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

DIGITAL SENSORS - A HUGE CHALLENGE FOR METROLOGY

WHAT IS A CONTROL ENGINEER?

METROLOGY SKILLS FRAMEWORK

NEW DEVELOPMENTS IN FIBRE-OPTIC THERMOMETRY FOR HARSH ENVIRONMENTS

DECEMBER 2021 | ISSUE 22

PRECISION

INSTMC END OF YEAR REVIEW

When I wrote this piece for Precision in 2020, I talked about the ways the global coronavirus pandemic had impacted us all for the majority of 2020 and expressed my hopes that you would be able to enjoy a Merry Christmas and a much improved 2021.

I hoped that when I came to write the piece for this year, that the pandemic might be a somewhat distant memory. At time of writing things are continuing to slowly improve, but I'm not sure many of us expected the effects of the pandemic to still be looming so large over our lives this late into 2021.

The head office staff have continued to work remotely for the majority of the year, and it is only as we have moved into the final quarter of the year that face to face meetings have started to take place. After so long it is wonderful to be able to meet our members and volunteers again.

During the year our SIGS and Local Sections have continued to improve their ability to communicate and engage with the members in a virtual space, which has enabled them to reach a wider audience. As we start to return to more normality, the Institute will continue to take advantage of virtual options where members have expressed a preference for this approach.

The enforced move to a virtual world has highlighted the importance of effective communication. This year we have started to completely rebuild the Institute website and internal database system. The new site will be launching in the first quarter of 2022 and we hope you will enjoy not only the new look, but also the suite of new features and pages that should make engaging with the Institute easier and more beneficial.

2021 has still been a difficult year for many, and as we approach the subscription renewal date, I would like to take this opportunity to remind members to get in touch with us if you are struggling to afford your fees, and we may be able to offer support.

I wish you all a Merry Christmas and a happy and healthy 2022.

Steff Smith
Chief Executive
Institute of Measurement and Control

"As we start to return to more normality, the Institute will continue to take advantage of virtual options where members have expressed a preference for this approach."

Membership Subscription 2022

We would like to remind all members that the Institute is sympathetic to anyone experiencing difficult personal circumstances and can offer help through a waiver or reduction of membership fees. If you would like to discuss any aspect of your membership renewal, please get in touch as soon as possible at admin-subs@instmc.org. We look forward to your continued membership in 2022.

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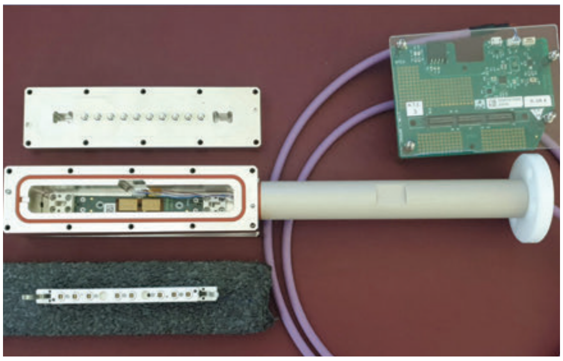

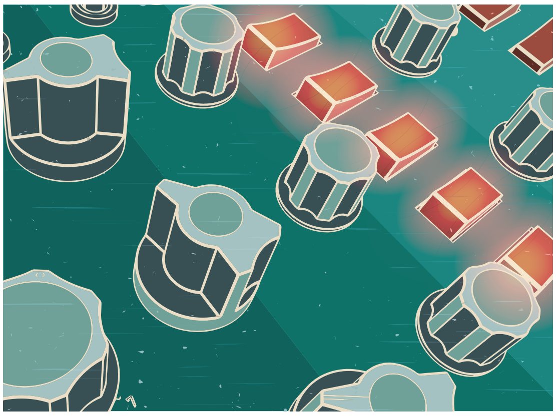

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DIGITAL SENSORS – A HUGE CHALLENGE FOR METROLOGY

Sascha Eichstädt from the Physikalisch-Technische Bundesanstalt (PTB) in Germany discusses the calibration of digital sensors and shows first solutions from the European research project "Metrology for the Factory of the Future" (Met4FoF).

Calibrations traceable to the international system of units of measurement (SI), harmonised treatment of measurement uncertainties, and industrial standards and guidelines are essential components of the metrological infrastructure that has enabled globalised manufacturing and international trade. Digital transformation is rapidly changing this landscape: sensors are becoming smart, and large networks of often low-cost sensors are being used together with machine learning algorithms to make automated decisions and manage production processes.

The metrology community needs to address the challenges arising from such digital transformation to ensure conformity and comparability of measurements. Two of those challenges are related to a core metrological service: calibration of measuring instruments to ensure traceability to SI. Firstly, sensors with digital output increasingly include some sort of pre-processing of the data, e.g., as part of the internal analogue-to-digital conversion. Therefore, the raw measured values are not available for the calibration and existing assumptions about the physical behaviour of the sensing element no longer apply. Another challenge is the use of low-cost sensors, such as micro-electromechanical systems (MEMS), for which a traditional calibration service is far from cost-efficient. On the other hand, without proper calibration the measurements made with such sensors are not traceable to SI and comparability of results becomes questionable. However, these characteristics are important when sensors in a network need to be replaced or when a machine learning method is trained on one system but applied on another one.

"Digital transformation is rapidly changing this landscape: sensors are becoming smart, and large networks of often low-cost sensors are being used together with machine learning algorithms to make automated decisions and manage production processes."

Calibration of sensors with digital output

The calibration of sensors with purely digital output requires, among other things, new concepts for the generation of time stamps for the signals provided by the sensors. This requirement is particularly important for dynamic, i.e. frequency-dependent, calibration. The reason is that the reliable calibration of the phase change in the sensor signal is an important element for time-dependent measured quantities. Simulated tests have shown that the reliability and performance of machine learning methods can deteriorate drastically when timing issues of the signal input data are present. A reliable phase calibration can help to overcome this.

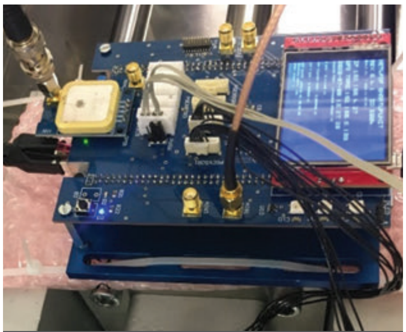


Figure 1: Smart up unit for the upgrade of existing measurement infrastructure with calibrated MEMS sensors and time stamps traceable to SI

In typical Industry 4.0 applications, sensors provide digital, time-dependent output signals and have internal signal processing capabilities. This makes the calibration of the phase difficult because the internal time measurement of the sensor is no longer managed by the calibration system. Therefore, new calibration approaches need to be developed or existing systems modified. The project Met4FoF developed a microcontroller board which can accommodate one or more MEMS sensors, provides options for connection to external, traceable timers and thus allows real-time pre-processing of the measured data. This board can be used to "smart up" existing calibration systems (Fig 1) such that they can be used for digital sensors. With that "smart up unit" in place, digital sensors can be dynamically calibrated with conventional approaches, including its phase response.

Moreover, with the appropriate hardware, a digital sensor calibrated in this way can be expanded to communicate its calibration information, including statements on the quality of measured data and the unit of measurement. It follows that basic principles of measurement can be integrated directly with the extended sensor or applied in an edge computing approach close to the sensor.

Novel calibration approaches for low-cost digital sensors

For some time, MEMS sensors in smartphones have been used to provide measurements of various quantities. In recent years, the use of MEMS sensors in industrial applications is also increasing, because of their rapidly improving value-to-cost ratio. However, traceability for practical MEMS calibration services is currently lacking both at the level of National Metrology Institutes (NMIs) and of accredited calibration services. This is a consequence of the lack of adequate technical set-ups and procedures as well as normative standards.

A general challenge in the development of calibration services is the financial benefit, because of the extremely low price of MEMS sensors. When reliability is required, MEMS sensors are typically tested using automated test equipment (ATE). Such an ATE can mount a large number of MEMS sensors and simulate conditions (e.g. of temperature or humidity) under which the sensors need to operate reliably. This approach is also known as one-touch automated testing.

The project Met4FoF developed an approach to further develop an ATE into a setup for one-touch batch calibration of MEMS sensors. A mobile reference fixture (Fig 2) is calibrated in an NMI laboratory. This device contains a network of sensors, which then serve as references in the transformed ATE. The project validated this concept for MEMS temperature sensors and demonstrated its practical applicability for a commercially available ATE.

