The rise of the Agribot

Last week I sat down with **Chris Rothery**, a consultant Agricultural Engineer, chairman of the LAMMA awards judging committee, founder of the Lincolnshire Farming Conference (LFC), and trustee/treasurer of the Lincolnshire Agricultural society. I asked Chris about the opportunities that agricultural robotics presents and what challenges there are for the future in this area.

Objectives

Before considering the challenges and opportunities that robotics present, it is important to consider the objectives of such technology. The ultimate objective of a robotic device is to tow the machine, whether it be a sprayer, drill or cultivator to the field and then as Chris says "*press go*". The device then trundles over the field completely un-supervised leaving the farmer to get on with other tasks. Ultimately it relinquishes the farmer of the heavy burden of labour and makes the farming process more efficient. And in most cases its aim is to improve farming practice from an environmental as well as efficacy perspective. Chris explained that the next LFC will be focussed on "*How we get the driver off the seat*". However, as I think everyone is aware, spending large amounts of money on something that will not sell is a pointless exercise, so one of the other objectives of robotics is to get to the stage where the practitioner can go to their nearest dealer and buy a device, whether it be a weeder or cultivator. Thus the objective is to get to a truly "*off the shelf*" machine.

The new Bonirob robot (above) is capable of distinguishing between weeds and crops by comparing them to images using machine learning.

The Status Quo

So where are we now with all this? In at least arable farming, there is now some level of automation in most aspects of practice, whether it be vehicle GPS tracking or route mapping. "*We are almost there*" as Chris says. Elsewhere, at this time, it is possible to go out and buy a number of truly robotic devices. For example, robotic mowers are now commonplace and represent, as Chris says, *"the sole example of a really commercially successful robotic device in something vaguely associated with agriculture".* These devices cost between £2000 and £10000, but will mow 2 acres twice a week. The labour saving alone from this obvious. And in the dairy industry we have seen robotic milking machines developed and which are in use today. They are expensive, but can improve output and the health of the cows.

Greenbot is an autonomous tractor (above) that uses a diesel engine to generate power. It is guided by GPS and has software specially designed to be used by the operator for commands and data analysis. The tractor robot comes with a series of systems for detecting obstacles, animals, people, etc. In front, it has mounted a radar and a bumper bar with mobile parts to detect the impact. Additionally, in the bumper are installed other sensors for detection.

Challenges and opportunities

"*With any truly autonomous robotic device, it must work, be safe and be legal*". Chris's statement here is currently ringing true in a number of manufacturer's ears. Of these three requirements, it is perhaps the safety aspect and the legal aspect that are hindering future developments presently. "*The thought of looking out of the window and seeing a robotic device in the field towing a cultivator with no driver would probably worry most people*", Chris says. Indeed in the US, where Case have developed and have working a number of driverless tractors, the locals who see these tractors in the field object – without fail. They believe that the tractor is not controlled properly. So public acceptance has a long way to go. This key safety requirement then leads to the legislative headache. What happens if one does go rogue? Whose fault is it? Technology can help in this regard. Field boundaries can be set with wires sunk in the ground to prevent the various robots from trotting off

into the neighbour's field. This would help to meet the legislative requirements, and also the environmental requirements by defining hard boarders in a field.

A Canadian company that develops all-terrain robots to explore the Moon has adapted its technology and builds robots for farming. The result is a mobile platform called Argo J5 XTR (above). The platform is already used to spray banana plantations in the Caribbean. Before using this robot, agricultural workers were exposed to fungicides, rough terrain, and high temperatures during the day. The robot can be remotely controlled by an operator more comfortably and safely.

You might be asking why the "*work, safe, legal*" triangle is not a square, with "*cost*" forming one of the corners. Indeed, historically cost has been a major implication, for example in robotic milking parlours. However if the work, safe, legal triangle is met, Chris believes that the cost of the various devices involved will actually come down.

Let's take the example of a robotic sprayer or cultivator. To date, most tractors and self-propelled devices have been designed towards improving driver comfort and reducing the amount of time the driver has to actually operate the machine. That means making comfortable cabs and making larger and wider machines. Take the driver out of the equation and immediately the machine can be made smaller and lighter. Also, the implement does not need to be 40ft wide, but could quite reasonably be 12ft wide. As the machine operates autonomously day and night it does not need to be massive, and we could quite easily see the rise of a number of small machines in the fields over the coming years. In fact the Small Robot Company in Bristol have cottoned on to this already. Their strap line is "Small robots: not big tractors." The front page of the website reads as follows:

"...unfortunately big tractors are neither efficient nor environmentally friendly. Currently, 90% of energy is used ploughing and cultivation. And ploughing is only necessary because of heavy

machinery crushing soil. We are building robots that will seed and care for each individual plant in your crop. They will only feed and spray the plants that need it, giving them the perfect levels nutrients and support, with no waste. This level of detail allows you to be kinder to the soil, kinder to the environment, more efficient, more precise and more productive. It's the best of all worlds. An increased yield, as well as minimal chemical usage. So you can increase revenues by up to 40% while reducing costs by up to 60%.".

Interestingly, the Small Robot Company operate a leasing scheme which further takes the capital cost out of the equation for farmers.

Credit – small robot company

Summary

Of course robotics is not for all areas of agriculture. Field scale livestock is still one area that will need a human interaction. However, its application for otherwise manually intense areas such as fruit and vegetables are very exciting. Being able to detect ripeness of strawberries by colour and then pick them without damaging them is well within the scope of existing technology and is being pioneered by the robotics group at Riseholme Campus, University of Lincoln, headed up by Prof Simon Pearson. The challenges of different shapes, and supermarket specifications in terms of size and stalk length for example, are also not insurmountable. Overall the future of the Agribot is bright and as Chris remarks: "*We are on the cusp of the next industrial revolution in agriculture.*"

Tim Fray