

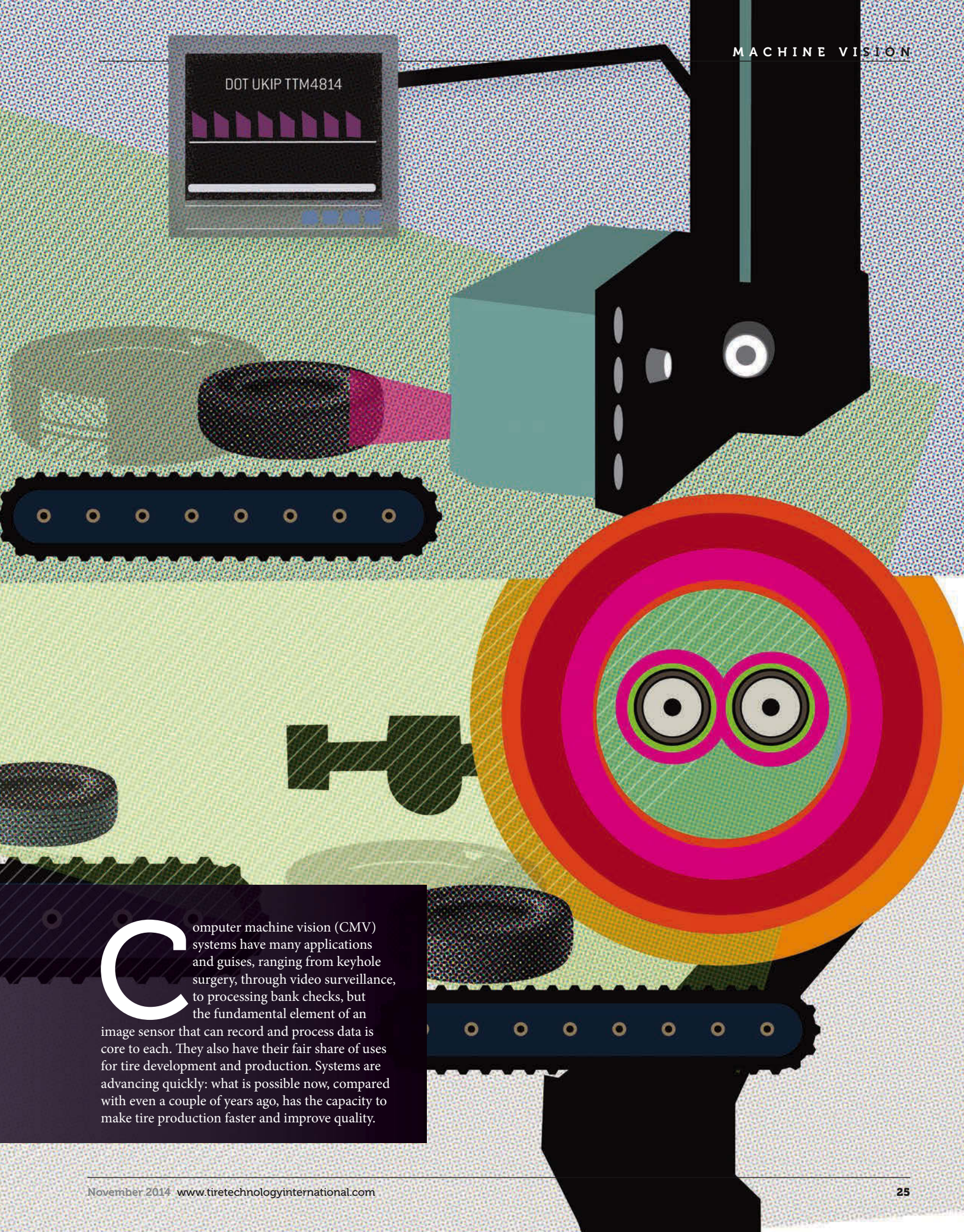


All-seeing eyes

Machine vision systems are already big business in tire production. The technology is now reaching science-fiction levels, with academic research now moving into facial recognition and cooperative robots

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DOT UKIP TTM4814



Computer machine vision (CMV) systems have many applications and guises, ranging from keyhole surgery, through video surveillance, to processing bank checks, but the fundamental element of an image sensor that can record and process data is core to each. They also have their fair share of uses for tire development and production. Systems are advancing quickly: what is possible now, compared with even a couple of years ago, has the capacity to make tire production faster and improve quality.



THE CYBORG WORKPLACE

Advances in machine vision technology are having an effect on robotics, to the point where we could soon see humans and machines working much more closely in an engineering and manufacturing environment.

"I can imagine there will be more robots within a few years that can work in the same workspace as humans," says the University of Edinburgh's Professor Fisher. "At the moment, to get accurate robotics you need very rigid robots and high power to get the speed up. But we humans are a bit too soft and squishy – we die too easily when we get hit by one of them. Instead, people are building softer and more pliant robots that can still do things accurately. These are the kinds of robots you need in order to be able to work with humans. You also need the robots to be able to watch the humans. There's a lot of research into that currently: a human handing something over to a robot can just say 'Here it is'; the robot can see what and where 'it' is and pick it up from the human. Or you ask the robot, 'Can you hold this for a minute while I screw this in?' They can work together in a limited context in a research environment and I think we will see more of that in the next 5-10 years." ■



Detecting surface imperfections, regardless of the subject, is one of the technology's fortes and an aspect that is constantly improving, according to Professor Melvyn Smith, director of the Centre for Machine Vision at the University of the West of England (UWE). "Any application where there are concomitant 2D and 3D features of interest could be inspected using photometric stereo, as we are able to isolate the 2D data from the 3D data and inspect each separately. In manufacturing this would enable, for example, defects in painted and printed finishes to be separated from other underlying 3D surface defects – or in wood, grain from knots."