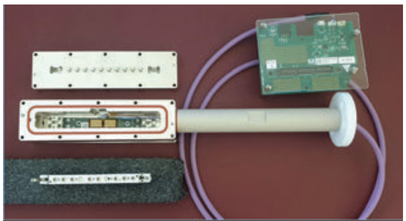
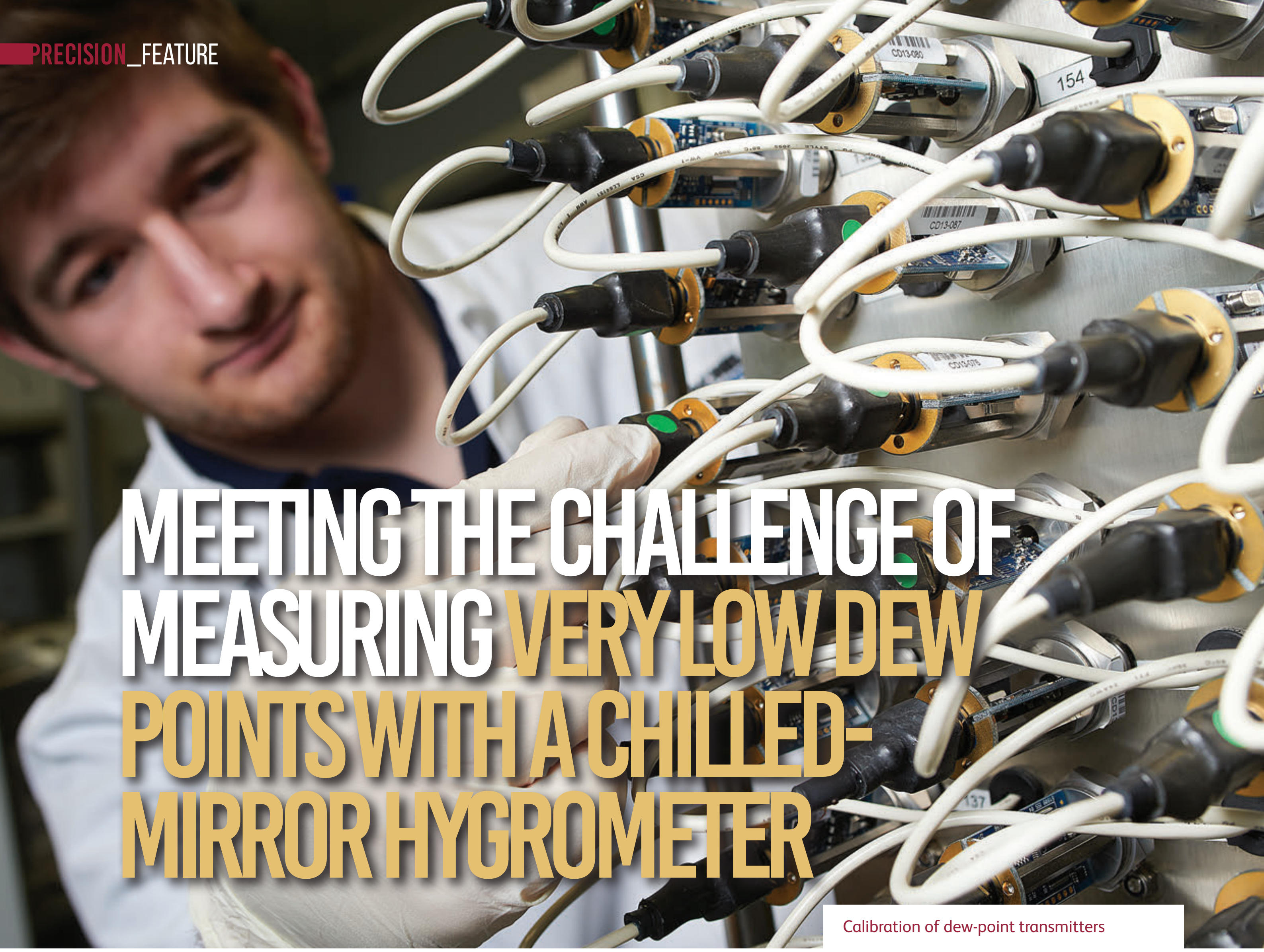


Figure 2 Reference fixture calibration setup

Further information

This work is part of the Joint Research project 17IND12 Met4FoF of the European Metrology Programme for Innovation and Research (EMPIR). The EMPIR is jointly funded by the EMPIR participating countries within EURAMET and the European Union.

MEETING THE CHALLENGE OF MEASURING VERY LOW DEW POINTS WITH A CHILLED-MIRROR HYGROMETER



Calibration of dew-point transmitters

Michell Instruments partnered with the National Physical Laboratory (NPL) as part of their Measurement for Recovery (M4R) programme to develop, test and validate a chilled-mirror hygrometer that is capable of measuring very low dew point temperatures down to –100 ˚C.

Stage 1 – The challenge

A chilled mirror hygrometer is an essential reference instrument for trace moisture and humidity calibrations. It directly measures the formation of condensation on a mirrored surface. Ensuring that the formation of the condensate is as repeatable as it can be is the basis for how the measurement is made.

Without external cooling, the current dry end specification is -90 ˚C frost point which is equivalent to approximately 95 ppb.

The challenge was to extend this capability to -100 ˚C frost point, or around 14 ppb, without needing additional cooling capability. This evolution in the specification of the chilled mirror would also allow the bottom end capability of National Measurement Institutes, and other accredited laboratories around the world, to be extended beyond the current -90 ˚C frost point limit and help the humidity community as a whole take the next step forward in terms of repeatable, reproducible measurements at the extremes of the dew/frost point range.

It is used as a reference in commercial laboratories for trace moisture and dew point calibrations of many instruments and sensors, such as dew-point transmitters. Improving the dry end specification of this reference will ensure extra reliability for these calibrated instruments at their lower measurement ranges.

Although the chilled mirror hygrometer was capable of cooling sufficiently to achieve a stable condensate layer at -100 ˚C, what the engineers didn't understand enough about were:

- the relationship between the condensate formation and the flow dynamics resulting from the design of the measuring head

S8000 -100 chilled mirror hygrometer

- the material properties of the flow path and the cold interface between the Stirling engine and the mirrored surface.

The temperature measurement at the point at which the condensate layer and the amount of water in the flow path when in equilibrium was key. They knew that they needed to look at the PRT (platinum resistance thermistor) making that measurement itself and what improvements could be made to it and its installation.

From previous attempts to solve the problem, the engineers knew that the current unit would measure down to the required level. In fact, a unit had previously been calibrated at -100 ˚Cdp by NPL which highlighted some of the repeatability issues that needed to be solved. There was a strong correlation between the measured value and the sample flow rate.

Despite the challenges, solving the problem of extending the dry end specification of the chilled mirror was essential. It would not only allow them to extend their UKAS accreditation down to the -100 ˚C frost point level, but would directly benefit customers with improved dry-end performance of their calibrated instruments.

Stage 2 – the Prototype

As a first stage, they developed a prototype chilled-mirror hygrometer, based on the previous design but with an updated measuring head and gas flow path to ensure the formation of the condensate was as repeatable as possible. Previous testing at NPL, utilising the Measurement for Recovery funding, helped with this evolution in the design.

The dry-end specification of the prototype chilled mirror was -100 ˚C frost point (approximately 14 ppb). With the available cooling capacity, they had the possibility of a stable condensate layer at -100 ˚C. But they needed to know more about the relationship between the condensate formation and the flow dynamics resulting from the design of the new updated measuring head. There were also some open questions regarding material properties of the flow path and the cold interface between the Stirling engine and the mirrored surface.

Although they were testing the prototypes at their manufacturing facility, they wanted to involve the NPL Humidity Measurement and Standards Group. NPL's expertise would provide the final information needed regarding the updated measuring head design.

With NPL's involvement and the use of their facilities, knowledge and equipment, the developers were able to validate the new flagship product without needing to involve a third party as a beta testing site.

As product manager Richard Gee, explained, 'We did not believe we could carry out the work necessary to give us the confidence in our redesign to launch the product in its current iteration. With the help of NPL, we reduced the time to market by at least three months.'

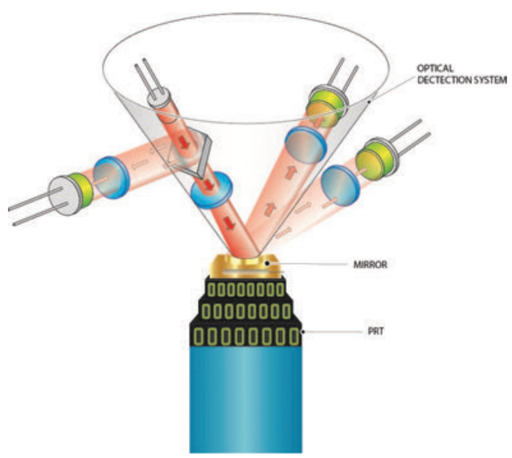
How a chilled mirror sensor works

Chilled-mirror dew-point hygrometers are precision instruments for critical measurement and control applications. Chilled mirror sensors measure a primary characteristic of moisture – the temperature at which condensation forms on a surface. This means that chilled mirror instruments are inherently repeatable, giving reliable results every time.

The chilled mirror sensor consists of a temperature-controlled mirror and an advanced optical detection system. A gas sample is passed into the sensor housing and flows over the surface of the chilled mirror contained within. At a temperature dependent upon the moisture content in the gas, and the operating pressure, the moisture in the gas condenses out on the surface of the mirror. An optical system is used to detect the point at which this occurs, and this information is used to control the mirror temperature and maintain a constant thickness of the condensation layer on the mirror surface.

At an equilibrium point, where the evaporation rate and condensation rate on the surface of the mirror are equal, the mirror temperature represents the dew point.

For further information visit www.processsensing.com/ChilledMirror/



Simplified diagram shows the key elements of a chilled mirror sensor

Q&A

Martin Belshaw

InstMC President, **Martin Belshaw**, gives us an insight into his career in engineering and his thoughts on where the sector is heading.

