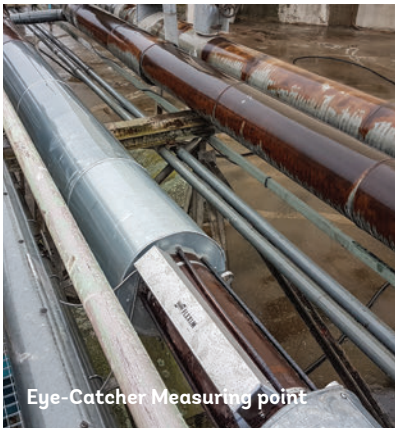
Reliable and robust

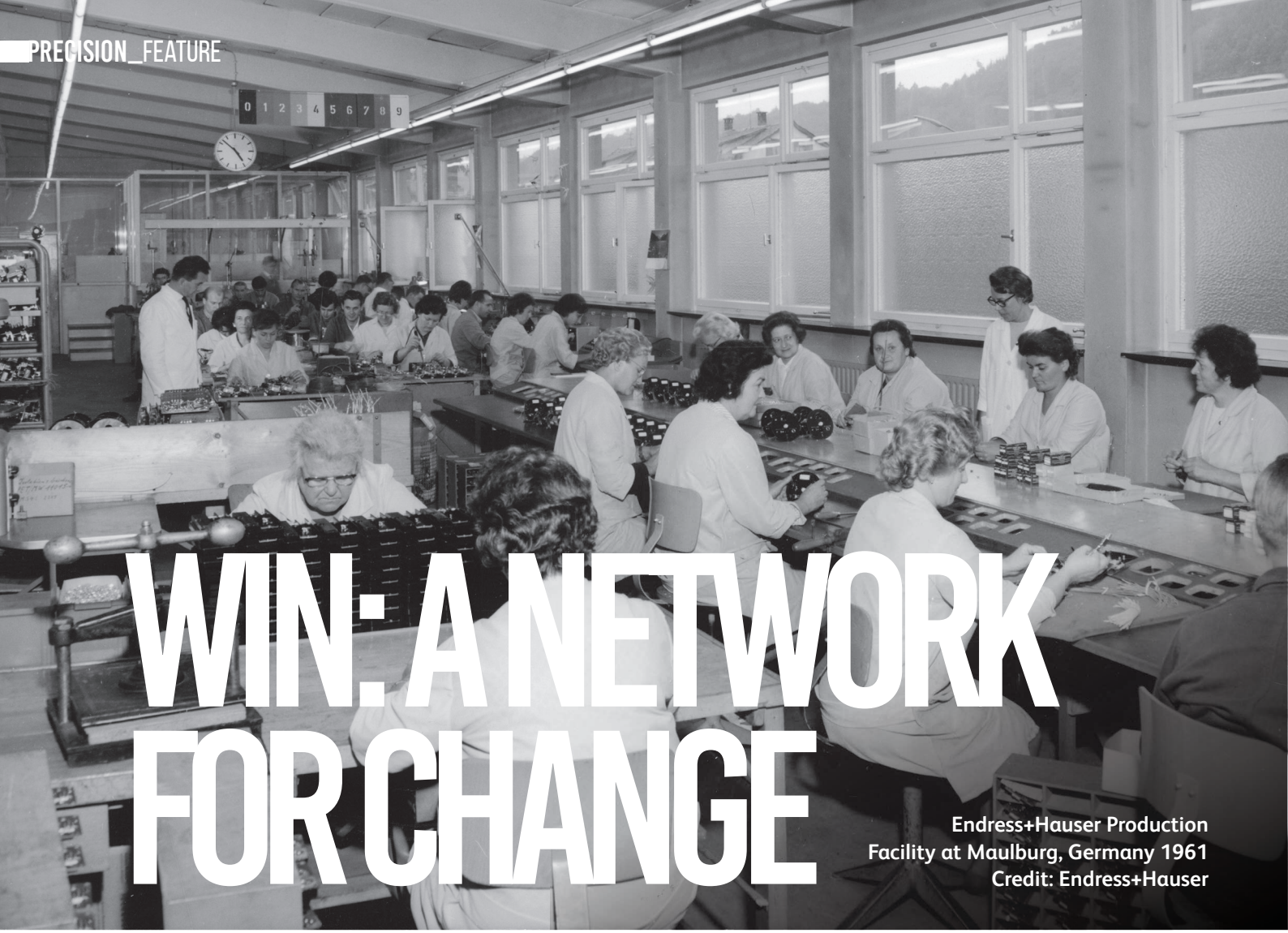
Using permanent acoustic coupling pads made of temperature and corrosive environment resistant Viton™ material, a virtually indestructible stainless steel mounting rail ensures permanently stable attachment of the transducers to the pipeline. This is securely protected against impact and any adverse weather under a robust, solid cover.

More than a year after installation, no maintenance had been required, even with the measurement system exposed to the harshest weather conditions. This is in stark contrast to the old flowmeter, which regularly required the time-consuming application of new coupling grease.