But applications run deeper than just picking out faults, and CMV systems in the tire industry have made for faster, more straightforward manufacturing processes. Andreas Hoffmann, field application engineer at LMI Technologies, says that greater levels of automatic configuration and processing have only recently become possible.

"The Gocator [the company's 3D sensor product] has a strip tool that enables you to configure the measurement tool inside the sensor to exactly the width and position of rubber strips – and at high speed and high resolution. Previously customers had to write their own software to do

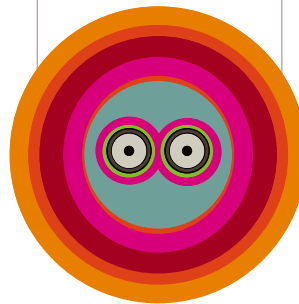
Above left: Tread measuring system at FATE Tires, Argentina

all the processing. It required a lot of raw data and processing to find those dimensions."

FATE Tires is one tire producer looking to take advantage of CMV to monitor quality at an earlier stage in the manufacturing process. Alejandro Firpo, head of process engineering at FATE's plant for passenger and light trucks tires in Argentina, says: "We are studying the possibility of using green tire measurement systems to correlate with the uniformity and/or balance results. This would give us the opportunity to correct deviations after a machine setup, even before vulcanizing a tire."

Improvements in computer image capturing have also moved the game along. "Since we have higher resolution now, people are increasingly wanting to read the DOT code," says LMI's Hoffmann. "To achieve this you create a point cloud of the sidewall and process it in a way that takes out the curvature. Then you can use image processing and OCR software to read the DOT code. That's something that wasn't possible before, because the resolution was just not good enough. It was good enough to do bulge and depth measurements but not to read the text on the sidewall. For us that started about two years ago, and now everybody wants to read DOT codes all the time."

For the immediate future of CMV systems in the tire industry, the expectation is that scanners, lasers



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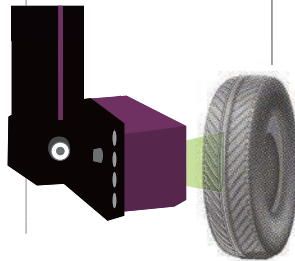




and processing will continue to become faster. "A typical development cycle is that we increase the resolution and we increase the speed, which is the most important thing in these applications," says Hoffmann "That will be the main future step. Another thing is that the internal tools we have in the sensors, for example the strip tool that takes the width and the height of the rubber strips, are constantly being updated and improved to be more stable and easier to use."

He claims there is still work to be done in the industry to make parts of the manufacturing and development process slicker, though: "The whole process whereby a piece of rubber is put on the drum is still very manual. There is no integrated measurement device and the operators still have to make adjustments. We have developments currently going into those stations."

FATE's Firpo believes that the future lies in systems that can digitally dissect the innards of a tire without cutting into it: "Recently we were in contact with a supplier, making inquiries for a kind of tomograph that would allow us to know, among many other things, how a vulcanized tire is formed without the need for mechanical cutting, simulating



Top left: Two views of UWE's Mark III machine vision camera

Above left: Sidewall inspection by LMI's Gocator technology

FACE TIME

The minutiae of what cameras are able to capture and interpret is increasing, and not at a huge cost, in the view of the UWE's Professor Smith: "Given recent developments in LED lighting technology, and faster, more powerful computing, we can now do things like capturing a talking human face in 3D at sub-pixel resolution. I believe we were one of the first if not the first to do this.

"The big advantage it offers over some other methodologies is using low-cost equipment. Our 'Photoface' system uses photometric stereo to recognize a human face based on 3D data – it is more robust than conventional 2D imaging. We are now able to extend this to a moving face and explore things like expression recognition and gaze tracking in human-computer interaction tasks. We are currently developing technology able to capture demographic data, such as gender and age, as well as a person's level of engagement." ■



mechanical interference with the rim and even detecting deviations. I think this is the future but it is still very expensive. We were also looking at the possibility of laser-marking vulcanized tires that would enable recording to QR codes."

As in many other areas of electronics, costs are coming down as the technology becomes more capable. One far less costly development with the potential to move the CMV game along is a motion sensor that is more generally used with games consoles and PCs. Professor Bob Fisher of the University of Edinburgh's School of Informatics, explains: "Another breakthrough is going to be the Kinect camera that Microsoft sells, just because it gives you a modem that is really very rich. It tells you about the 3D world in a very low-cost package.

"I've been doing my own research in this area since my PhD in the 1980s, and it was always pretty tough to get data. If you wanted to get more than one image it would take hours, and now with Kinect you can get pretty reasonable data at 25fps and you also get an associated color volume. It's a very capable sensor and it's very affordable for everyone. It has opened the door a lot." **tire**

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