

advances

THE JOURNAL FOR SCIENCE, ENGINEERING AND TECHNOLOGY IN wales

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ISSUE 67

Global reach

How a marine biologist in Wales is helping to protect coral reefs around the world

Products to assist and protect soldiers on the front line 12

Crucial breakthrough in breast cancer research 14

A new design for the hyperspectral camera 18













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THE JOURNAL FOR SCIENCE, ENGINEERING AND TECHNOLOGY IN WALES

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Much has happened since the previous issue of *Advances Wales*. It is no secret that we live in tough economic times, and that this has caused hardship for many. However, we share these tough times with almost all countries in Europe.

We all have one thing in common: we can improve our future economies only by investing time and effort in innovative new businesses.

Innovation is central to future economic success, and here in Wales we have many examples of innovation to show the world. That is what this magazine is for: to showcase the diversity and sophistication of academic partnerships and commercial success in Wales.

The first third of *Advances Wales* reports news on business and academic developments in or affecting Wales. In this issue, for example, you can read about an agreement between British Airways and the University of Glamorgan to combine technical training with the enhanced career prospects of a university degree, or about how Wales has become the first country in the world to DNA barcode all its flowering plants, opening up huge potential for the future of plant conservation and human health.

Feature articles make up most of the remainder of each issue, and aim to demonstrate the success that an innovative approach brings. On pages 10 and 11 of this issue you will find a special feature on four companies that have enhanced or developed products and services featured in previous issues. That they are featured again is proof that innovation is part of their corporate DNA, proof that past innovation creates future investment.

Other articles report on products that protect soldiers in the field (p. 12), a model of how seagrass meadows may reduce the impact of acidification on coral reefs (p. 16), innovative variable-speed motor drives to help increase energy efficiency (p. 20) and a new tool to aid the analysis of sedimentary rocks (p. 27).

And that covers less than half of the content. I could just as easily have picked any of the other features to demonstrate that the Welsh economy is investing in exciting new products and services.

The hard times are not over, but the problems that face Wales are ones that face most modern economies. Some economies and countries will undoubtedly do better than others in the coming years. Those that do well are planting the seeds of innovation now in order to reap the benefits in future years. I believe that in the long term Wales will be one of those winners: I see too much evidence of ingenuity and commitment to market success to believe otherwise.

Finally, if you have developed a new application of science or technology, or established a new manufacturing process, then we want to hear from you. Your contribution to the success of the Welsh economy deserves to be showcased as widely as possible.

Catriona Vernal
Editor, *Advances Wales*



COVER IMAGE A marine biologist at Swansea University has developed a model of how seagrass meadows may reduce the impacts of ocean acidification on nearby coral reefs (see p. 16)

PHOTOGRAPHY Sourced from organisations featured, their representatives and iStockphoto.

Advances Wales is a high-quality, quarterly 'transfer of technology' journal produced by the Welsh Government to showcase new developments in science, engineering and technology from Wales. Devoted to concise reports and commentary, it provides a broad overview of the current technology research and development scene in the Principality. *Advances Wales* raises the profile of the technologies and expertise available from Wales in order to facilitate collaborative relationships between organisations and individuals interested in new technologies and innovation.

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Cardiff professor leads NATO project against bioterrorism

New research aims to develop a vaccine against anthrax to help counteract the threat of bioterrorism

WORKING WITH SCIENTISTS from the Republic of Georgia, Turkey and the USA, Professor Les Baillie of the School of Pharmacy and Pharmaceutical Sciences at Cardiff University is leading a NATO project to tackle the potential misuse of anthrax.

'Currently the majority of the world's population is susceptible to infection with *Bacillus anthracis*, the bacterium that causes anthrax,' according to Professor Baillie. 'The US postal attacks in 2001 highlighted the vulnerability of civilian populations and brought home the need to develop effective, rapid, robust medical countermeasures to combat the threat posed by terrorist use of this organism.'

Growing concern over the threat posed by bioterrorism has prompted world authorities such as NATO to support efforts to develop more effective vaccines and medical countermeasures.

But these efforts have so far been hampered because scientists have been unable to trial the efficacy of the vaccines on humans.

