Appendix 1 – Case Studies

Case Study 1:

Computer vision and machine guidance for weed control

Strong collaborations between agricultural engineering research and university engineering groups from the late-1980s underpinned the development of computer-based image analysis as an effective technology for the control of mechanisation and automation of biological systems. The variability of biological targets and their environment provided new challenges that required real innovation. Out of these partnerships, a range of innovations in machine vision were generated with impact on autonomous vehicle operation, animal management, vegetable sorting and weed control.

The capability to accurately interpret crop scenes in varying natural lighting conditions was initially demonstrated through real-time control of an autonomous vehicle negotiating rows of vegetables. The implications for management of inputs to vegetable crops were then translated into projects with industry support, showing how a research tool could be translated into a practical method to manage weeds.

Implementation of this technology and its extension to a wider range of target crop/weed combinations has been paralleled in the last decade by commercialisation through partnerships with UK businesses active in the area. The first product has been a vision-guided hoe for mechanical control of weeds. The demand for such technology has been considerable. Organic farmers utilise hoeing as one of the few acceptable tools to control weeds, but needed faster work rates and better accuracy. But conventional farmers also had major problems as the tightening of pesticide approval procedures had led to withdrawal of effective selective herbicides for crops like carrots. The technology is of particular relevance to carrots, onions and leeks, with an annual value of £0.25 billion in the UK.

The engineering science was considerable, having to deal with the challenges of sun and shade within images, recognition of crop rows in heavily weed-infested scenes, controlling the hoe to deal with weeds in the row not just between crop rows, and meeting the target operating speeds that could make the tool commercially viable whilst minimising the risk of crop damage. The result has been a successful technology translated into a product that is generating attention and sales.

The innovation team, operating as a small business, continues to provide the new ideas and technical insights, and works with commercial partners to ensure that the implementation is robust and reliable. The commercial partners have delivered into UK and overseas markets (leading to a Queens Award for export achievement in 2010 for Garford Farm Machinery) with sales exceeding £2m within three years of commercialisation. New scope for innovation is still being identified, including plant scale operation utilising minimal quantities of pesticides to difficult targets, drawing in other expertise in novel pesticide applicators to complement this very different approach to weed control[19]. This plant-scale spot application can reduce herbicide use by 95%.

[19] National Horticultural Forum. Research into Use: The Strawberry and Brassica Crops. April 2011

Improving agricultural efficiencies

Computer vision for the precision control of field machines

The Challenge

The high costs and logistics of using human labour for weeding operations have become prohibitive.

Traditional mechanical weeding is not always accurate and often results in crop damage.

Farmers are under increasing pressure to reduce the use of an ever decreasing number of herbicides.

The Solution

The use of machine (computer) vision has been successful in accurately mechanically weeding both in-row and between rows.

Recent developments have demonstrated how computer vision can detect weeds and target herbicide application so that overall volumes can be significantly reduced with no loss of efficacy.