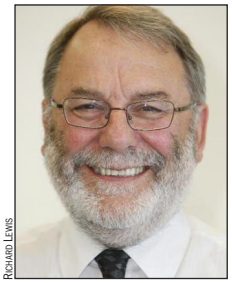
Physics and: the 2012 games

An Institute of Physics briefing note



RICHARD LEWIS

Two months of sport are set to descend on London for the summer, and this time they're inextricably linked with physics-based technology.

The relationship cuts both ways. Physics has helped the games to happen in the first place, to improve them as a spectacle and to ensure their safety and security.

And conversely, the games have spurred improvements in infrastructure, catalysing the installation of newly developed technology that will lead to healthier, more productive lives as well as enhancing the public's leisure time.

From increased broadband capacity and Wi-Fi at tube stations to instruments detecting air pollution across London, the benefits will last for years to come.

This legacy is just a handful of examples of what physics can achieve, given the proper investment.

With visitors from across the globe visiting the UK over this summer, the games have provided a powerful incentive to develop specific technology and infrastructure for a particular occasion. Sustained support for physics and its resulting innovations would be better still, putting this country back on the winner's podium and ensuring its economy can keep pace with its competitors.

Prof. Sir Peter Knight
President, Institute of Physics

"Wi-Fi will improve the journeys of millions of people that use the Underground every day at no cost to taxpayers."
Virgin Media statement

"What this set of games will reveal is still something of a mystery, but sure as (Olympic) shooting, physics and physicists will be in the thick of it."
Norman Apsley,
Institute of Physics vice-president, business and innovation

Sport enabled by technology

Fairer and faster

Physics is not only helpful in improving athletes' performances or techniques – such as by biomechanical analysis of throw, mathematical modelling of running technique, or electronic devices to improve breathing – and healing or examining their injuries through medical technology such as ultrasound. It can facilitate a sport becoming both fairer and more entertaining too.

In Beijing in 2008, Britain's taekwondo competitor Sarah Stevenson was initially wrongly knocked out of the contest after judges failed to spot a last-second kick that would have won her a semi-final place. A protest saw her later reinstated. Such decisions have now been partly taken out of the hands of fallible human judges and entrusted to computers, with touch sensors integrated with the contestants' body armour.

The pressure sensors are wirelessly connected to a computer which records point-scoring. The sensors and the transmitter have to be small and flexible enough not only to fit within a martial artist's protective equipment but also to allow them to perform complex movements without impediment. This is all enabled by the continuing incremental improvements in making technology smaller and smaller.

Competitors in the sport are said to have changed their technique in response to the introduction of sensors, making for a more fast-paced and exciting contest. "They've certainly improved the transparency of the sport," says British Taekwondo president Adrian Tranter. "That in itself has to be good for public perception. It's also changed the game – it's continued to make the sport evolve and grow. Our sport is always changing, and I think that's a good thing."

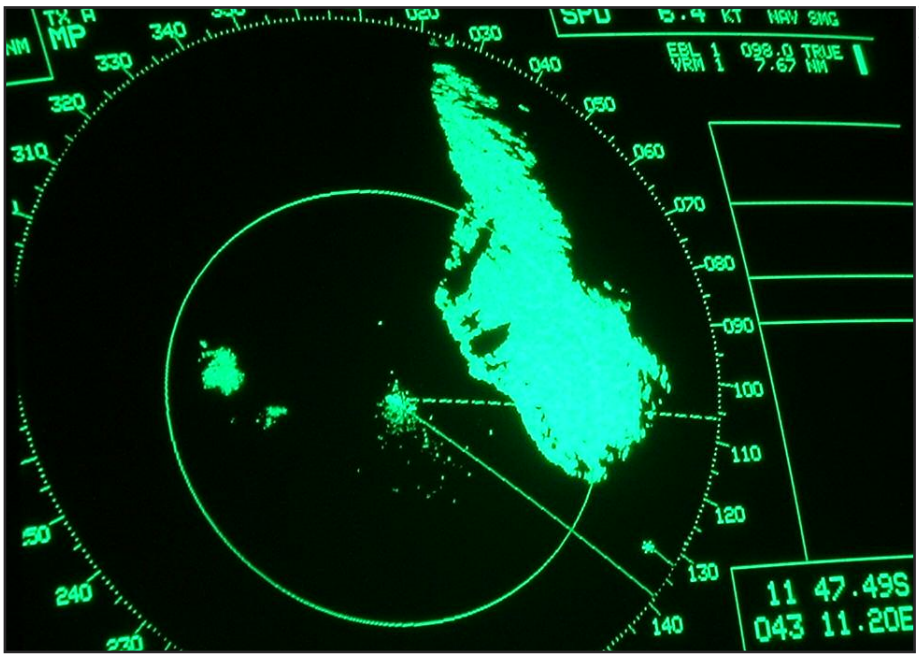
Physics will ensure security through radar, chemical detection and biometrics

Spectator safety

As well as in producing an entertaining spectacle, physics has proven important in communications, ticketing and, of course, security.