Such trials require access to several thousand volunteers at risk of infection and so would be almost impossible to perform in Western Europe or the USA.

In contrast, anthrax represents a significant disease of animals and humans in the Caucasus and Central Asia. For this reason, researchers from the UK and USA have joined with colleagues from Turkey and the former Soviet Republic of Georgia to tackle the problem.

The outputs of this study are expected to underpin the development of future vaccines capable of conferring broad-spectrum, robust protection following minimal dosing.

This would directly improve the life of workers at risk of contracting anthrax,



such as farmers. These vaccines would globally contribute to the protection of citizens from the use of anthrax as an agent of bioterrorism.

www.cf.ac.uk/phrmy

Super score for Welsh football medicine

THE WELSH FOOTBALL MEDICINE INSTITUTE (WFMI) has been accredited as a FIFA Medical Centre of Excellence, the first in the UK.

The accreditation comes as a result of recent collaborative work between the Football Association of Wales (FAW) and the Cardiff School of Sport at Cardiff Metropolitan University.

The WFMI was created to manage and provide a range of sports medicine services to footballers of all ages and abilities across Wales.

Andy Miles, Director of Enterprise at Cardiff Metropolitan University's Cardiff School of Sport, said: 'This is another remarkable first for Cardiff Met.'

'We're delighted that the WFMI has become the UK's first FIFA Medical Centre of Excellence.

'It's a high accolade and one that will help attract more positive attention to

the Cardiff Sport and Exercise Medicine Centre along with high-quality students, staff and associates.'



The FAW and its partners have identified injury prevention and the health and well-being of football players of all ages and levels across Wales as key strategic priorities and so the Institute's aim is to coordinate and provide sports medicine and science services,

education and research to male and female footballers of all levels across the country.

FIFA wants players of all levels and standards to have access to expert help and education regarding their health and well-being so that, when players are injured, returning to fitness as soon as possible is a priority. This process needs to be monitored and controlled to prevent re-injury as a result of returning too soon, and good sports medicine support allows players to return after appropriate recovery to ensure that they can enjoy playing for many more years.

FIFA accredits established centres that have demonstrated their leadership in football medicine. These centres offer a team of specialists from different fields working together to protect players' health and well-being.

www.faw.org.uk

Enabling communication for stroke victims

Research at the University of Glamorgan is helping to make life a little easier for people with severe motor disability

Every year in the UK, an estimated 150,000 people suffer a stroke. Strokes often result in a loss of cognitive and motor functions, dramatically undermining quality of life. The condition affects mostly the over-65 population and presents a significant financial (£8.9bn) and social cost to society – a burden likely to increase with demographic trends.

A small proportion of people who have suffered strokes develop locked-in syndrome: an extreme case of motor disability in which the patient loses control over almost all of his or her body. Patients with locked-in syndrome find it extremely difficult to have a normal life because of

their inability to move or communicate freely. Such frustration and difficulties often add a psychological angst to their physical suffering.

One of the most limiting difficulties is the loss of the ability to communicate. Brain-computer interfacing (BCI) has been proposed as a solution. This is the use of brain signals as a non-muscular communication channel, where mental states can be recorded and used as direct input to external devices such as computers. The use of electroencephalography (EEG) as a modality for BCI has gained interest in recent years, mainly because of the

reduced cost of EEG acquisition systems as well as the cost of real-time computing.

It is now becoming clear that slow performance is a major hurdle in the wider application of BCI-based spellers.