For more information on non-invasive ultrasonic flow measurement in the chemical industry, contact Simon Millington www.flexim.co.uk | sales@flexim.co.uk | +44 (0)1606 781 420

Transmitter-FLUXUS_F721


Eye-Catcher Measuring point



WIN: A NETWORK FOR CHANGE

Endress+Hauser Production Facility at Maulburg, Germany 1961
Credit: Endress+Hauser

A global initiative is breaking down barriers for women in measurement and control engineering.

Despite progress made in recent years, men still far outnumber women in science and engineering roles, particularly when it comes to high-level positions. The measurement instrumentation specialist Endress+Hauser is seeking to address that with its Women's Integrated Network (WIN) initiative. WIN's ambitious goal is for women to comprise 40 percent of the Endress+Hauser workforce by 2030 and represent one-third of management.

The mission is not only to empower and connect the women of Endress+Hauser, but to drive equality and positive change within the organisation and the industry as a whole. Behind all of this is the conviction that diversity makes companies more successful. As more people with different perspectives become involved in the company, the more robust, agile and innovative the organisation becomes. Studies show that initiatives intended to retain and advance women to management have tangible benefits for the entire organisation, such as increased knowledge and skill diversity, increased retention and satisfaction, and improved reputation, all bringing a positive business impact.

Endress+Hauser is a family-owned measurement instrumentation business with headquarters in Reinach, Switzerland, and facilities around the world. Its sales companies and production centres have embraced the WIN initiative, none more so than in the UK. "It's not about promoting women over men, as some people thought in the beginning," explains Claire Jones, Application Consultant – Flow, who is a member of the WIN group in Manchester. "It's about creating an equal playing field for everybody and not being treated differently just because you're a woman. Equally, we want to remove that assumption of tokenism when women are promoted into more senior roles."

After being established in 2015 in the United States, the WIN initiative was expanded to the whole Endress+Hauser Group, including the UK, in 2019. The initiative focuses on areas such as talent acquisition, personal and professional development, leadership, mentoring and networking.

Most recently, four members of the group represented Endress+Hauser at the Central North West InstMC annual dinner in Manchester. "We've met so many interesting people through networking events and it feels like there's a real appetite for

change in the industry," says Claire Jones. "Other companies have got similar initiatives, or they've expressed interest in starting their own groups, so we're getting together to share best practice."

A notable success for WIN so far has been securing improvements to paternity pay. In addition, Endress+Hauser's maternity and paternity policies are in the process of being reviewed to ensure that they're clear and accessible to all, and that there is sufficient information and resources available for all employees. The group also organised an Equality of Voice survey among the Endress+Hauser workforce to ensure that people feel heard, understood and comfortable regardless of their gender, religion or disability. More widely, the group is hoping to further encourage mindset changes in the industry by having more women attend exhibitions, fostering relationships with universities and colleges and even potentially hosting their own event with the InstMC.

Today, one out of every six management positions at Endress+Hauser is held by a woman and nearly one-third of the workforce is female. Getting more women into the industry and into management positions is not just a 'nice to have' for the company but an essential part of their strategic planning. "What we don't want is for talented people – and consequently the business – to miss out on opportunities because they don't feel they will have opportunities to develop with

Representatives of Endress+Hauser UK WIN Team

us," says James Langford, General Counsel and Associate Director for Endress+Hauser Ltd. "It's obvious that we do have an issue with too few women in the industry, which we're very aware of at board level, and the fact that it's part of our long-term strategy shows how seriously we're taking this and how important it is to the success of the business."

The desire to attract more women to the industry is being driven from the top down at Endress+Hauser, where the company founder's granddaughter recently took her position on the Group's Supervisory Board. It's also a matter of pride that the Family Council is firmly in female hands with six women and two men making up the advisory body.

As Claire Jones says, despite progress in recent years, there is still work to be done to level the playing field: "As a woman in a technical role I've had to prove myself. Overall, my experience has been positive, but there's definitely still a need to promote women in the industry and show what we are capable of. That's why we're determined to make the most of this opportunity to have our voices heard." With initiatives like WIN, and more positive role models than ever before, it seems that achieving the target of 40 percent of women in the workforce by 2030 is just the beginning.

Representatives of E+H WIN at InstMC CNW Local Section Annual Dinner

We are pleased to announce that InstMC is currently seeking advice from Endress + Hauser and subsequently hope to launch our own Women's Integrated Network. If you are interested in joining or would like to offer support in setting up this initiative, please email caroline.trabasas@instmc.org.

