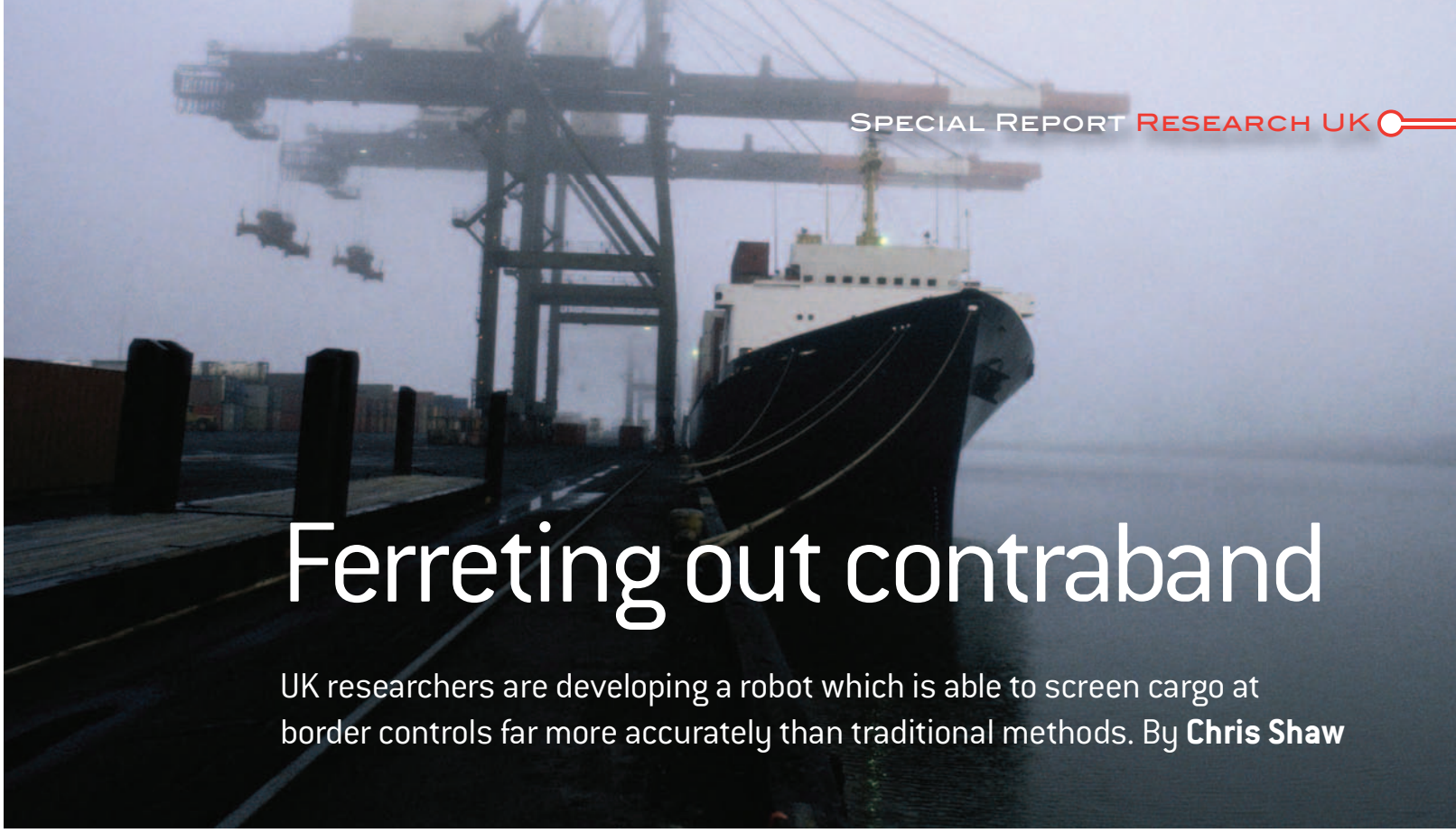


Ferreting out contraband

UK researchers are developing a robot which is able to screen cargo at border controls far more accurately than traditional methods. By **Chris Shaw**

Smuggling – whether goods or people – is a growing problem and one which presents challenges for those charged with countering the practice.

While a variety of technologies is available, the screening systems are external, typically bulky, expensive and require ultra high sensitivity as the sensor is remote from the cargo. Further investigation requires either time consuming unpacking of the cargo or the need for staff to enter the container, putting them at risk of potential contamination. There is, therefore, an urgent need for an alternative solution that overcomes the shortcomings of current techniques of detecting cargoes.