What was the root of your interest in Engineering?

Fifty years ago, I was ten. I knew what I wanted to do just not what it was called. I had some early engineering experiences through my father taking me to work and visiting industrial plants on rainy days while on holiday - not that they were open to the public, we just turned up and asked to be shown round. I saw the making of, and stood inside, the cylinders which lift the Thames barrier. This continued though my formative years, Yelland PowerStation - Devon, Cruachan Power Station – Scotland, Wiggins Teap Paper Mill – Scotland, Dounreay Nuclear Power Station – Scotland, Pilkington Glass – St Helens, and many many more. All undoubtedly sowing the seeds and going a long way to explaining why I am where I am today,

I built things and made things with real electricity; I lit up nails … I built a blast furnace … I broadcast radio to the street … electrolyzed water (with mains) and documented these projects meticulously with drawings, narrative, and test results. Looking back these were FEEDs, Specifications, and Operating manuals that seemed necessary at the time. I had no idea what I was doing except a determination and aptitude for making things work thorough brute force and thought writing it down would be useful later on.

I took the usual subjects maths, physics and chemistry plus a relatively new subject, Computer Science just at the time when the Oil & Gas discoveries in the UK North Sea were showing some significant promise. I remember a 35mm colour slide of a drilling rig in a box of cereal got me thinking “wouldn’t it be nice to be a computer programmer working offshore”.

I discovered electronics and had a job of sorts repairing TVs in an electrical retailers in Leeds, the sort of TV shop that sold bicycles as well. People would invite you into their homes to work miracles in their front rooms and in the event that we couldn’t, we would offer a spare one out of the van, which was usually someone else’s.

I arranged my own “work experience” with ICL, Burtons and architects, Abby-Hanson-Rowe, schools of the day didn’t do this. I explained to the deputy head and common sense prevailed … “we’ll see you in a couple of weeks”

On the back of this I studied maths at what is now Teesside University, but then was the Middleborough Institute of Technology, so I can legitimately claim I went to MIT.

I worked at the Cabinet Office, Westminster, Maths and Stats division doing some really clever stuff and was seconded to the Dept. of Energy to do even more. This is when I re-discovered programming. A baptism of fire, from fifty lines of basic to being responsible for 125,000 lines of FORTRAN more or less overnight.

> I worked at the Cabinet Office, Westminster, Maths and Stats division doing some really clever stuff and was seconded to the Dept. of Energy to do even more. This is when I re-discovered programming.

I had a budget of millions and I was twenty. Pretty soon I had this working more or less automatically, and 500 pages of global energy analysis would pour out of the machine on cue every day for government advisers to pour over and run the country. This worked fine for several months until one day I was ill, it continued to work obviously, but I wasn't there and the cat was out the bag!

Eric my boss and parliamentary secretary, turned a blind eye to my apparently not working because what I was supposed to be doing was obviously getting done and he knew, although it didn't appear so. I was probably working on something else anyway, which was true.

These were big programs - compiles would take an hour or so matrix generation the same, matrix generator-generation the same and actually running the models the same again. Our next coup was block booking the biggest supercomputers in the UK for 90 minutes every lunchtime, whether we used them or not, saving millions and sufficient to buy outright our own supercomputer that same year.

I was fortunate enough to see out the installation and commissioning of the new machine and one of my responsibilities was the first to be transferred. Perhaps not surprisingly the guys at the then DoE wanted me to stay, but I returned to MIT to finish my degree, albeit now with a slightly different goal in mind: long term job prospects, maths teacher, boffin: computer science 'world's your oyster' it seemed.

I graduated the following summer BSc 2.1 Maths & CompSci. Job done. I started work in the Dutch Shipyards a few months later developing the controls and automation for Subsea Templates.

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

Survival: cohort-covid has presented a significant catch-up challenge to anyone between 4-24yrs, learning outcomes have been missed, the method of recovery still the subject of much debate, but more than just moving the bell curve. Additionally an overall decline in numeracy and numeracy-related subjects, student capacity, teacher capability, subject breadth and depth, make worrying reading. The trouble is that technology is changing so fast that education can't keep up. What was the mainstay of connectively yesterday, is taught today and will be obsolete tomorrow. There is nothing new here, the shape of the curve has remained the same for decades, probably centuries, and the slope depends on how closely you look. However, what is different is innovation that took years before, now takes a few months/days/minutes… and how on earth do we teach this?

Forever the optimist, I believe there is tremendous opportunity in fields not previously envisaged as "engineering" but that most definitely are, with connectivity beyond our wildest dreams just around the corner. Meshed instrumentation over wide areas will eclipse conventional wireless HART, wireless Ethernet (maybe) and LampPost will talk to each other. Glasgow Smart Street to provide lighting, car charging or back feeding the grid to iron out local perturbations, even back feeding out of the connected car!

However, this needs numeracy and understanding of the sciences beyond "general science".

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

It seems socially acceptable to be "no good at maths", a trait which

spans more than a generation already, and that needs to be fixed. The feedstock of the future is at school right now, and it is being short-changed through lack of capacity and curriculum.

In primary schools, STEM subject teachers lack the background and confidence to teach this sufficiently well and/or to promote technical careers. In secondary schools, the lack of choices of more traditional exam subjects restricts subsequent career choices before they have even started. Teachers all too often don't have a relevant degree in the subject they are teaching, and career advice is ill informed. Across the board, they need more support.

We need to get industrialists, engineers and scientists into the schools to help teach these important subjects. It is time for government & industry to work together to facilitate this, and perhaps sponsor engineers to go into schools in roles similar to that of the Industrial Advisory Board (IAB) at a university level. These IABs can review the direction of classes/courses on a regular basis and to give guidance and comments on the future developments within industry. This could become the main link between the curriculum and industry. The IAB members would present at various school events and be given the opportunity to extoll what industry is actually working on firsthand. Moreover, by inspiring impressionable youngsters, we will create the demand later on, required to put UK engineering back on its feet again.

I know the governments are doing "something" because I am involved in those committees and groups that advise them but they need to act more quickly because geniuses are slipping through the net. Unfortunately, I know this might take longer than ten years.

What do you do in your free time to relax?

We have a big garden and a woodwork shop where I tinker about, making wooden things mostly as presents for friends. My style is rustic, more than cabinet making, but it still demands precision if the finished product is to look good, rustic or not. I also enjoy making presentations for schools, colleges and graduate recruitment programs about all things engineering, usually more tangential subjects than mainstream. I am known locally for my "rocket man" exploits, brute force engineering again, that I trot out for the Feeder Schools to our local academies.

Given one wish what would that be?

There is risk in absolutely everything we do, so without a second thought, I would wish to replace a manikin on one of the Orion/Artemis test flights out to the Lagrange points and back; seems such a waste of a seat otherwise!

"I know the governments are doing "something" because I am involved in those committees and groups that advise them but they need to act more quickly because geniuses are slipping through the net. Unfortunately, I know this might take longer than ten years."

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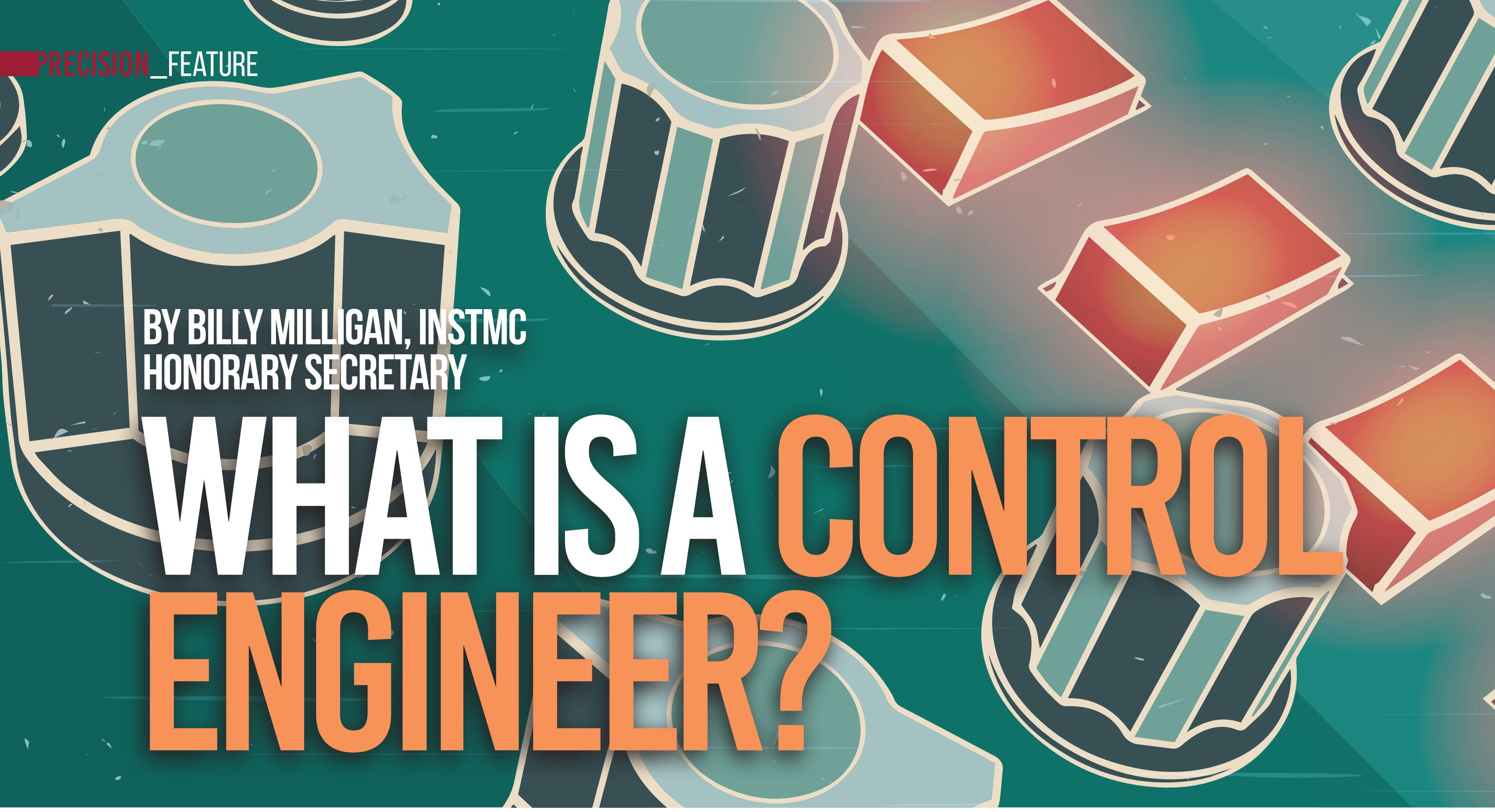

