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X-ray specs promise new insights

DIT research group is exploring the exciting applications of ultra-wide band radar technology, writes **Karlin Lillington**

Described by one researcher as "the original X-ray specs", ultra-wide band (UWB) radar devices can see through walls, the ground, snow, rubble, or the human body – suggesting a wide range of relatively unexplored commercial applications in search and rescue, medicine, or object discovery and retrieval.

The possibilities are inspiring a research group at Dublin Institute of Technology (DIT), recent recipients of a €106,000 grant from Enterprise Ireland, to perfect the components at the heart of the systems, the antennae that send and receive the radar signals.

The antenna & high frequency research group at DIT's School of Electronic and Communications Engineering is part of the eight-university CTVR (Centre for Telecommunications Value-Chain Research) unit based at Trinity College, one of the C-Set (centres for science, engineering & technology) R&D groups set up and part-funded through Science Foundation Ireland.

"Some call it the ultimate X-ray specs, where you can see through things. You can aim it like a torch," says Dr Donal O'Mahony, director of CTVR. "It has a number of very interesting properties, such as carrying a huge amount of information over short distances."

The release of ultra-wide band spectrum for research and development in 2002 – previously classified for military use only – is what has spurred researchers to think about fresh applications for the technology, says DIT researcher Dr Max Amman, whose work on antennae has given him and the DIT group a long list of publications and a high international profile in the area.

"We believe ultra-wide band systems were used during the Vietnam war; because they can penetrate into the ground, they were probably used for landmine detection," says Amman.

But the lack of the cheap computing power widely available today meant that it was probably difficult to analyse the signals back then or develop other inexpensive, practical applications. Now that has changed, and the declassification of UWB spectrum means new uses are finally being explored.

Amman says little is currently known about how the technology has been used "because the military doesn't publish research papers". The knock-on effect has been that only now, half a decade later, are researchers beginning to realise the possibilities – especially in medicine – for a technology that is safe (no radiation waves are needed, in contrast to X-rays) and cheap (devices could be the size of a flashlight and cheap to manufacture, unlike multi-million euro magnetic resonance imaging machines).

Perhaps unsurprisingly, the first commercial application for UWB was as a transport mechanism for large data files in the electronics industry. "The initial take-up was for communications – for wireless data transfer from, say, a digital camera to a laptop," says Amman.

As home and office digital networks proliferate, the research under way at DIT could be applied in this area: allowing laptops to connect wirelessly to office networks, or forming wireless connections between consumer electronics devices and computers.

But some of the most interesting and unusual applications take advantage of UWB's "see-through-walls" abilities.

A flashlight-like beam from a handheld device could scan rubble from a collapsed building or snow after an avalanche to pinpoint bodies – and could even tell if people were alive, because one attribute of UWB is that it can "see" dynamic systems, such as a beating heart or breathing lungs.

Hence, one existing medical application is the monitoring of patient respiration, because the technology has very good resolution and can see movement in the heart, lungs and blood vessels. A scanning device could also be used instead of ultrasound for foetal monitoring, Amman says.

UWB can also locate and provide information on tumours because of the particular electrical properties of tumours, he says.

This makes UWB far more accurate and informative than X-rays for this particular use.

"It's also very safe because the power levels are minuscule," he says.

However, MRIs are better for seeing structures deeper in the body, because UWB has limited penetration of human tissues, he adds.

Another promising medical use for UWB is to heat tissues. One DIT doctoral researcher is exploring using heat generated by UWB to treat cancer tumours. UWB has also been used to revive hypothermia victims, Amman says.

The Enterprise Ireland grant is intended to help researchers move their antennae designs towards commercialisation, perhaps through a partnership with a medical device company.

The antennae are extremely important, as the better the design, the better the quality of the image and the information conveyed. Poor design means the device might see false targets and ghost images, says Amman, and different purposes may need different types of antennae.

Does that mean cheap, effective devices are way off in the future?

"I think development will happen quickly. There are no critical components – the only critical component is the antenna," he says.

While a medical device company would make an an obvious industrial partner, Amman says the group are happy to develop antennae for any range of applications.

"We love antenna design – and we don't really care what happens with them," he says with a laugh.

Bavarian Alpine rescue workers dig through the snow during an annual avalanche dog training session: one of the possible applications of UWB technology could involve a flashlight beam from a handheld device scanning snow after an avalanche to pinpoint bodies, and could even tell if people were alive. Photograph: Reuters