"While current cargo screening methods work, they have severe limitations," noted Dr Tony Dodd, from the department of automatic control and systems engineering at the University of Sheffield. "X-rays and similar scanners produce images that can often be difficult to interpret – not to mention the dangers of working with radiation. Similarly, sniffer dogs have to be trained to search for a specific item – whether it be drugs, explosives or humans – and they can only work in half hour shifts before they get tired."

Dr Dodd's solution is the Cargo Ferret. The device, which will be capable of detecting drugs, weapons and illegal immigrants hidden in cargo containers, is being developed as part of a £732,000 project funded by the Engineering and Physical Sciences Research Council (EPSRC).

The three year research project will result in what its developers say is the world's first screening device able to pinpoint all kinds of illicit substances and the first designed to operate inside standard freight containers.

The Ferret will reduce the need for customs and security officials to enter or unpack freight containers. Suitable for use at seaports and airports, the Ferret is equipped with a suite of sensors that, according to Dr Dodd, is 'more comprehensive and more sensitive' than any currently employed in conventional cargo scanners.

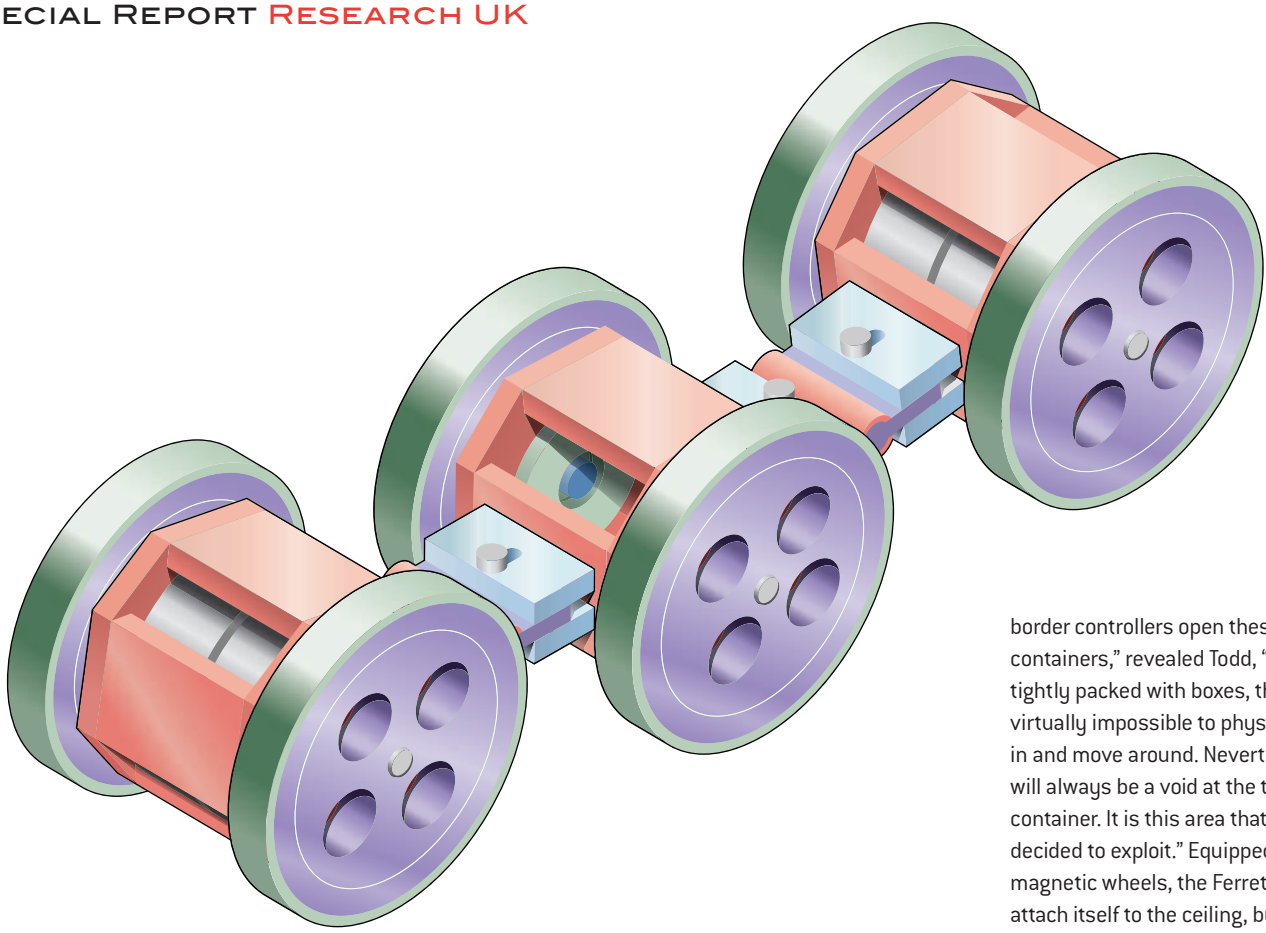
The Cargo Screening Ferret project, which began in October 2008, also involves the University of Glasgow, Loughborough University, City University London and defence and security specialist Qinetiq. The idea emerged from an event organised by EPSRC, the Home Office Scientific Development Branch and the UK Borders Agency which identified the need for more sophisticated methods of screening cargo. Dr Dodd explained: "About 20 academics locked ourselves in a room until we came up with an idea."