BY BILLY MILLIGAN, INSTMC HONORARY SECRETARY

WHAT IS A CONTROL ENGINEER?

I have been tasked with writing 1500 words on "What is a Control Engineer?" after one of the strategy trustee meetings where we discussed what makes our Institute unique. As the only UK based Institute solely focused on measurement and control, we are better placed than other professional engineering institutes to service the needs and wants of these engineering disciplines.

Before I go any further, as with most of the engineering work I've been involved in since the 1990s, some readers will have a difference of opinion to the answers I propose here. That's fine, people will have different journeys. An academic based control engineer working with physics-based maths models of systems, will have a different viewpoint on what makes a control engineer from one based in a process industry. Hopefully not radically different but different none the less.

Now with that caveat out of the way we can focus on what is a control engineer. I was building motor control centres and instrumentation, control and automation panels when I first heard of a control engineer and that's despite having studied physics for three years and technological studies for two years at secondary school which incorporated obscure topics such as boolean logic and pneumatic logic. The words "control engineer" or "control engineering" were never mentioned. This isn't the place to try to answer the STEM conundrum, but suffice to say engineering in general wasn't pushed at my school at the time, let alone one of the more obscure niches of the profession. So back to building these panels, which was a fantastic foundation for my career in engineering, once we were finished and had completed our in-house tests the clients' control engineers would arrive for the factory acceptance tests. They would review the paperwork, drink coffee, witness the tests, drink some more coffee, sign off the tests and disappear. We occasionally saw these coffee drinking ninjas again after we had installed the panel at site as they were getting ready to start commissioning. I decided that this group was the pinnacle of the industrial automation game and planned on emulating them one day, but I genuinely think I was 19 or 20 before I knew that control engineers were a thing. With no evidence whatsoever, I suspect north of 90% of the population don't know that control engineers exist.

My plan on answering this question was to get the definitions of Engineer and Control Engineering, and combine the two. Unfortunately, the definitions for Engineer made for depressing reading, often containing references to designing and building engines. Probably the best one I found was an old one defined by the Engineers Council for Professional Development in the United States (now ABET Inc) as "the creative application of scientific principles to design or develop structures, machines, apparatus or manufacturing processes, or works utilising them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast the behaviour under specific operating conditions; all as respects to the intended function, economics of operation and safety to life and property". I thought that one was pretty comprehensive and the bit about forecasting the behaviour under specific operating conditions was right up a control engineer's street. As an aside, from the Encyclopedia Britannica this time, the word engine and ingenious are derived from the same Latin root, ingenerare, which means "to create" but I suspect most readers already know that.

The background to control engineering is even harder to pin down. A great many may point to the pre-classical and classical

periods during the first half of the 20th century as the golden age, when the likes of Zeigler, Nichols, Bode, Nyquist et al were making great strides in our stream of engineering. For the next part of this article, I was going to lean heavily on some previous articles published in the InstMC journal on the history of automation but I couldn't dig the article up. Some of you may remember it? It was in two parts telling us first of myths of automatic control devices in ancient Greece (see Hephaestus), before showing devices that were actually created using control principles back in ancient times such as the escarpment mechanism and repeating crossbow built by Philo Mechanicus in circa 250 BC. One of the best examples of this I think is Heron of Alexandria (c. 10 - 70AD). Heron created the first programmable robot as a device to entertain audiences at the theatre. Heron used the same system of ropes, cylindrical axles and knots to create a mechanical play of almost 10 minutes in length, including dropping metal balls onto a sheet of metal to resemble thunder. His work, Peri Automatopoietikes (on the Making of Automata), demonstrates that this theatre was actually programmable. I did find a good read on the subject when searching for the old article entitled 'A Brief History of Automatic Control' by Stuart Bennett.

Moving swiftly over the dark ages and a great deal of the enlightenment as well, where most of the engines designed were for military purposes, we come to the industrial age. This is where a lot of articles point to the likes of James Clerk Maxwell, Scottish physicist, who published 'On Governors'' where he mathematically models the behaviours of governors used to control the speed of steam engines used at the time and claims that this established the theoretical basis for control engineering. I tend to agree and claim that Zeigler, Nichols, Bode, Nyquist et al were standing on the shoulders of a Scottish giant. Interestingly, Routh, of Routh-Hurwitz stability criterion fame, worked alongside him at Cambridge.

For two thousand years engineers have been trying to predict and control the behaviour of machinery, processes or their systems built using combinations thereof, by using either individually, or an ensemble of mechanical, electrical, chemical, metallurgical, electronic or pneumatic control elements. Over the same period of time these engineers developed a series of mathematical tools to use on these machines, processes and systems to first predict how the machine will operate and then how to achieve stable, optimised operation at the desired setpoint. This collection of tools is called control theory. The more tools you have in your toolbox, and the more you know how to use them, the better the job you can do. That's pretty much the same as any other profession. This could be a simple temperature or level control loop or, moving to the other end of the spectrum, it could be the hundreds of control applications working in harmony to land a SpaceX first stage booster on a drone ship at sea.

So here it is, trying to combine these two definitions to answer "What is a Control Engineer?" gives us something along the lines of: someone who creatively applies control theory principles to design, develop or operate machines, apparatus or manufacturing processes, or works utilising them singly or in combination in a desired, stable and optimised condition and to forecast the behaviour under specific operating conditions; all with respect to the intended function, economics of operation and safety to life and property.

I know! It rolls off the tongue!

I read a book recently called the Nature of Technology after it was recommended at a compressor conference. Don't read it, spare yourself, I'll give you the overview. The author, rather self-indulgently in my opinion, explains that new technology is borne from older technologies, even this new digital age is an evolution from the transistor age, which is itself an evolution of the vacuum tube. Some technologies eventually cease, some continue to evolve and some spawn completely new sets of technologies. We can see this happening in our industry clearly since the industrial revolution. Control engineers have been around for four industrial revolutions now, continually making use of the technology around us to sharpen the tools in the toolbox. With the adoption of industrial digitisation, mass data collection, artificial intelligence and system connectivity, there has never been a more exciting and dynamic time to be a control engineer. The range of opportunities open to control engineers thanks to the increasing use of automation is phenomenal and to be materialistic about it, The Engineer 2021 Salary Survey saw the mean average salary across the engineering sector rise 10% since 2019. You will also be one of the very few coffee drinking ninjas in the UK that no one knows about, and to quote an old engineering saying, solving problems for people they didn't know they had in ways they can't comprehend.

MIDLANDS CENTRE For Data-Driven Metrology

University of Nottingham UK | CHINA | MALAYSIA
Loughborough University
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UK Research and Innovation

METROLOGY SKILLS FRAMEWORK - SUMMARY PAPER

The **Midlands Centre for Data Driven Metrology** is keen to receive feedback on their proposal for a global framework for metrology skills and is also looking to establish a working group to participate in further discussion.

There is currently no existing internationally recognised standard for the competency of practitioners in metrology so this framework is an attempt to address this gap.

Purpose: *This paper outlines the proposal for a global framework for metrology skills and is intended to generate discussion and engagement with interested parties. It has been developed through the Midlands Centre for Data Driven Metrology (MCDDM)*

Context

Metrology underpins over £622 billion per year within the UK, delivering confidence to business and society, ensuring fairness in trade and giving the supplier and customer quantifiable levels of confidence in products, processes, and services[1]. Metrology, through the SI and derived units is an international infrastructure of standards and traceability, with its own language and nomenclature, that is threaded throughout all trade, science and industry. Trust in the robustness of these measurements is vital, as failures of metrology can lead to multi-million-pound losses[1].

