The rise and rise of rural robotics

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Agricultural robots are predicted to be the future of farming technology in Australia, enabling greater efficiencies and productivity in broadacre production.

Are robots the future of Australian agriculture? According to Robert Fitch, Senior Research Fellow at the Australian Centre for Field Robotics (ACFR) at the University of Sydney, there is huge potential for agricultural robots, which will play a key role in the future of farming.

Automation in agriculture is not new. The industry has been commended for being one of the most adaptable sectors for technology, with many growers across Australia routinely using GPS guidance and automated steering systems. However, the rise of robotics will introduce the next level of automation, with robots replacing large machines and human labour, saving time, energy and money.

Dr Fitch has worked with a variety of government and industry-sponsored projects in broadacre agriculture, horticulture, bird tracking and commercial aviation within his role at ACFR. Most recently he and his team have been focusing on how to use sensors and algorithms to 'train' machines to autonomously undertake farm tasks ranging from harvest to weed control.

"Significant advances in future farm sustainability and productivity will be enabled by robotics and autonomous systems," Dr Fitch said. "Scalability gains from monolithic tractors will be replaced by the use of many small autonomous robots operating within a whole-farm optimisation context.

DR ROBERT FITCH, SENIOR RESEARCH FELLOW AT THE AUSTRALIAN CENTRE FOR FIELD ROBOTICS (ACFR) AT THE UNIVERSITY OF SYDNEY.

TARGETED SPOT SPRAYING. FITTED ARMS PRECISELY TARGET INDIVIDUAL WEEDS TO MINIMISE HERBICIDE VOLUME.

"As Australian food production demands increase, farmers will need to adapt to increase productivity while engaging in environmental stewardship and contending with rising human labour costs and diminishing availability of human labour. This is where robots will play a role."

ACFR, a leader in the research and development of field robotics and intelligent systems, is beginning to apply successful methodologies in real farm situations.

"We conduct basic and applied research using ground robots and aerial robots and have found there is a real opportunity for robots to assist with tasks such as weed maintenance and crop intelligences," he said.

"We have created robots with arms that can precisely target individual weeds to minimise herbicide volume and ensure a targeted spot spray."

Robots can minimise workloads by refilling themselves at docking stations, so humans do not need to be involved in the process, he said.

"We have developed algorithms for automatically balancing the workload among many robots and for optimising the decision of when and where to dock and replenish energy or herbicide during spot spraying.

Robotics will enable new methods of farming that have never been possible with traditional equipment.

"The key challenge to be addressed in realising the benefits of these new technologies is to 'think beyond the robot' and develop new logistics and information systems for farm operations."

Aerial robots equipped with sensors will assist ground robots by gathering information, Dr Fitch explained.

"In the broadacre context, aerial robots

can enhance the capabilities of ground robot systems by helping find concentrations of weeds that can then be efficiently targeted by ground robots on an as-need basis."

Crop monitoring and other farm operations such as autonomous harvesting are also being worked on, he said.

"The best outcome would be a system of activities for robots in a whole-farm optimisation approach.

"Although the projects we have described, and others worldwide, are focused on addressing the fundamental capabilities of farm robots, the role of robots in a whole-farm context remains an open question. How will such robots be used operationally, and to what benefit? The answer requires a whole-farm optimisation approach.

"The farm of the future will not simply replace manual practices with autonomous operation, as is the case with GPS-guided tractors, but will adopt a systems view that coordinates all activities.

"This whole farm approach is where we see the greatest benefit of agricultural robots for sustainable production," he said.

Real robots in action

Queensland grower and founder of SwarmFarm Robotics, Andrew Bate, is already putting robots to the test on his 8,000ha property at Gindie, near Emerald in central Queensland.

In 2009, Mr Bate and his wife Jocie started their own company, SwarmFarm Robotics, to develop and commercialise robotic technology in agricultural production systems.

ANDREW BATE, FOUNDER OF SWARMFARM ROBOTICS.

A SOLAR-POWERED ROBOT WITH RECENTLY PLANTED ONIONS IN A VEGETABLE TRIAL AT COWRA, NSW (JUNE 2014).

As a broadacre farmer growing cereal and pulse grains and turning off 2,000 head of beef cattle a year, Mr Bate is striving for a new farming system to increase yields and improve efficiency while remaining environmentally friendly.

"The trend in modern agriculture has been to increase operator efficiency through development of larger and faster machinery," he said. "Whilst these machines have increased the amount of work each farmer can achieve in a day,

A SWARMFARM ROBOT IN ACTION IN A MUNG BEAN CROP.

they have come at a cost. Big tractors, sprayers and other farm machinery are heavy, creating enormous amounts of damage to soils and paddocks.

"Instead of a large machine that costs hundreds of thousands of dollars, we decided to look at smaller robots as a smarter way to automate farming systems."

SwarmFarm Robotics is working with two universities to develop a robotic system that can autonomously perform agronomic tasks in a range of agricultural production systems.

"We set out to develop better ways to kill weeds, by developing small robot platforms that are nimble and can slow down and even stop to treat individual weeds. This allows us to use new technology such as chipping individual weeds out of the ground or burning them off with microwave technology.

"Hard-to-kill weeds cost the Australian grains industry $200 million every year. Small robots that can work around the clock, are lightweight so they cause little soil compaction and use non-herbicide technology to individual weeds are the future of sustainable farming systems.

"We see robotics as an 'enabling' technology for agriculture. A robot itself has no use; it's the ability of the robot to carry and control tools in an organised way that gives it the potential to increase food production. Robotics will enable new methods of farming that have never been possible with traditional equipment," he said.

SwarmFarm plans to be trialling robots on a commercial scale by the end of 2015, Mr Bate said.

"At SwarmFarm we aim to create affordable, smaller robots that work in a coordinated team, performing a range of repeatable tasks. They will be affordable, lightweight and reduce paddock erosion and soil compaction."