Much of the ticketing and payment system is contactless, relying on radiofrequency identification technology similar to that used in the Oyster card, use of which has become increasingly commonplace since a drop in cost in 2010 as the technology has been perfected.

The security arrangements for the games are comprehensive. Defence against attacks from the air will be provided by new electro-optical >>>



JAMES STAPLEY

Radar is one of the physics-based technologies that will help to keep the games safe

sensors as well as traditional radar systems, which are increasingly compact and precise as electronic components become smaller and cheaper. Equipment used to detect chemicals such as explosives is derived from the instrumentation on telescopes originally designed to investigate the composition of celestial bodies. Staff working on sites used for the games have to pass through biometric scanners, being granted access only after precision measurements of bodily features such as irises confirm their identity.

Technology based on the steady developments of physics made over the years will help to ensure that this summer's games are safer and smoother than ever.

FURTHER READING

Reports

- *Technology for the Olympics*, POST-note346
- *Supporting a UK success story: the impact of university research and sport development*, Universities UK/ British Universities and Colleges Sport/ Research Councils UK
- *Radar: A case study highlighting the vital contributions physics research has made to a major technological development*, IOP, 2011

Previous briefing notes

- *Physics and: digital security*, 2011

Institute of Physics publications and policy documents are available online at www.iop.org.

A physics-based legacy

Connecting the city

The installation of Wi-Fi at underground stations will be of immediate benefit to Londoners, particularly during the games themselves, allowing tube passengers to access the internet on mobile devices from ticket offices, escalators and platforms despite being beneath ground.

The rollout of Wi-Fi, being undertaken by Virgin Media, will not only allow passengers to continue working or accessing entertainment while in stations, but will also allow them to receive up-to-the-minute updates on the running of train services, helping to reduce the expected congestion during the summer months. The company says in a statement that their Wi-Fi installation will "improve the journeys of millions of people that use the Underground every day at no cost to fare- or tax-payers".

Wi-Fi technology has been in development for around 20 years, but there has never been as powerful a reason for it to become as widespread as now. Many cities across the world already have free-to-use Wi-Fi covering the whole town – Sunnyvale, California and Minnesapolis, Minnesota in the US, Mysore in India, and Jerusalem. South Korean capital Seoul will join them by 2015.

With greater demands on wireless communication generally – OfCom estimates that usage will double over the summer – making sure there is enough bandwidth available to those who need it is also a challenge. Some of the increased demand will be met by freeing up spectrum no longer required since the switch to entirely digital TV broadcasting.

Similarly, the BBC is set to increase its live web-streaming capacity to cope with the volume of viewers expected to view the games online.

A new 'pollution radar' will let councils better manage traffic and respiratory health

Improving the atmosphere

The games will see the first large-scale trial of CityScan, a system developed by physicists at the University of Leicester that monitors the level of pollution in the city's air. The trial is funded by the Natural Environment Research Council as part of its Clean Air for London programme.

CityScan was developed by the university's Earth Observation Science Group, and uses scattered sunlight to monitor the amount of gases such as nitrous oxide in the air. Two or three of the devices working together can create a 3-D map of atmospheric gases across the city – its creators describe it as a "pollution radar".

With 11 m extra people expected in the capital over the summer and an additional three million car journeys on the busiest days, the games provide an ideal opportunity to examine how traffic affects the urban atmosphere. Using the technology more widely is expected to benefit local authorities across the UK by allowing them to improve environmental planning and traffic management as well as enabling people with respiratory problems affected by pollution to better manage their health.

The achievements of investment

"Mounting an event of this magnitude, in which the world's elite will compete to fractions of a millimetre and milisecond, and which the whole world will be watching, is an opportunity to solve a myriad of new problems," says Norman Apsley, the Institute's vice-president for business and innovation. "The trick for us, when it's all over, is not just to have a legacy of development sites but to have a corresponding myriad of solutions, tried and tested and ripe with potential for further commercial exploitation."

This is a small sample of the ways in which physics-based developments can be of benefit to the UK. Spending two months with the eyes of the world on London, and the feet of the world in London, happens to have provided an incentive to invest in technology, or an opportunity to test it widely – even though technology was not a specific part of legacy-planning.

Continued support for and investment in physics and innovation, even when there isn't sport taking place, would achieve even greater things still.

STEPHEN TAUNTON

Commuters will now be able to access the internet from tube platforms for the first time