Like any technical discipline, metrology requires high levels of skill from the people involved. Metrology skills are needed for those directly involved but also for all engineers and scientists who specify requirements and make decisions based on measurement data. As we progress with digital and industry 4.0, the needs of measurement science and engineering are evolving; traditional skills are still important, but metrology has moved into the digital space, and skills must develop to support this.

Today, skills are developed via a range of different solutions including training and education, on-the-job learning, self-directed research, etc. These solutions are provided by a wide range of organisations from the individual, through to recognised academic and industrial training providers.

Problem

The competency requirements, training, education and testing for metrology are not well organised[2] or documented. Currently, there is no existing internationally recognised standard for the competency of practitioners in metrology, leading to:

- Variations in competency across industry, resulting in knowledge gaps and associated problems;
- Inconsistency of training and development solutions between providers;
- Industrial and scientific companies each developing their own solution for the competence of metrology staff creating duplicated effort and inconsistency;
- Unclear recognition of what a metrologist is or development paths for metrologists to build their career;
- Uncertainty when recruiting.

The field of non-destructive testing (NDT) had this same problem several years ago. To solve the issue, the industry developed the ISO 9712 framework[3]. This standard defines the competency requirements and framework for people carrying out NDT across a range of industries, as well as providing a common standard for training solutions.

Solution

To address the gap in metrology, we are proposing the creation of a framework that defines the competency requirements for the metrology community. This standard will include:

1. A standardised framework that defines and provides structure to metrology skills across different levels and disciplines (for example beginner, practitioner, advanced across areas such as flow, dimensional etc).
2. Definitions of the competency requirements for different tasks and disciplines within the framework.
3. Clear career development paths for metrologists.
4. An international standard that formalises the framework and competency requirements, similar to the approach already adopted by the NDT community in ISO 9712.
5. An assurance/accreditation process to enable:
    - Demonstration of an internationally recognised level of competency and professionalism.
    - Training providers to demonstrate consistent quality of their products to the standard.
    - Organisations to have confidence when they recruit and train their staff.

Metrology is a vast subject, with diverse topics ranging from fundamental physics, to varied applications for each of the major measurement areas (time, length, mass etc.). For example, in length measurement, applications range from inspecting the size/shape of an industrial product or the length of a building site, to the size of bacteria. Each of these applications has its own technology and standards. Because of this variety, it is impractical to define the skills required by every discipline. However, by defining a framework to operate against, groups active in each area can develop standards and solutions for their field. The framework will then provide transferability between disciplines, as well as efficiency in covering the fundamentals.

Figure 1 shows the concept where each discipline (length, time, etc.) has a range of lower-level subject "nodes" included at different levels of skill (basic, intermediate, advanced). At each "node" in the framework (for example "Dimensional, Intermediate Skill, Coordinate Metrology"), competency requirements can be defined together with any assurance/accreditation processes and requirements.

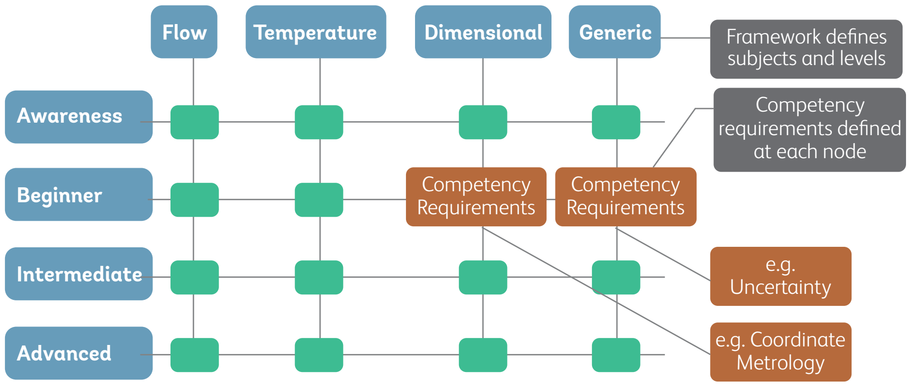

Figure 1 - Concept for the Metrology Skills Framework

Next steps

To make this solution happen, a diverse team from industrial and scientific companies will be required; academia, national laboratories, professional bodies, metrology technology OEMs and service providers. With this requirement in mind, the immediate objective is to form a working group with the necessary diversity, influence, collaboration and bias for action to make this goal a reality. Once a critical mass is formed, it is expected that regular workshops will be used to develop the basic proposal for the framework, selected standards and the "route to market", be it via an international standard (e.g. ISO, ASME etc) or another robust route. To help this the aim will be to develop principles to support the framework and supporting information as follows:

1. It will not be "owned" by any one organisation. Rather, it will be a collaboration with the alignment to an international standard providing the necessary governance structure.
2. It will not be directly monetised. It will however provide a standardised framework against which different organisations are able to build products aligned to it.
3. It shall be international, so it has relevance across industry.

If you are interested in participating, please contact Phil Bamforth or Trevor Toman for more information.

References

1 UK Measurement Strategy: the value of measurement - supporting information (publishing.service.gov.uk)
2 MCDDM Training event report & survey - Training Workshop (mcddm.ac.uk)
3 ISO 9712- Non-destructive testing — Qualification and certification of NDT personnel

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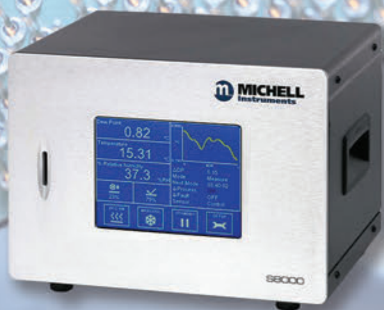

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INSTMC SPECIAL INTEREST GROUPS

InstMC SIGs provide an opportunity for like-minded engineers to network, share ideas and expertise, collaborate and learn, and keep updated on industry news and developments.

We currently have 7 Special Interest Groups covering the following technical topics within the measurement and control fields: **Cyber Security, Digital Transformation, Explosive Atmospheres, Flow Measurement, Functional Safety, Measurement** and **Standards.** Driven by groups of volunteers who work, or have expertise, within the relevant topic area, SIGs promote the sharing and advancement of knowledge through a range of activities. These include producing white papers and briefing notes, as well as hosting and attending conferences, seminars and exhibitions.

How to join

Members can join any SIG through the members only area of the InstMC website. Click 'MyInstMC' on the homepage and login to your account. Select 'Manage Personal Details' and under Special Interest Groups, click the 'Edit Special Interest Groups' button. Click 'Join' for any SIG you wish to become a member of.

If you are interested in finding out more about a particular Special Interest Group visit https://www.instmc.org/Special-Interest-Groups or email the relevant contact below.

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FOCUS ON A SIG: DIGITAL TRANSFORMATION

The Institute's Special Interest Group dedicated to Digital Transformation (DT-SIG) has a strong membership with many of its members contributing towards creating a series of experience-based guidance notes on the topic.

A topic of interest to many of the Institute's members and one where the greatest challenge lies in the pace-of-change and a plethora of "buzz-words" creating much "mystique" around the actual roll-out of a project.

One of the first tasks the DT-SIG has set-out to complete is to create a number of individual guidance notes, that will be published in the coming months, with the aim of assisting both members and non-members in gaining sufficient insight to successfully implement a DT project. So what is Digital Transformation in the Controls and Automation arena?

Digital Transformation is the novel use of digital technology, including instrumentation and control systems, to solve traditional problems. These digital solutions enable inherently new types of innovation and creativity, rather than simple enhancement, and support of traditional methods. As the term implies, digital transformation uses digital technology through interoperable systems, modelling and simulation, intelligent automation, and networked sensors to analyse data and disseminate information throughout the entire lifecycle. This allows a company proactively to manage its operations with informed and timely decision-making.

An Introduction to the Guidance Notes

The DT-SIG guidance notes are formed around individual themes. Each theme has its own guidance note for which there is a total of four themes that are generic across most businesses, as follows:

- Assets (theme based on ISO 55000);
- People (organisation and skills development);
- Processes (process plant); and
- Successful Adoption.

The Digital Transformation Themes

One could imagine numerous individual themes within the digital transformation arena; however it was considered useful to start at the plant level and then focus on processes within the plant, the associated assets, and then the personnel who are operating within the plant.

In connecting processes, we can consider the topics of assets as well as human capital. Assets and, further, asset management is a vast topic that is well documented within industry, and for which we are able to access public domain materials as well as national and international published standards. Assets are, generally, regarded as the "foundational element" within any DT initiative as they span a diverse number of industries and are ubiquitous in deployment.

There is no doubt that the digital transformation era will have a positive impact on human capital, as it provides many advantages compared to the previous industrial revolutions. Greater connectivity with knowledgeable insight, being provided in novel ways, assisting one to perform their role and responsibilities in an immersive experience. Technologies that not only assist on a day-to-day basis but can also be the enabler for new job descriptions creating career possibilities not previously available. The following 2018 quote from McKinsey was as valid then as it is today and as it will be for the foreseeable future:

"As digitisation, automation, and AI [artificial intelligence] reshape whole industries and every enterprise, the only way to realise the potential productivity dividends from that investment will be to have the people and [associated] processes in place to capture it. Managing this transition well, in short, is not just a social good; it's a competitive imperative."

[Original ref: Retraining and reskilling workers in the age of automation, McKinsey Global Institute, January 2018].