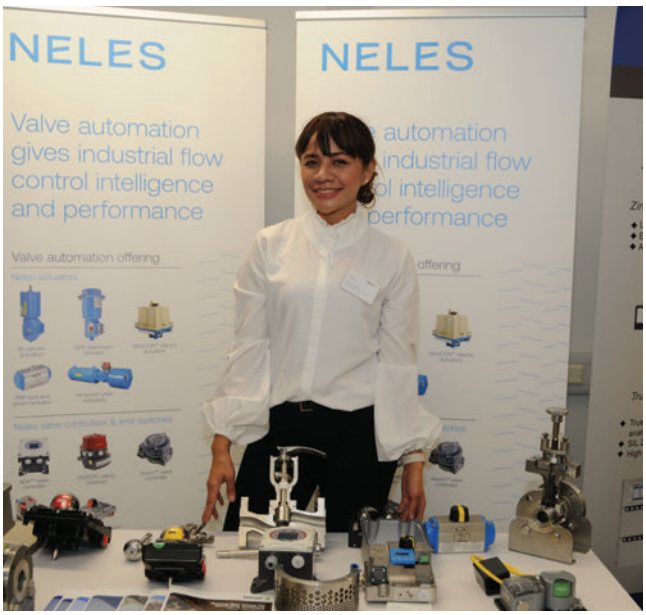
LOCAL SECTION NEWS

NORTH EAST

35th Annual InstMC North East Local Section Control, Instrumentation & Electrical Exhibition

The 35th annual InstMC North East Local Section Control, Instrumentation & Electrical Exhibition was held in November 2022 at Middlesbrough College STEM Centre, attracting 21 exhibitors and 119 visitors from local industries and education & training providers.

Once again, the North East Local Section thanked their exhibitors for their welcome attendance & support with a bottle draw which was won this year by Joanne Dean of Roxby Training Solutions (pictured right).



DYNAMIC THERMOMETRY AT NPL

BY GAVIN SUTTON, PRINCIPAL RESEARCH SCIENTIST, NATIONAL PHYSICAL LABORATORY (NPL)

The EMPIR[1] DynPT project, under its full name of "Development of measurement and calibration techniques for dynamic pressures and temperatures", had the overall objective of improving the accuracy and reliability of pressure and temperature measurements in dynamically changing conditions.

It received funding within the 2017 "industry" call of the EMPIR framework, and thus was co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme. The consortium comprised a total of 11 partner institutions, with 7 National Metrology Institutes, two universities, and two industrial partners.

The DYNPT consortium members

Low uncertainty traceable dynamic temperature measurements are critical during the development and operational phases in automotive, marine and gas turbine engines. Improvements in the understanding of the temperature evolution during the combustion process can lead to improvement in combustion efficiency and reduction in harmful emissions such as NOx, CO and CO2. A typical combustion process is dynamic, with a repetition rate of up to 1 kHz, generating very high temperatures and pressures - up to 3000 K and 400 MPa respectively. To measure the temperature during such a process requires both detailed understanding of the combustion environment, e.g., is the flame clean or sooty, and a thermometer with a sufficiently fast response.

Considering luminous flames that are often found in the combustion of heavy molecular weight fuels

The DYNPT consortium members

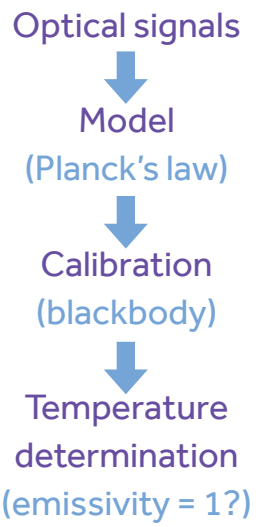
used in the marine sector, NPL's Temperature and Humidity group developed a fibre-coupled dynamic thermometer capable of measuring up to 250 kHz for temperatures up to 3300 K. Calibration of the instrument against an ITS-90 traceable blackbody standard was performed and initial testing on an in-house pyrotechnic facility allowed for instrument optimisation on dynamically varying events. Field trials were performed at Wärtsilä, Finland, a ship engine manufacturer, on a specialised combustion spray temperature rig that simulated combustion under different fuel/pressure environments.

Development of the fibre-coupled thermometer

For optical thermometers, it is critically important to understand how the temperature can be determined from the optical signal measured in the combustion process:

Optical signals: the signal acquired from the dynamic combustion process – the emitted thermal radiance.

Model: the relationship between the emitted thermal radiance and temperature is given by Planck's Law, which describes the emission from a perfect emitter – a blackbody.



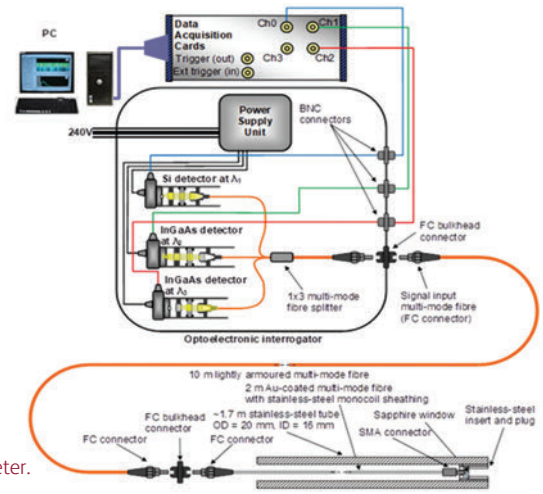
NPL dynamic optical combustion thermometry – signal interpretation

Calibration: the relationship between the measured signal (detector voltage) and temperature is obtained by observing a blackbody standard that has been traceably calibrated to the International Temperature Scale of 1990 (ITS-90).

