

It has been nearly 10 years since the last Journal of Field Robotics special issue on agricultural robotics. In this time significant advances have been made in developing robotic technology for agriculture and demonstrating complete field tested systems. There is also a rising level of investment to commercialise agricultural robotics as demonstrated by an increasing number of new startups and developments by established companies.

The motivation is clear, in order to feed a growing population we must find new methods to increase production, whilst balancing environmental impact and constraints on resources and people. This will require a dramatic shift in the way that we currently think about farming. This shift is already underway as demonstrated by technologically advanced tractors. Farmers can essentially purchase an autonomous machine which has automated steering based on Global Navigation Satellite Systems enabling a high level of autonomy and precision. However, new robotics technology can help us go further in optimising plant care and reducing the time humans spend on time consuming, dangerous and repetitive farming operations.

Of the 22 papers submitted for this special issue, 14 papers were accepted for publication, and 8 of these are featured in this agricultural special issue. These papers represent the state-of-the-art in field tested technology for agricultural robotics. The interest in this special issue demonstrates the continued interest of robotic researchers to this field and provides a glimpse into the bright future ahead. The papers selected for inclusion cover the following areas:

- phenotyping and crop detection,
- automation of harvesting and pruning for field and orchard crops, and
- weed detection and management.

The paper by Bargoti et al, applies recent advances in computer vision with artificial neural networks to fruit detection and counting in orchards. Feature and pixel-wise algorithms are used to segment, detect and count individual fruits. Experiments were conducted in a commercial apple orchard and the results compared favourably to ground truth from a post-harvest counting machine.

Underwood et al. presents an autonomous unmanned ground-vehicle robot for data acquisition and an efficient data post-processing framework to provide phenotype information over large-scale real-world plant-science trials. In field tests the system was found to be a more labor-efficient mechanism for gathering data comparing favorably to current standard manual practices.

Kurita et al describe a complete operational framework which includes automated harvesting, homing, scheduling and unloading for rice fields. Whilst harvesting, the robot followed the target path and unloaded the grain without spillage. For unloading, the camera system detects its pose, and hence the robot's pose, relative to fiducial marker located on the side of the grain wagon.

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Botterill et. al describes a mobile robot for automatically pruning grape vines, by straddling a row of vines, and imaging them with trinocular stereo cameras. A computer vision system builds a 3D model of the vines, an AI system decides which canes to prune, and a six degree-of-freedom robot arm makes the required cuts. The system is demonstrated cutting vines in the vineyard.

Reliably grasping fruit is an ongoing challenge for harvesting robots, and the subject of significant research. The paper by Hemming et al presents an evaluation of two types of end effectors for sweet-pepper harvesting, and investigate the case where stem position is used to guide grasp pose. The results indicate that this is an area that requires significant further research, but that, at least for simplified crops, progress is being made.

Silwal et. al describe the design and evaluation of a robot for harvesting apples. The system comprises a seven degree of freedom robot arm, a global RGB-D colour depth camera and an underactuated, tendon driven compliant end effector. The system had an average picking time of six seconds per fruit and successfully picked 127 of 150 attempted apples.

Research in the area of weed detection and destruction continues to be an important topic. Precision farming robots must be able to differentiate between the crops and weeds. Lottes et. al address the problem of detecting sugar beet plants as well as weeds using a camera installed on a mobile field robot. The system was implemented and evaluated on a real farm robot on different sugar beet fields, illustrating accurate identification of weed on the field.

Lastly, Bawden et al. describe the design, development, and testing of a modular robotic platform with a heterogeneous weeding array. The results from the field trials demonstrate the potential for robotic plant-species-specific weed management enabled by vision-based classification algorithms and mechanical and chemical weeding applicators.

The editors would like to thank the reviewers for their time reading the submitted papers and giving constructive feedback to the authors. This effort is crucial to maintaining the high standard and quality of research in this journal. Lastly, we would like to acknowledge the author's research efforts and contributions to this field.

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