



LEADING EDGE

Leading Edge, supported by the Society for Engineering in Agriculture and the Australian Centre for Precision Agriculture, provides a local and worldwide window on engineering and PA research.

The eye of an eagle, the strength of a ROC

By Gary Alcorn

A Rugged Outdoor Camera (ROC) developed at the National Centre for Engineering in Agriculture is making machine vision technology available to applications right across agriculture, from sugar and cotton to citrus and fodder.

NCEA director Erik Schmidt believes the ROC's current applications, including guiding machinery precisely down crop rows, yield-mapping macadamia trees and assessing export hay quality, are just the beginning.

"We believe the ROC is so versatile that we are keen to hear more ideas from primary producers where instant image analysis and reporting could help their bottom lines.

"The system, developed at NCEA by

Mark Dunn, is capable of recording still frames or videos, but with the intelligence to select what to keep and what to discard. It can equally well interpret images to control gates and machinery. So we reckon there are plenty of farm operations which could benefit from this low-cost tool," he said.

Machine vision is not new. Professor John Billingsley at the University of Southern Queensland, has been developing and refining digital systems for more than 15 years.

But its capabilities are continually expanded by new technology and components, plus integration with other systems such as GPS.

"The original vision guidance system which introduced hands-off steering for driving machinery accurately through

crops has a number of patented features. These have been carried through into the new versions of the system.

"The basic strategy of in-crop guidance is to form 'keyholes' in the image, each of which embraces a single row. A regression calculation is made to fit a line to the plant pixels in the keyhole, updating the estimate of the row's location and direction," he said.

Exciting new applications include a program funded by RIRDC. Prior to hay-making, human assessment of crop quality used to be needed, using sub-sampling to assess size, plant stem ratio and water damage.

Now this subjective system is replaced by a ROC capturing and measuring multiple images of stem width and colour. This objective reporting system is impressive

Australian Society for Engineering in Agriculture

The society contributes to the development of a strong engineering involvement in agriculture to aid economic growth and environmental sustainability for the entire Australian community.

WHO CAN JOIN SEAg?

Membership is open to anyone interested in the application of engineering to agriculture and related industries. This includes scientists, farmers, surveyors, technical officers, engineers, manufacturers, distributors and processors.

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The ROC features rugged portability, low battery drain and remote reporting facilities.



ROC can identify and analyse macadamia nut density on picker bristles to calculate tree yields. Another side scanning camera locates and identifies individual trees to yield per tree.



Image keyholes enable ROC to fit a guidance line to row crops.

export hay buyers who demand only top quality product.

Applying irrigation water to cotton crops only when plants need moisture could be a simple task for the ROC and associated software. Attached to an irrigation boom, the camera can sense plant geometry and leaf colour and compare that value through image analysis to known plant moisture levels. This monitoring system ensures optimum water use and crop production.

Machine vision can also guide spray machinery down the crop row and identify weeds which are spot-sprayed using minimal chemical.

In sugar crops, image analysis using low-cost algorithms can differentiate weed leaves from young sugar plants with highly repeatable accuracy, meaning herbicides are applied only to the unwanted grassy or broad-leaved targets.

“By using the ROC for macadamia yield

mapping, we can locate the position of each nut and identify the tree it fell from. We are also researching the role of machine vision in identifying and differentiating between domestic and feral animals and indigenous wildlife. That way sheep and cattle can be admitted via actuated gates to fenced watering systems but wild pigs or goats are diverted to separate holding pens.

“Very sensitive cameras can scan the surface of export citrus fruit counting the depth and prevalence of dimpling. Markets which prefer smooth-skinned oranges, grapefruit, mandarins and lemons will get just that specification,” Erik said.

In the near future John Billingsley sees new roles for machine vision such as a refractometer for measuring sugar cane juice to control topper height, judging when a tiny endangered dunnart marsupial is ready to mate, monitoring and managing

livestock and enhancing farm security with 24-hour monitoring of fuel and fertiliser storages.

WHAT IS THE ROC?

The Rugged Outdoor Camera developed by NCEA is a microprocessor-enabled digital camera system (see picture) capable of still and video image processing. It utilises the latest advances in low-power technology so it can be placed in remote areas for extended periods. Using a small solar cell the ROC can be deployed indefinitely. It has been specifically designed for harsh environments. As well as being waterproof, it is light, small and uses a 200MHZ processor with serial communication ports, optional LCD display and remote information downloading.

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