Temperature determination: measurements are made on the combustion process and the signals converted to temperatures using the calibration. If the measurements at each wavelength are in good agreement, the assumption that the combustion event is similar to a blackbody is confirmed.

The NPL dynamic thermometer is a passive instrument, collecting the thermal radiance from the combustion process via a ruggedised fibre at three discrete wavelengths - 850 nm, 1050 nm, and 1300 nm, using a fibre splitter. The light is then measured by three high-speed Si or InGaAs photodetectors, and the coresponding voltages measured by a 1 MHz data acquisition card and PC.

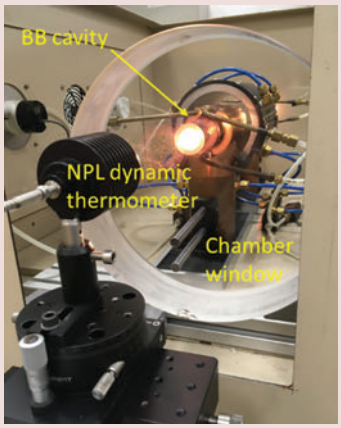
The bandwidth of the system can be adjusted by changing the detector gain – for optimal gain, the instrument bandwidth is 250 kHz. Following calibration, the measured voltages can be directly related to combustion temperature.

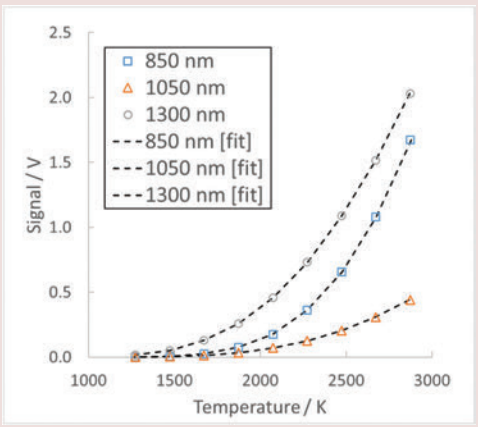


Schematic of the NPL fibre-coupled dynamic combustion thermometer.

Calibration

NPL's high temperature blackbody cavity is used to calibrate the fibre-optic thermometer. The blackbody is adjusted to fixed temperatures from 1200 K to 3000 K, in 200 K steps. At each temperature, an ITS-90 traceable non-contact thermometer (KE-Technologie GmbH LP3 linear LP3) first observes the blackbody and determines its temperature. Then the dynamic thermometer observes the blackbody, and the detector voltages at each wavelength are measured. The process is repeated for other temperatures over the required calibration range. The image to the right shows: a) the dynamic thermometer observing the blackbody – in this case, measurements are made through a thick glass window, later used in field trials; b) the measured calibration voltages at each wavelength versus temperature. An overall calibration uncertainty of less than 2 % of temperature was achieved.



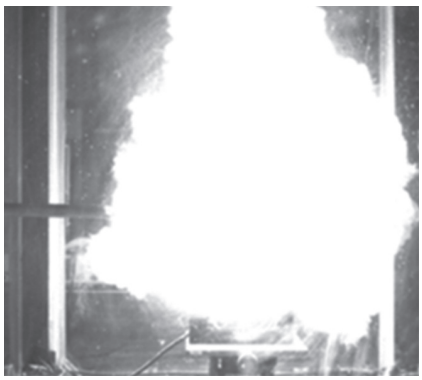


Calibration of the NPL dynamic thermometer using the NPL high temperature blackbody source

> An overall calibration uncertainty of less than 2 % of temperature was achieved.

