New Royal Academy of Engineering Fellows announced in the field of Ultrasonics

The Royal Academy of Engineering (RAEng) is a learned institution and charity whose stated aim is to harness the power of engineering within the United Kingdom in order to build a sustainable society and an inclusive economy that works for everyone. They work to grow talent and develop future skills, driving innovation, building global partnerships, influencing policy, and engaging with the public. The Royal Academy's Fellowship represents the nation's best engineering researchers, innovators, entrepreneurs, and business and industry leaders. Election to the Academy is by invitation only; about 50 Fellows are elected each year through peer review and nominations made by existing Fellows. They are distinguished by the title Fellow of the Royal Academy of Engineering and the post-nominal FREng. This year, two of the Fellows elected were recognized for their contributions to the field of Ultrasonics. We took the opportunity to meet each of them to discuss their career and what the award means to them and their field. Meet Professor Zegiri FREng.

Professor Bajram Zeqiri FREng

Professor Bajram Zeqiri FREng, is a National Physical Laboratory (NPL) Fellow in Ultrasound and Head of Science for Medical and Marine Physics within the Medical, Marine, and Nuclear Department at NPL. He is an internationally recognised leader in the field of ultrasound metrology, specifically supporting its medical and industrial applications. He has been an NPL Fellow since 2008. His research has been instrumental in developing devices, calibration methods, and specification standards critical to ensuring the safe and effective application of diagnostic and therapeutic ultrasound technologies. His passion for technical innovation is reflected in a string of patents and broader IP generation. He works closely with industry, forming strong partnerships with national and international companies, seeing this as a key mechanism for accelerating the impact of NPL's work. This has enabled the adoption of his innovative ideas in a range of engineering applications. He was appointed Visiting Professor in the University College London Department of Medical Physics and Biomedical Engineering in 2019.

Bajram gained his Chemical Physics degree and Ph.D. on the topic of "Thermoelectric power studies of fluorite crystals" at the University of Kent (Canterbury). After University he joined NPL in 1983 where he began his research career in the field of ultrasound. In the last few months, he was elected a Fellow of the Royal Academy of Engineering and additionally awarded the Institute of Physics James Joule Medal and Prize.

1. **Congratulations on becoming a Fellow of the Royal Academy of Engineers, can you explain what this means for you and your career?**

I've always regarded this appointment as the pinnacle of what one can achieve as a scientist or engineer. At NPL we have about 700 scientific staff and only 7 RAEng fellows. So, it's really quite special and actually something I never thought I'd achieve. For the first 30 odd years of my career, I was fully focused on my research work but I guess it's only late in life that I've realised the importance of this type of recognition. It recognises not only my work but that of my Group at NPL. It also gives me a huge sense of pride given my background. I was born in a refugee camp in Italy, from a Kosovo-Albanian father and Italian mother and we came over to the UK when I was two. In the council estate

I grew up in the UK, it was very unusual to go to University (I think I was only the second person to do so). So, my feeling is that this type of recognition is important in highlighting to people from non-traditional and diverse backgrounds their potential in terms of what they can bring to engineering and what they can ultimately achieve. I've really enjoyed every single part of my research career with the range opportunities it has brought to continually learn and develop and looking back I really wouldn't change a single thing.

2. Your career has been predominantly in a national lab setting, can you tell us a little about your career path and what you've been most proud of in your achievements?