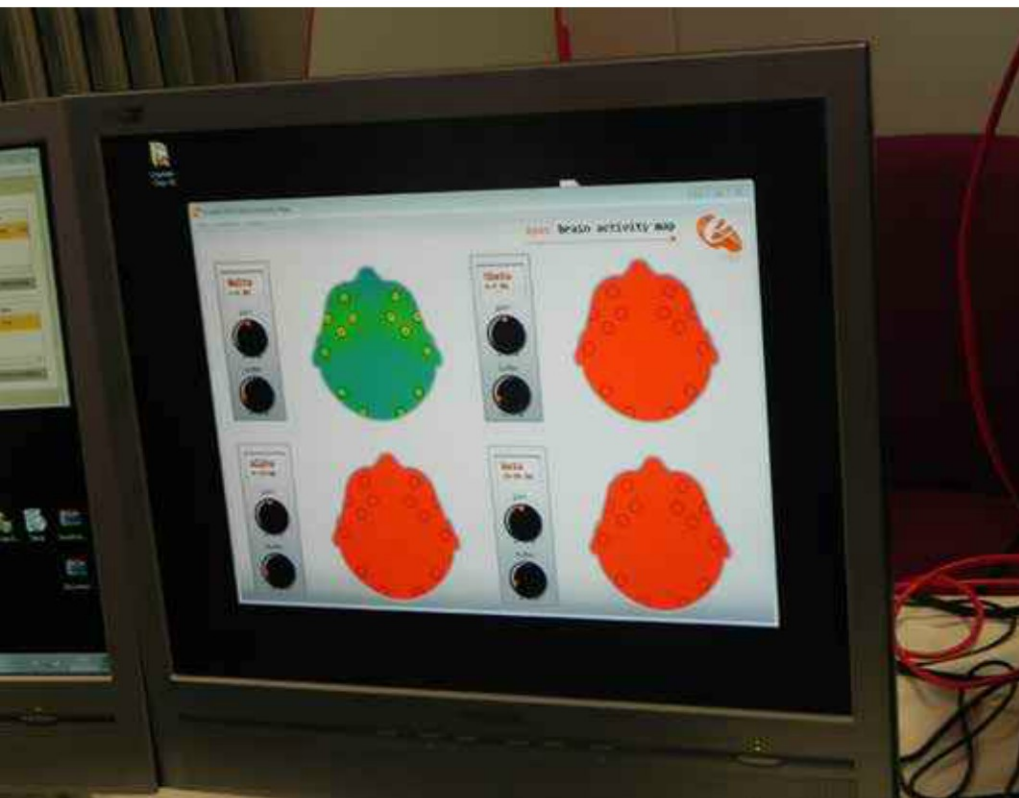
Dr Ali Roula
University of Glamorgan

Previous methodology

Many BCI systems that have been proposed present the disadvantage of slow character translation, which partly explains the lack of adoption. Most previously proposed speller systems use a distinguishable brain signal called P300, an evoked potential in response to external stimuli, because event-related potentials produce more prominent signals than non-evoked potentials, and thus present the advantage of greater accuracy. These systems use what is called the oddball paradigm, by which the user is presented with a graphical user interface containing a grid of alphanumeric characters.

The visual brightness of these characters is intensified at random one at a time, or one row a time. A P300 response can be recorded when the character under observation is intensified. The timing information of the response can be used for character recognition.

This approach is, however, slow because the user has to wait for the randomly generated highlight to reach the letter under focus. Typical systems





achieved a 92.5% accuracy using a 6 by 6 character matrix where one row is flashed randomly at a time (until a response is elicited) followed by columns.

This means that, on average, it takes seven intensification cycles per character, with a possible maximum of 12 cycles and a minimum of two, an average of 22 seconds per character.

New approach

A research group at the University of Glamorgan in South Wales, led by Dr Ali Roula, has focused on improving the speed of BCI spellers to make them more useable by people suffering from locked-in syndrome.

They have proposed a new approach that incorporates the use of motor-evoked potentials (MEPs), which are generated when a subject vividly imagines moving a limb such as a left or right hand.

Motor imagery has been shown to elicit signals in EEG in the form of mu rhythm event-related desynchronisations.

Because these potentials are elicited by the user's thoughts, they are nearly instantaneous, in that there is no need to wait for external stimuli to respond to, which could potentially result in an increase in spelling speed.

Detecting these potential changes is more challenging because they are much smaller. An advanced signal processing technique called wavelet is used for

maximum information extraction. It works by analysing signals in time and frequency domains simultaneously.

Dr Roula's team has achieved successful brain to computer character translation at double the average speed of the best systems to date. Future work will focus on improving accuracy rates and testing the system on a large sample of users to assess its performance and robustness. ■

Profile

- Product** Research into the use of motor-evoked potentials to increase the speed of BCI spellers
- Applications** Aiding sufferers of locked-in syndrome (severe motor disability)
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