Laboratory validation

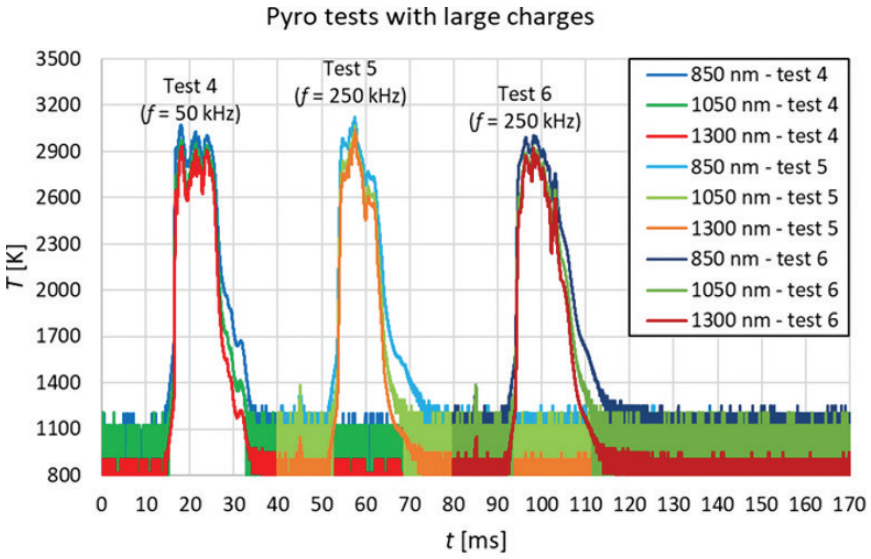
To validate the speed of the instrument, dynamic tests were performed using small pyrotechnic charges in a bespoke NPL facility – this consists of a vented enclosure where pyrotechnic charges are remotely triggered by a controller that is synchronised with the instrument. An example of the results is shown right, with a photograph of the fireball during a firing and an example of three firings, offset in time for clarity (overleaf). The agreement in temperatures measured at the three wavelengths confirms that, in these cases, the blackbody assumption is reasonable. Additionally, the instrument was demonstrated to be capable of measuring temperature changes of at least 3.25 K/µs.

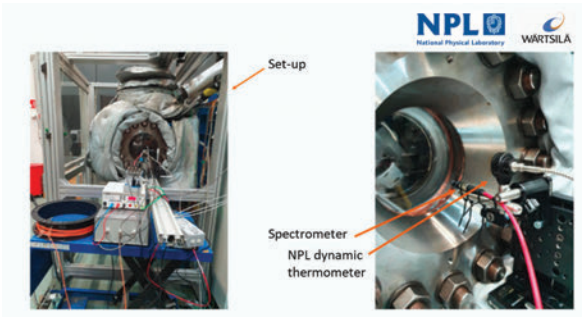


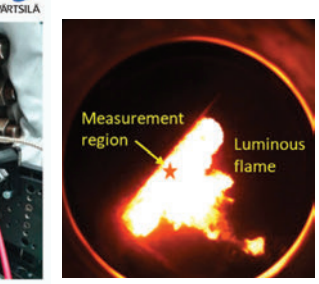
Tests of the dynamic thermometer in the NPL pyrotechnics facility: (previous page) photograph of the fireball – the thermometer probe can be see entering the enclosure on the left; (right) example of three firings, offset in time for clarity.

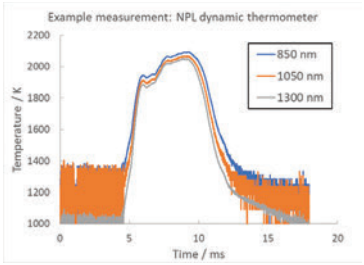
Field trials

Field trials were carried out at Wärtsilä on the newly commissioned combustion spray chamber facility. Since luminous combustion events are both turbulent and semi-transparent (at times), the assumption that they are similar to that of a blackbody may not be valid. By measuring at three independent wavelengths, the assumptions can be tested, i.e., the level of agreement between the three temperature measurements gives a good indication of the validity of the assumption and the level of uncertainty. The measurement setup is shown right, as is a photo of the combustion event and the NPL dynamic thermometer measurement. The agreement between the temperatures measured at each wavelength, for a maximum combustion temperature of 2100 K, was better than 50 K or 1.7 % of temperature, suggesting that the blackbody assumption is again a reasonable one.







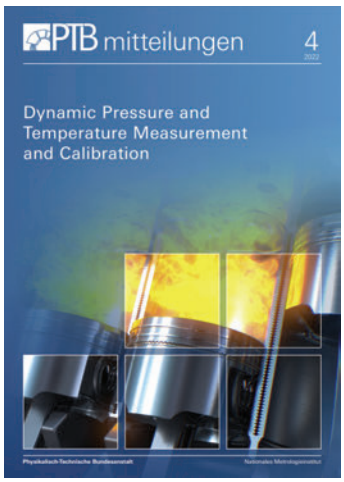


Field trials of the NPL dynamic thermometer on a combustion spray chamber at Wärtsilä, Finland: instrument set-up (above, left), high-speed image during combustion event (above, right) and an example of dymanic thermometer measurements at three wavelenghts (right)

Outlook

The NPL dynamic thermometer was developed, suitable for measuring rapidly changing temperatures on luminous (sooty) flames. Following ITS-90 traceable calibration and laboratory validation, engine tests at Wärtsilä show a very good agreement between measurements at different wavelengths indicating that the blackbody assumption is valid. If you have an application that could benefit from the development described here or dynamic thermometry measurements more generally, please contact Gavin Sutton Gavin.sutton@npl.co.uk.

Highlights of the project outputs have been published in the PTB-Mitteilungen.



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References

[1]https://www.euramet.org/research-innovation/research-empir

Acknowledgments

This work was funded through the European Metrology research Programme (EMRP) Project 17IND07 DynPT. The EMRP is jointly funded by EMRP participating countries within EURAMET and the European Union.