After my Ph.D. I was hired at NPL to join the relatively newly established and small Ultrasound Group. I was given my own project to set up a facility for measuring the acoustic properties of tissue-mimicking materials. I then moved on to many other projects including the use of hydrophones, measurement of power, cavitation and most recently developing a solid-state sensor for imaging breast tissue. Although I've worked in the field and at NPL for a long time it never gets boring because the projects keep changing as do the challenges and the intellectual stimulation. What I've really liked about the national laboratory setting is the ability to shape work in the direction you want to go. Of course, to get research grants and work programmes approved you rightly have to justify why you intend to work in an area in terms of its ultimate likely impact and it helps that ultrasound has so many exciting medical applications. I have particularly enjoyed what you might call the middle ground between academia and end-user application. You are always able to see very clearly the impact of your work; whether it is in terms of paper citations, the way in which your research outputs are employed, or in terms of how techniques or models have supported standards development. There is something you can point to something and say look that's what I've done; that's the difference the work has made. Blue sky research is very important, but I always like to have an end problem and application in mind. Also, within the context of a national laboratory with relatively stable funding, at NPL we had more time to really look into a subject and understand it, especially for standardisation. Additionally, the opportunity to collaborate with other European national laboratories and standardization committees was a key part of the work I enjoyed.

One of the areas of my research I'm most proud of was my team's work on acoustic cavitation detection. After patenting the initial hollow sensor, we won some internal funding to build a new type of reference facility. That was really exciting because no one else had established this type of facility before and we won the IEEE UFFC-S best paper prize in 2003 for the sensor design. Then we developed further instrumentation for use in combination with the sensor which won the Ultrasonic Industry Association prize. The most impactful part of my career has probably been the work I did with the UK SME Precision Acoustics developing various measurement-related products including specialist absorbing materials which still today have many customers worldwide. So, my career has been a combination of academic type focus on developing an understanding of ultrasonic measurement, its application to real-world problems but also on the business side in terms of delivering impact. Bridging all of this there's a real need to understand what users want in terms of new capability.

3. What challenges have you had to deal with in your career?

Despite my comments about the stability of funding for a national laboratory such as NPL, I guess the real big structural challenge has been the many changes in the laboratory organization over the years. I joined as a government civil servant but in 1995 the government decided to part privatise NPL. It was known as a GOCO (Government Owned, Contractor Operated). It was a worrying time for many of us regarding the future direction of the laboratory. However, although it may not be a view shared by everyone, looking back, I think that the GOCO model put a beneficial buffer between us and

Government and also helped us develop the commercial side of the business with the driver to develop more impact for the UK. We also have the same issues as in traditional academia with funding cuts, and this is always a challenge in terms of prioritising and refocussing work. With this in mind, my feeling is that NPL, across all of our 25+ technical fields, punches above its weight at an international level. Both locally and across NPL we continuously have to make sure that we do not spread ourselves too thinly and identify which projects to prioritise.

4. What inspires you about the future of ultrasound and what you think might be the next big innovation, what area of research do you think attention will be focused on?

I think quantitative medical imaging in general is going to be really big across a range of modalities. I guess generally people don't realize that the ultrasound images you have today (and medical images in general) are relative in nature and depend on the skills of an operator and equipment settings in a frequently complex way. As a metrologist, I am interested in turning these images into measurements that are independent of both instrumentation and user. There is a much bigger emphasis lately on measurement to aid precision medicine and that's going to be helped along by artificial intelligence and machine learning. If you are basing diagnostic decisions on these measurements, then understanding the imaging process or pipeline as a measurement and the uncertainty that can be achieved becomes critical. Other areas that will develop are HIFU and transcranial ultrasound research for neurostimulation. We've been working on the metrology required for HIFU development for over 15 years so that other researchers and companies can employ measurement techniques and devices for whatever final applications they're focused on. The assimilation of measurement with traceability is the key thing, so people can compare different systems in a reliable way in order to underpin safety and efficacy. I'm really positive about the future - you do tick a lot of boxes with ultrasound; non-ionizing radiation and safe application, the generally low cost, so I think ultrasound has a really promising future.

<u>IOP James Joule Medal and Prize update:</u>

Since Professor Bajram Zeqiri's interview with UFFC-S regarding the RAEng Fellowship, he has also been awarded the prestigious Institute of Physics James Joule Medal and Prize for his distinguished contributions to the development of acoustic measurement techniques and sensors; in particular, underpinning the provision of international standards enabling the safe clinical application of medical ultrasound.

Amendments:
Bajram Zeqiri
28-February-2022