The DT-SIG guidance note for people has a focus on organisation preparedness, skills development and enhancing workforce competency enabled by collaboration opportunities, for example, via mobile solutions enabling artificial and virtual reality approaches to the day-to-day job. Creating connectivity and generating insight along with the priority topic of worker safety. There is no doubt that a DT initiative will have a positive impact on the workforce, and this is an area that we considered essential as a theme.

The DT-SIG guidance note for successful adoption has a focus on the principles, challenges, and opportunities of successfully adopting digital transformation with references of where to go for specific information. It looks at both brownfield and greenfield adoption in having a "real-world" perspective.

To summarise, a digital transformation initiative will embrace the InstMC themes and it is the connectivity across the individual themes that provides a total solution. We are always open to new members joining us and we very much welcome your feedback so please do contact us today!

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NEW DEVELOPMENTS IN FIBRE-OPTIC THERMOMETRY FOR HARSH ENVIRONMENTS

The efficiency of high value manufacturing processes can be enhanced by improving temperature measurement and control capabilities.

In this article we explore new fibre-optic thermometry developments as part of the European Metrology Programme for Innovation and Research (EMPIR)[1] project 'Enhanced process efficiency through improved temperature measurement – EMPRESS [2]'.

A key requirement for reproducible and comparable measurements is measurement traceability. This means that the calibration of the instrument can be traced back, through an unbroken chain, to the SI via national measurement standards. In the case of temperature measurement, this means traceability to the International Temperature Scale of 1990, which is a practical approximation to the SI unit of temperature, the kelvin .

There are many processes (e.g., brake pad production/testing, forging, silicon processing, nuclear waste processing, infrared heating) which strongly depend on temperature and which are not amenable to monitoring with conventional sensors such as thermocouples (due to contamination/transmutation/electromagnetic fields) or thermography (due to unknown emissivity/background radiation/reflections/no line-of-sight/inaccessibility).

Here methods based on optical fibres are ideal, but there are few traceable calibration techniques, and in some cases (ionising radiation) the darkening of the fibre needs to be overcome by the development of practical 'hollow core' fibres. Fibre-optic thermometers are also generally fragile and have a very restricted maximum operating temperature. The new fibre-optic thermometry developed in this project are summarised as follows.

Phosphor-based contact thermometer to 650 °C

Thermographic phosphors are well established for use in thermometry. When the phosphor is illuminated with a pulse of light from a laser or LED, it fluoresces with a characteristic decay time and wavelength dependent intensity. Providing the phosphor is calibrated *a priori* the temperature can be determined by measuring these quantities.

By coating the tip of a fibre-optic, a probe can be assembled which enables the phosphor thermometry to be performed remotely from the phosphor, with light transmitted and received along the fibre. The thermometer was built with the phosphor powder encapsulated in a ceramic tube that is bonded to the cleaved end of the gold-coated high-temperature fibre (Figure 1). The instrumentation has a blue (450 nm) LED coupled to the fibre that excites the phosphor. A dichroic beam splitter separates the emitted radiance from the excitation, and the emitted radiance is further divided into wavelength bands at 630 nm and 660 nm, again with a dichroic

[1] The EMPIR is jointly funded by the EMPIR participating countries within EURAMET and the European Union.
[2] https://www.bipm.org/en/publications/si-brochure

beam splitter. The signal at each wavelength band is detected with high sensitivity photodiodes, and the intensity ratio (IR) calculated. The thermometry system was traceably calibrated (IR versus temperature) and tested from -90 °C to 660 °C with an uncertainty of the order of ±1 °C. Furthermore, the thermometer proved to be completely unaffected by a very strong magnetic field (2.5 Tesla).

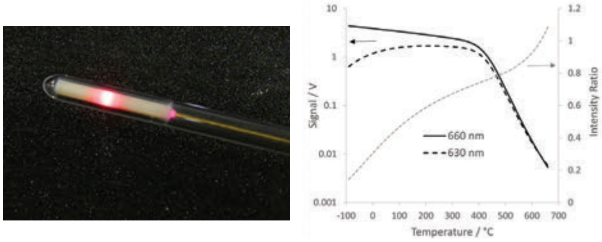

Figure 1: Left: NPL phosphor-tipped fibre-optic thermometer. Right: Phosphor intensity ratio calibration from -90 °C to 660 °C.

Novel hollow-core fibre-based thermometer for harsh environments

The University of Southampton has investigated various types of hollow-core optical fibres (which offer higher immunity to gamma radiation) for a phosphor-tipped fibre-optic thermometer, and concluded that for phosphor excitation at wavelengths of 450 nm and emission at 660 nm, antiresonant-type fibres (i.e. those optimised for transmission of light at visible wavelengths) are the most promising options (Figure 2). The new fibre design can deliver the excitation signal to the phosphor at the distal end and collect and guide the emitted signal back to the proximal end for analysis. Two types of antiresonant hollow-core fibre samples, the 'tubular' and 'nested antiresonant' fibres, have been fabricated, and interfaced with standard optical components.

NPL assessed the gamma radiation immunity of these fibres in its irradiation facility. The change in transmission following an exposure of 400 Gy (1 Gy corresponds to 1 Joule of energy deposited in 1 kg of material; to put it in context, a dose of 10 Gy is fatal within a few hours) was less than 2 %. This demonstrates that it should be possible to operate an intensity ratio phosphor thermometer with high gamma radiation immunity using hollow-core fibres.

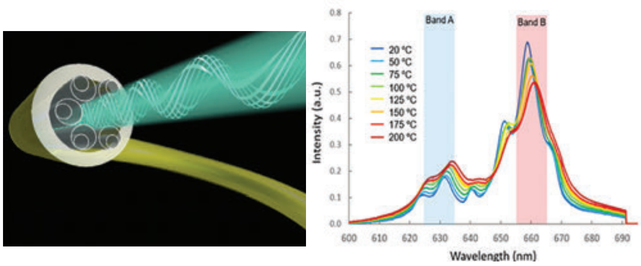

Figure 2: Left: Nested Antiresonant Nodeless Fibres (LANF) transmitting light in a hollow core (Image: Greg Jasion University of Southampton). Right: IR principle showing how the luminescence change with temperature. Phosphor is Mg4FGeO6:Mn.

Hybrid fibre-optic based high temperature sensor to 1500 °C

Temperature measurement up to 1500 °C is very challenging and often left to thermocouples or non-contact methods e.g., thermal imaging or pyrometers. However, in some cases these are unsuitable, and the advantages of a fibre-optic based thermometer are needed. To address this, a hybrid thermometer was constructed by IPHT, PTB and JV based on a Fibre-Bragg Grating (FBG). The FBG consists of a regular array written with femtosecond laser pulses into the sapphire fibre, which changes its reflection spectrum with temperature; by measuring this the temperature can be determined. The fibre also provides access to the thermal Planck radiation of the probe, which can be analysed with the same set-up as the FBG spectrum and enables a hybrid temperature determination.

Typical silica-based fibres are currently limited to around 1000 °C. FBGs in sapphire fibres have shown great potential, but they are currently limited in their measurement precision due to the complex multi-mode reflection peak. The challenge here was to develop FBG fibre-optic sensors based on sapphire fibres with the aim of combining FBG and the Planck radiation signal in a single hybrid sensor. By doing this, confidence in the measurement can be greatly improved as the redundancy of the two methods can be exploited.

To demonstrate its performance, a triple thermometer was constructed, consisting of a sapphire fibre for the hybrid FBG/Planck signal and a thermocouple in the same sleeve. The 80 cm long probe was installed in cooperation with Elkem in a silicon melting facility at REC Solar, a photovoltaic solar panel manufacturer in Norway, operating up to 1575 °C (shown in Figure 3), where thermometry is extremely difficult with thermocouples due to the disastrous effect of silicon on thermocouples. The first results are promising, with the triple sensor in the process at around 1414 °C (the melting temperature of pure silicon) showing good consistency between the three signals: 1417.5 °C was indicated by the thermocouple, while the FBG thermometer indicated 1416.3 °C and the Planck signal was in agreement within about ±5 °C. After several weeks in the industrial process with 300 hours above 1400 °C, the sensor was re-calibrated at PTB, where it was confirmed that the FBG signal does not drift within the measurement uncertainty.

Figure 3: Left: Silicon processing environment. Right: Probes emerging from the space above the melt pool.

These early developments, and related ones such as new traceable calibration techniques for distributed fibre-optic thermometers at CEM, are still being progressed and the authors are seeking exploitation opportunities. For further details contact jonathan.pearce@npl.co.uk or gavin.sutton@npl.co.uk

LOCAL SECTION NEWS

INSTMC WELCOMES RETURN OF SOCIAL EVENTS

Central Northwest Annual Dinner 2021

On Thursday 14th October 2021 some normality returned to Manchester. Central Northwest section hosted their annual dinner, having been forced to postpone in 2020, which was the first face to face gathering of any type since February 2020.

The CNW committee decided in March to try and run the dinner this year after feedback from companies confirming they would support the event, so we went for it, full speed ahead in April. This year's organisation was a bit bumpy to say the least. Our usual venue couldn't accommodate us this year, as they are supporting the government with a Nightingale court for 12 months, so a new venue was needed. After receiving some interesting quotes from some venues wanting to double the ticket price for the same service, we ended up with The Edwardian hotel in Manchester; a much more historic location than we are used to.