Furthur reading

[1] Project website: https://dynamic-prestemp.com/

[2] Euramet project page: https://www.euramet.org/research-innovation/search-research-projects/details/project/development-of-measurement-and-calibration-techniques-for-dynamic-pressures-and-temperatures/

[3] Linkedin group: https://www.linkedin.com/groups/12123594

COMPANION COMPANY SCHEME (CCS) SHOWCASE

The InstMC Companion Company Scheme has been running since 1992, enabling companies to raise their profile amongst our membership of 3,000 professional engineers in the measurement, automation and control sectors.

There are opportunities to network with other businesses, InstMC accredited universities and with individual members, at local and regional level, through Local Sections and Special Interest Groups. We currently have 70 active CCS members and are pleased to introduce some of them to you here.

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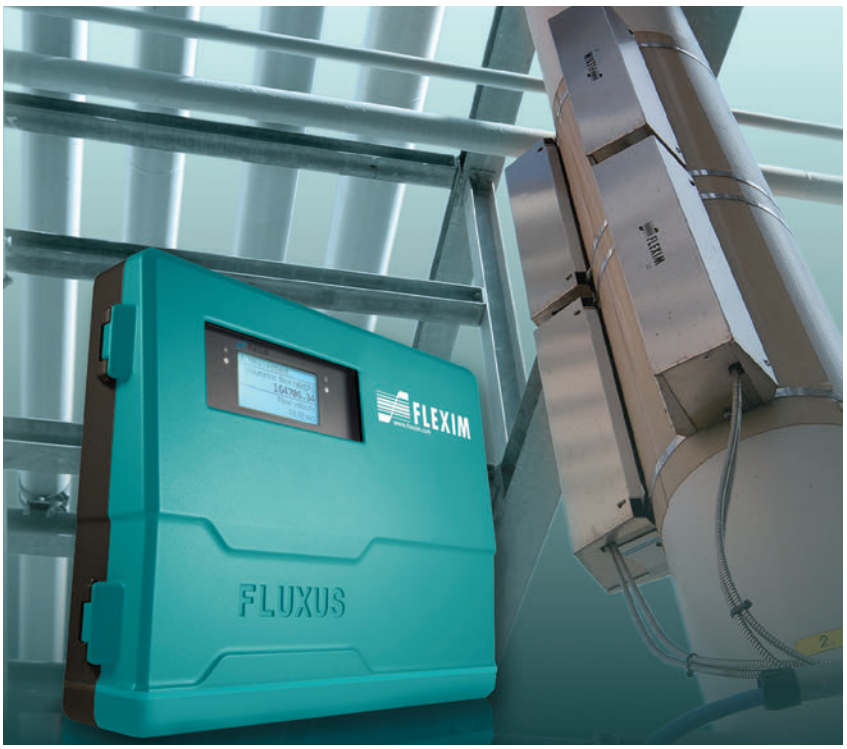
Codra

Codra is an Anglo-French company, whose international centre is in Manchester, with regional offices around the world. Well-known in the Industry and Infrastructure markets as the manufacturer of the real-time data platform: Panorama Suite, which comprises of three standalone, combinable and complementary software packages with a single design workshop. Panorama Suite allows users to collect, centralise, control, operate and analyse data from their installations to improve optimisation and operational performance within a cybersecure platform. Panorama was the first SCADA certified and qualified by ANSSI (the French Government's cybersecurity agency).

With 35 years experience, and more than 60,000 licenses deployed, Panorama Suite is much more than just a SCADA. It provides Central Control-Command capabilities, Edge-to-Service architectures and full Web Displays.

The team at Codra is highly experienced regarding technical and challenging projects.

A network of certified integrator partners, add local support for customers to successfully



complete their projects in Digital Transformation and Energy Efficiency across any sector, including Industry, Building Management, Transportation and Energy.

Tel: +44 (0)161 955 4200
https://codra.net/en/

DP Flow Ltd

Founded in 2013, DP Flow started out specialising in primary elements for flow measurement.This covers Orifice, Pitot, Venturi, Nozzle, Wedge and Cone meters.

As we enter our 10th Year, we are extremely pleased to be working with a new vendor of Senior and Junior orifice fittings and are able to supply spares and expertise for the supply and maintenance of the ageing and extensive fleet of fittings installed both onshore and offshore.

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Flexim UK

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ICSS Ltd

ICSS is an industrial automation engineering service provider with an innovation led approach to improving productivity throughout the engineering process, from conceptual design through to operational support. Formed in 2019, we have grown rapidly by utilising subject matter experts with our own proprietary software to deliver mission critical and complex projects on time, on budget, and to a high standard.

Our business consists of four delivery streams which are as follows:

- Consultancy - Functional Safety, Process Optimisation and Alarm Management to name a few.
- Design - We scope and design greenfield and brownfield process control, safeguarding, and instrumentation solutions.
- Systems Integration - We build and test solutions for our clients preferred system platforms.
- Commissioning - We manage multi discipline commissioning activities and deliver end to end projects or modifications we have engineered.