Dr Dodd stated: "By combining two different types of sensor – laser and fibre optic based – the Ferret will lead to confidence in detection improving considerably."

According to Dr Dodd, the sensors are small enough to be carried on the robot and can detect specific 'fingerprints' of illegal substances at much lower concentrations than currently possible. When placed inside a steel freight container, the ferret will attach itself magnetically to the top, then automatically move around searching for contraband, while sending a stream of information back to the controller.

It was important that the Ferret was small and versatile enough to get its sensors inside a container. Dr Dodd explained: "There's a better chance of detection if the sensors are inside a lorry. It improves detection rates and minimises false alarms – which is a huge problem. The act of emptying a lorry and finding nothing wastes a great deal of time."

By focusing on new sensor technologies, Dr Dodd and his team have made huge advancements in terms of miniaturisation and improving the



capabilities of the sensors. Professor Tong Sun, from the School of Engineering and Mathematical Sciences, City University London is also working on the project. She noted: "The development of optical fibre sensors at City University London is designed to be able to detect specifically (and in very low concentrations) given illegal substances. The sensors developed are targeted to match the sensitivity of dogs in detecting substances, but without the problems of distraction, tiring or confusion, with a much longer on duty time, due to the sensor's inanimate nature."

Prof Sun says that, because the sensor device is built upon an optical fibre with a diameter of less than 1mm, it is able to both couple light from a light source to a sensor material and to collect and transmit the sensing signal generated to a photodetector or a spectrometer through a fibre coupler.

She pointed out: "The core component of the sensor device, however, is the specific sensor material design, which is required to be able to interact with specific drugs and in the meantime to produce corresponding output signals – for example, fluorescent or spectroscopic signal variations in relation to the presence and the concentration of the drugs present.

"Due to the advantageous nature of an optical fibre, both in terms of the wave guiding and of sensing, the sensor device created will be compact, low power and lightweight to be best tailored to use in field."

Dr Dodd added that fibre optic and laser properties vary greatly, depending on the presence of different items. In many ways, the approach is similar to fingerprinting, he noted. "Our sensors can detect extremely low concentrations of illegal substances and have the ability to locate multiple items. They transmit peak signals which correspond to particular substances."

According to the Council of Europe, human trafficking is the fastest growing criminal industry in the world, with a global annual market of about $42.5billion. In particular, detecting immigrants hidden in freight containers is a time consuming process. "When border controllers open these cargo containers," revealed Todd, "they're so tightly packed with boxes, that it is virtually impossible to physically climb in and move around. Nevertheless, there will always be a void at the top of the container. It is this area that we have decided to exploit." Equipped with magnetic wheels, the Ferret can not only attach itself to the ceiling, but can also dangle sensors deep into the container. These can then detect tiny traces of carbon dioxide, which indicate the presence of humans in the container.

Above: The Cargo Ferret is equipped with two different types of sensor - laser and fibre optic based. When placed in a steel freight container, the device will attach itself to the top magnetically and transmit data to the operators.

Dr Dodd observed: "Once in the container, the robot will start its search and transmit images, data and detection probabilities to the controller's laptop screen autonomously. We are designing the Cargo Ferret to be as user friendly as possible, so UK border agents will require only minimal training and the process of detection will be as quick and efficient as possible."

The compact robot's dimensions are currently 27x 7cm, although this is like to change as designs evolve. Dr Dodd predicts that the Ferret will be ready for testing within two years, with potential deployment within five years.

"This technology will also address peripheral issues," Dr Dodd concluded. "Recently, a container was opened following intelligence that there may be drugs inside. Instead, the lorry was filled with rotting animal hides. So, as well as making the searching process more efficient, the Cargo Ferret will also resolve issues such as health and safety."