Next, we needed to watch closely whether the government would allow us to run the event - thankfully this was OK. We then needed confirmation people would come. We knew the event would be smaller than normal and therefore, were expecting a smaller, more intimate affair. So, the venue was a go, government was a go and we had a fantastic response to the event.

HTS Engineering Group provided us with administration support from Maria Tabiner, helping with the advertising, company interaction, invoicing and chasing. This allowed me and Stuart Wilson to get on with making it a safe and successful event in conjunction with the hotel.

We were very conscious that COVID rates in the Northwest were increasing in the weeks before the dinner and some companies did see some participants drop out. Some were replaced while others had

some empty seats. We asked every attendee to take a lateral flow test within 48 hours of the dinner and if the test was positive or inconclusive to not attend. This actually resulted in a few committee members not being able to attend too!

So it worked and we ran our event with almost 190 attendees. The evening was a great success with Manchester University attending for the 2021 awards presented on the night. There was a great presentation on how they needed to adapt the project with people building and testing robots via zoom! The Liverpool John Moore's university award winner was out of the region and will therefore have their award presented off-line.

The networking between companies, clients and the committee members was fantastic to see. The speeches we well received, and comedian, Gary Delaney entertained us all after the dinner with his visual take on the evening and the audience.

The networking opportunity for myself and the other committee members on behalf of the InstMC was great to be able to do after so long and I was very hoarse for the next few days!

We had a lot of positive comments on LinkedIn, supporting the success of the event, with great feedback from the survey too;

"Everything, so brilliantly organised and the venue, entertainment and food were excellent".

"The format and venue worked very well".

"…… the venue was fantastic as was the food and the entertainment was outstanding".

So now it begins; review and all ready to start planning 2022.

Dave Green Chair
Central Northwest
Local Section

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LOCAL SECTION NEWS

LONDON

Webinar: 'Stage Automation' presented by AVW Controls – 21st September

AVW Controls are a company with an international reputation in stage automation and will be one of many webinars which the London Section intend to present in future, away from our traditional Oil & Gas industry themes.

AVW demonstrated that theatre shows are rarely static and that there will always be the movement of people. Often, there will also be movement of scenery, transforming the stage from scene to scene, space to space, location to location. Sometimes in view, in carefully choreographed transitions. Sometimes invisibly, as if just by magic. Of course, the magic of this kind of stagecraft is rarely magic at all. The history of theatre stagecraft, particularly in traditional proscenium-arch theatres, is designed into the building itself. While the stage will be in full view of the audience, above it, hidden out of sight, would have been the fly tower – a place for scenery to hide until its moment comes. Although it could not be seen from a theatre seat, it could often be seen from outside: the tall rectangular box at one end is a feature that makes theatre buildings distinctively easy to spot. It's called the fly tower because scenery flies up into it. How this is done has changed over the decades, but for most of that history it has involved teams of people: the flymen (for men they most often were), pulling ropes. Originally, they pulled the scenery itself: 'hemp flying' ran a series of hemp ropes from a bar onto which the scenery was hung up to a grid at the very top of the fly tower, over pulleys and then back down to the fly floor, a platform located about halfway up one side wall of the stage. The limitation here was the strength of the teams of people versus the weight of the scenery. The scenery was often painted cloths and was manageable with the combination of several people pulling or, on occasion, sandbags or other weights tied to the ropes to provide a bit of counterbalance. But the constant need for greater spectacle led then, as it still does now, to bigger, heavier, more demanding scenery, and new approaches were required. One such: the drum tambour, a giant pulley in the grid above the stage. Ropes from the fly floor now rotated the drum, which in turn raised the scenery. The mechanical advantage gave the fly crew the ability to deal with much heavier scenery since they were no longer lifting it directly. These remarkable wooden drums can still occasionally be found, albeit unused, in theatres where there has been no need or no will to remove them. From the late 19th century, a new approach arrived, brought about by a new technology, theatre construction techniques: new buildings, at the same time steel-wire rope had become available, providing a stronger and more stable way of suspending scenery. However, the 20th century brought a much more refined version of the same counterweight system and was provided to cope with the three dimensional, heavily engineered sets for the next generation of theatre designers to automation – the motorised, computer-controlled movement of scenery.

AVW advised they have now developed and manufactured motion control products, complex computer-controlled automation systems to achieve the latest theatre and film requirements, demanding stunning spectacles. The Covid-19 pandemic caused major disruption to the entertainment industry, however, AVW are now building their QAxis stage automation systems for new and resurrecting shows, 'Joseph and the Amazing Technicolour Dreamcoat', 'Jersey Boys' and many more. AVW also develop automation systems for television shows, such as 'The Wheel', which powers a three and a half ton 14-meter diameter ring revolve. The revolve control system accepts position, speed, acceleration and deceleration OSC commands from a kinetic pixel show control system and returns real-time position and speed information for the synchronisation of graphics to revolve as it spins. The control system is based on a QAxis revolve control system named 'Revolver'.

Graphic detailing AVW QAxis system:

Features of the QAxis system include.

FINS Fast Ethernet communications, DMX controller (digital multiplex) over sACN streaming architecture for LX integration, PosiStageNet (PSN)-data protocol developed to communicate the position of identified points within a 3D space, OSC command for triggering cues, MTC timecode sync to external systems, named presets, Time/distance display, Weight readout, Sed Calculator, High and Low limits.

AVW advised 'Stage Automation' is the art of moving scenery and equipment, and often performs as if by magic. Movement created through machines is used in live and immersive entertainment to set the stage for a production or to propel the narrative into an entirely new direction.

The very essence of stage automation is a motor used for the muscle, which then connects to an electronic control box sending position information to a computer with automation control software. The operator sets the parameters to drive the scenery to any point on stage, at any speed desired.

Modern theatre stages are divided up into nine parts: upstage left, upstage right, upstage centre, centre, centre left, centre right, down stage left, downstage right, and downstage centre. A false floor built on top of the theatre stage, which contains technical elements such as automation tracks or revolves, concealed lighting or smoke effects. In some large shows, the show deck completely replaces the existing theatre stage, which is put back into position when the show has finished its run.

Barry O'Regan
Hon Secretary
London Local Section

NORTH EAST

Harry Orr Award 2021

Each year, the North East Local Section presents awards to the best students completing HNC and BEng courses in Instrumentation and Control at local colleges and universities. This year, the Harry Orr Award for the best student completing a BEng course at Teesside University was presented to Mr Nicholas List. His citation, written by Senior Lecturer, Mr Neville Winter is as follows:

It is my pleasure to support the award made by the local network of the InstMC to Nicholas List. Joining the BEng Instrumentation and Control Engineering programme as a mature entrant, Nicholas was able to utilise his previous experiences of academic study and industrial practice to smooth the transition into higher education. From the outset it was evident of the commitment and dedication Nicholas would show throughout his studies, spending many hours working in the university laboratories in independent study and utilising the other resources available to him. His assessment work was always completed to an excellent standard and deadlines were always met. When working as part of a group it was good to see the time Nicholas would spend with peers who were less experienced and potentially lacking in confidence as a result. This aspect was mutually beneficial and was another outstanding factor that demonstrated Nicholas' ability to contribute, something that will stand him in good stead for a career as an engineering professional. Colleagues and I are proud of his achievements and wish him well in his future career.

Congratulations to Nicholas on his award.

InstMC

Awards 2021

Congratulations to our Award Winners

Sir Harold Hartley Medal	Prof. Graham Machin
Honeywell International Medal	Dr. David Angeli
Callendar Medal	Prof. Adrian Long & Prof. P A Muhammed Basheer
Finkelstein Medal	Prof. Frank Härtig
Cornish Award (sponsored by WCSIM)	City University Team
Lambert Award	Prof. Eddie Lock
Hon FInstMC	EurIng John Morley & Prof. Ron Summers

Institute of Measurement and Control

www.instmc.org

INSTMC VIRTUAL 2021 AWARDS NIGHT

27TH OCTOBER 2021 6PM – 6.45PM

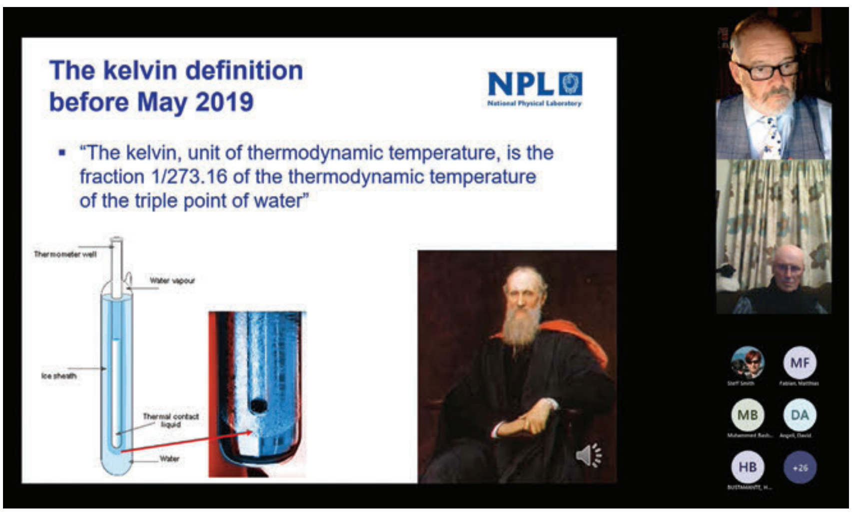
In October we hosted the 2021 InstMC Awards Night which, for the first time, was held virtually. Having been forced to cancel the event in 2020, due to the Covid-19 pandemic, we were pleased to be able to honour our award winners and acknowledge their achievements in front of an audience.