Our custom-built engineering tools are the USP behind our organisation. Please get in touch to find out more.

Tel: +44 (0)7480 556506
https://icss.engineer/

MEASUREMENT QUALITY MATTERS: ASK TREVOR

A documented laboratory management system, ISO/IEC 17025 style

Is it an unnecessary complication and time-wasting costly overhead? Or a simple way to ensure high quality consistently valid results in your measurement work?

In this issue we shall consider the possibilities, the benefits of implementing a simple and good system and contrast the effect of that with a conflicting unwieldy inherited legacy system that does not properly fit your laboratory operation. Regrettably, the latter is all too often found.

Laboratories often start with people and sometimes documented procedures taken from other laboratories. If the people are competent then that may be a perfectly valid start point, but we must be wary of using methods or procedures developed for another laboratory. The equipment used may differ, and/or the environment may be tighter or looser to a specification and the assumed skill levels of the operatives for that given level of documentation may be inappropriate. That is sometimes the first stumbling block to getting easily and efficiently started with a new lab, and applies equally to buying an off-the-shelf procedure document from a consultant.

Let's consider the three broad principal features of modern laboratory management system standards, for example, ISO/IEC 17025:2017.

Three Essential Features

1. Technical Competence – knowing that your staff are capable of "getting the right answer" in a measurement because of their demonstrable technical skills, suitable equipment and environment
2. Management System – to ensure consistency, reliability and "once right, always right"
3. Quality Assurance Measures, interlaboratory comparisons, proficiency testing and similar activities, some of which will be external to compare your work with other laboratories. "The proof of the pudding is in the eating"

So, the best way to develop a simple and effective management system, for many labs, is to start by watching what your technically competent people actually do in practice in the laboratory. During the testing or calibration, of course, but also in defining and agreeing the work with the customer, through to issuing the results in some form of certificate or report. The aim being to document the process sufficiently for a suitably qualified and experienced person to be able to achieve comparable results. It follows, therefore, that the level of detail in the descriptions/ instructions will differ according to the staff competence levels but will ensure that even the most highly qualified and experienced technician is constrained (!) to do any tasks in the same way as any other person authorised to follow the procedure. The primary aim being to ensure consistency of the work with your staff and equipment in your environment following your procedures. The best, most simple, documents are therefore usually those you have written yourselves containing what you need and only what you need.

The documentation may differ in style and structure to sort the activity. For the actual performance of test, it is usual to provide a step by step set of instructions. For things like determining the customer requirements and writing reports, the documentation might appear as a checklist to ensure all features are covered.

Some laboratories do this very well and it is often when they have developed their own procedures from scratch by observing the

work of their people. A person contemplating starting a task, if he/she is already trained and authorised for the work should be able to identify any variable issues surrounding the task such as the "who, what, where, when and how" involved in getting the same valid results as the other authorised staff.

Laboratories using old legacy inherited arrangements sometimes find that they "cannot see the wood for the trees" and search in vain for where some requirement might be featured in their documentation. Not finding it, they then add another clause to their manual, often not in the right place! Over some years this can result in conflicting, unwieldy unusable documentation that does indeed constitute a heavy unnecessary overhead.

A concise, well written manual or set of procedures minimises training time, avoids disputes, errors and misunderstanding and, most importantly, prevents invalid results being given to customers.

The third tenet "Quality Assurance Measures" in the chart above serves to check that your people are indeed competent, that you consistently follow sound procedures and are actually getting valid results. Staff and customers are given confidence in your work and in the comparability of the measurements made, often with SI units and sometimes internationally. In regulated sectors there are mandatory schemes, for example, in Asbestos and Water Quality, but in most industrial activity it is for the laboratory to find schemes or take part in homemade intercomparisons with other laboratories. The better schemes enable you to ascertain if your result at a particular point is within the combined measurement uncertainty of yours and of the reference laboratory. This is known as the Zeta score or En ratio.

The value of these schemes does vary as some use consensus values rather than a reference and some do not use the

E_N Ratio or Zeta Score

Reference value

Laboratory value

$$E_N \text{ratio} = \frac{LV - RV}{\sqrt{U_{LV}^2 + U_{RV}^2}}$$

Expanded uncertainties of the two labs

+ Establishes if the two results potentially come from the same population.
+ A lab having an E_N ratio <1 shows results within the combined uncertainties so the better the reference lab the more critical the measure.

measurement uncertainty. There is a comprehensive database of Proficiency Testing and Interlaboratory Comparison schemes for both testing and calibration. It contains schemes in the UK, Europe and beyond. It is called the European Proficiency Testing Information Service, is operated by BAM, a large laboratory and PT provider in Berlin and is free of charge to consult. Scheme participation costs from a few tens of GB Pounds to several thousand according the nature of the scheme.