Around 40 attendees gathered online to celebrate the winners and to hear a short guest lecture from Professor Graham Machin, winner of the Sir Harold Hartley Medal. Graham gave us a fascinating presentation – 'A Career in Thermometry in 15 Minutes'- covering his work at NPL, including topics such as redefining the kelvin,

Covid-19 – what is fever? and decommissioning the UK's nuclear heritage. We also heard from InstMC President, Martin Belshaw, who spoke about new ways of working and opportunities that have come out of the Covid-19 pandemic as well as the advantages of being a member of a professional engineering institute. Ken Grattan, Prizes & Awards Committee Chair, honoured each winner by reading the citations and acknowledging their award, which will be physically presented next year.

We would like to take this opportunity to congratulate all our winners and we look forward to seeing you 'in-person' next year on 19th October at Prince Philip House, for our extra special event where we will honour all award winners from 2020, 2021 and 2022.

Visit our You Tube channel https://youtu.be/_qnxak4nAoU to view the recording of the event.



2022

The Institute of Measurement and Control is committed to promoting the professional excellence and standing of engineers and technologists at all levels in the automation, instrumentation, control and related industries.

Our aims are to serve the public by advancing the science and practice of measurement and control technologies and their various applications, to foster the exchange of views and the communication of knowledge and ideas in these activities, and to promote the professional development and qualification of our members.

ADVERTISING RATES

Discounts can be given if 3 or more adverts are taken. POA.

Full Page	£1,400
Half Page	£845
IFC	£2,250
IBC	£2,250
OBC	£2,250

INSERTS

A4 & A5 Inserts	£845

Inserts are accepted into Precision magazine and must go to the entire UK circulation.

CIRCULATION BREAKDOWN:

2519 UK Engineers / 500 Overseas Engineers
85 Companion Company Members

In 2017 the InstMC launched Precision, a new coffee-table style quarterly magazine, presenting technical articles related to measurement, control and automation. The journal is circulated to our 3000+ members and shines a spotlight on current topics, developing technology, opinion pieces and member-related news. It is also aimed at anyone interested in the various uses of measurement and control.

Precision is a positioning and marketing tool for the InstMC and speaks to a wider audience on the use of measurement and control in the world today.

PRECISION MAGAZINE

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 81 CCS members and are pleased to introduce some of them to you here.

Exloc Instruments UK Ltd

Exloc Instruments UK Ltd and our staff have many years' experience in the process industry and in hazardous area protection. We lead the way in supplying hazardous area products which enable manufacturing facilities and processing plants to operate more efficiently with the use of forward thinking technology and solutions.

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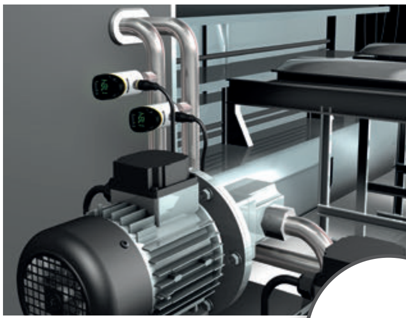

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Turck Banner Ltd is a UK joint venture company owned equally by two globally recognized leaders in the field of process and industrial automation; Hans Turck GmbH and Banner Engineering Corp. We offer efficient solutions for factory and process automation in many industrial sectors.

Although our name is synonymous with sensors the extent of our product range and expertise is far greater. Today Turck Banner supplies complete systems, LED lighting products and is recognised as a total solutions provider.

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NATIONAL
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Royal Academy of Engineering

Six engineering ambitions for the UK Spending Review

The National Engineering Policy Centre's submission to the 2021 Spending Review

September 2021

The National Engineering Policy Centre sets out six priorities for investment at this year's Spending Review, that are necessary if the government is to deliver its ambitions to 'build back better'[1].

Achieving a thriving, low-carbon economy and reaching the 2050 net zero target is an unprecedented challenge – in the scale and pace of policy change, action and investment that is required. Whether achieving the skills, digitalisation, infrastructure or research and innovation needed for the future, all are shaped by the need to achieve net zero.

The UK's path to net zero, and its ability to decarbonise at sufficient speed and scale, is contingent on urgent decisions made by the government now, and in the years that immediately follow – as reflected in the actions set out here. This must be in parallel with development of a far-reaching and comprehensive transition plan.

As engineers, we build and maintain the national infrastructure, built environment and the supporting systems on which society and the economy depend. Engineers have a vital role to play in creating systems and solutions to address the climate crisis and support sustainable use and management of natural resources. We innovate, design and create new products and services to improve the quality of life, and the safety, security, health, and wellbeing of the public. Our priorities come from that practical perspective.

Engineers and the professional engineering institutions to which we belong are ready and willing to support delivery of these priorities.

VIEW AND DOWNLOAD THE FULL REPORT AT
https://www.raeng.org.uk/news/news-releases/2021/september/engineering-profession-sets-out-six-clear-areas-fo




National Engineering Policy Centre
We are a unified voice for **42 professional engineering organisations**, representing **450,000** engineers, a partnership led by the Royal Academy of Engineering.

ACCREDITATION CORNER ASK TREVOR

Calibration Systems ISO/IEC 17025? ISO 10012? Or Both?

Trevor offers answers to metrology and accreditation questions and in this issue he considers the relative roles of ISO/IEC 17025:2017 and ISO 10012:2003 in providing assurance of the work undertaken in a calibration system.

The role of a calibration system in any organisation is to ensure that calibrations of measuring instrument and standards are conducted, are valid, consistent, and meeting the user's needs. That system may be for a commercial calibration laboratory or for a small part of a larger organisation needing calibrations within its own organisation, as would be the case of a manufacturer, either of measuring instruments or of any goods needing to meet a technical specification.

The standard ISO 9001 specifies management system features, previously known as "quality systems", which should ensure consistent fulfilment of requirements. It may be applied in any industry or commerce situation and is very broad in application. It is revised and modernised every few years and presently features a risk-and-opportunity-based approach which is necessarily less prescriptive than hitherto. There are sectorial interpretations for some industries and these are more focused on that industry's needs. The standard ISO 10012:2003 might be considered as such an interpretation for organisations with calibration systems. Certainly, if ISO 10012 is followed then that management system should comply with ISO 9001 for that work. It is presently under review and may be republished with a version featuring risk and opportunity to match the latest ISO 9001.

The essential difference between ISO 9001/10012 and ISO/IEC 17025 is that the latter contains competence criteria as well as management system features. It is used by accreditation bodies to accredit the competence of calibration laboratories as it also contains technical requirements to be met by a competent calibration supplier giving valid results.

Features manifest in a competent calibration supplier would include all these below:

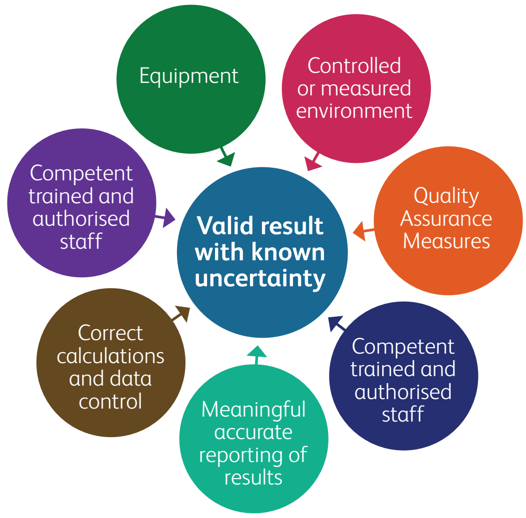
A management system ensuring consistency of application, understanding and implementing customer requirements. It features contract review, internal audits, complaint handling and more. It is usually described in some form of quality manual. This is covered by 9001/10012 or similar as well as in 17025.

Technical Competency as provided by staff training, competency criteria, suitable equipment and environment, validated and verified methods and procedures, uncertainty budgets (no result is valid without knowledge of how uncertain that result is!) and more. This is described in 17025.

Quality Assurance Measures to ensure that valid results are actually obtained in practice. "The proof of the pudding" by taking part in interlaboratory comparisons with other laboratories. This is an important feature to provide confidence and to be compliant with 17025.

Diagram 1 shows the main features of a credible calibration system. A management system demonstrating the consistent fulfilment of the technical requirements of ISO/IEC 17025 is also required. That management system is described in ISO 17025 itself or use may be made of ISO 9001 as a basis.

Diagram 1



Trevor Thompson is an experienced metrologist and accreditation specialist. Semi-retired from UKAS and now independent at www.bestmeasurement.com he looks forward to receiving any questions you may have. Contact Trevor at questions@bestmeasurement.com

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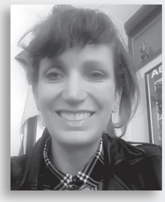

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