The Standard ISO 17025:2017 requires that some form of external comparison is undertaken and this drives an increasing availability of schemes. Sometimes labs, especially in niche areas of activity, make their own arrangements with other laboratories and there are several techniques for ensuring good technical comparisons whilst maintaining commercial competition.

Trevor Thompson was with the United Kingdom Accreditation Service (UKAS) for 30 years, where he assessed and managed the accreditation of many testing and calibration laboratories, mainly in the physics and electrical disciplines. He was also one of the authors of ISIO 17025:2017 being the UK representative on ISO/CASCO WG44. He is now partly retired but operates independently at www.bestmeasurement.com offering "internal" audit, mock assessments, and consultancy for laboratories.

Trevor is here to offer some expert advice in all measurement quality matters! If you have a question, please email him at questions@bestmeasurement.com and we will feature your question and answer in a future edition of the magazine.

2023

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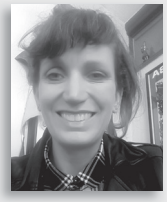

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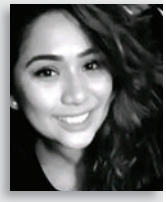

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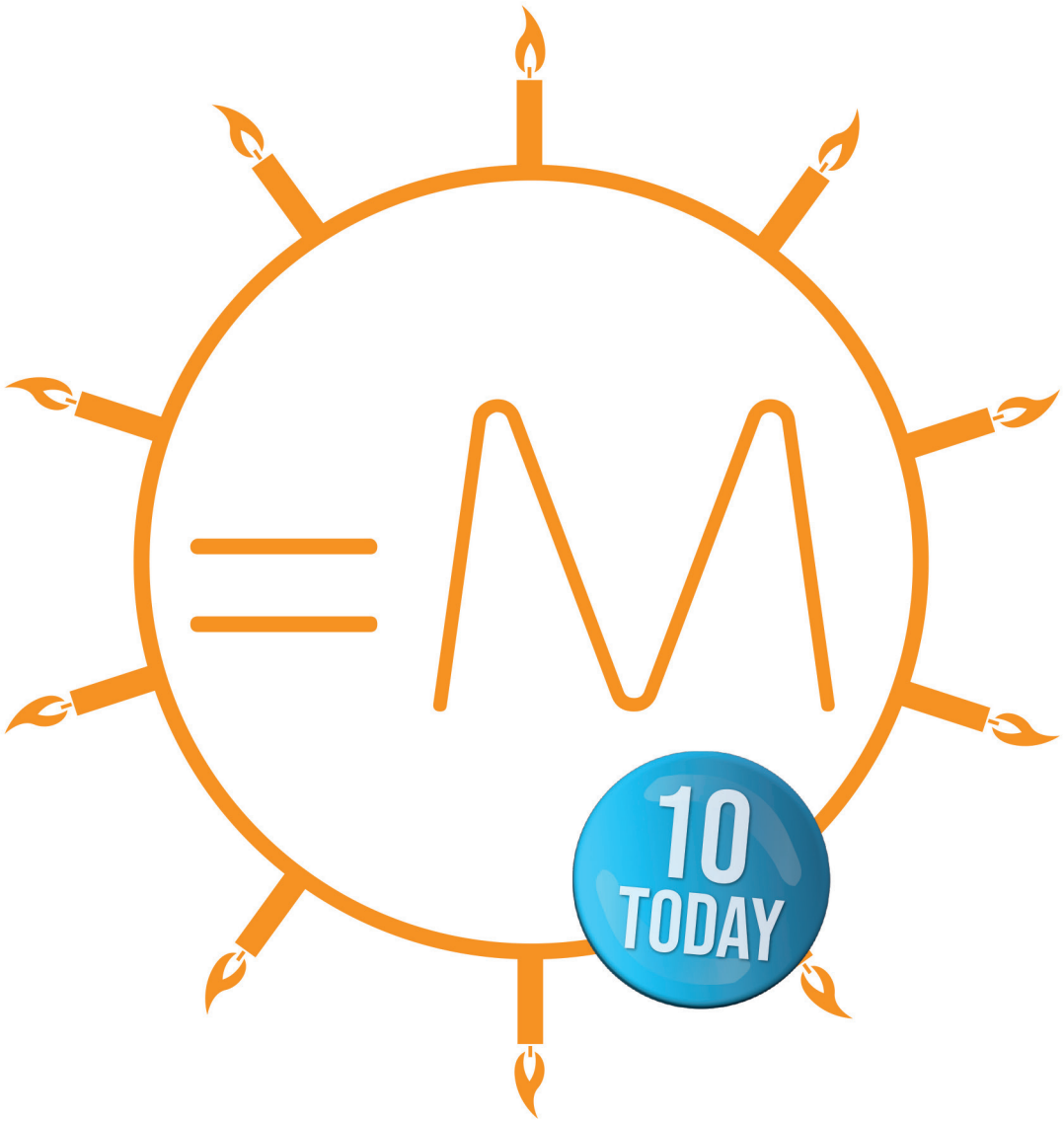

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