



The University of Adelaide
The School of Mechanical Engineering

Image Processing and Analysis for Autonomous Grapevine Pruning

by

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Abstract

In recent years, efforts are made to automate vineyard operations to cap the ever increasing labour cost. However, one of the operations that have not been completely automated is grapevine pruning. A robotic machine for grapevine pruning needs to respond to the changing physical characteristics of the environment, and to date, no algorithm can accurately identified appropriate positions for grapevine pruning in a variety of environmental conditions. The aim of this research was therefore to develop a new algorithm using image processing, image analysis and stereo vision system to determine pruning positions and making automatic grapevine pruning possible.

In order to get the pruning positions accurately and automatically, images taken from two cameras are processed and analysed. Utilizing the latest computer vision techniques, the algorithm takes three steps before the final cutting positions are derived. First, the uploaded images are pre-processed by the so called image processing phase during which binary image is obtained from the original image. Second, image analysis technique is employed to identify different parts of grape vine and obtain the 2D positions of the cutting points. Novel algorithms are proposed to locate the cordon, the branch and finally the nodes step by step with high accuracy. Both the locating precision and computing complexity of the algorithms are considered, so that the images could be processed incessantly. Finally, cameral calibration and stereo vision were also performed after that to determine the 3D pruning point, so the system can inform the robotic machine to perform the pruning.

For the experiments, images were taken from the vineyard which located in the Adelaide National Wine Centre and the University of Adelaide Waite Campus. Ten images full of canes were analysed, and an 85% success rate for pruning positions was achieved. 85% of the cutting positions found by the proposed

method were consistent with those found by experts, while the rest 15% of the cutting positions found by the proposed method would not affect the growth of the grapevine significantly in the next year although they don't match the positions found by experts perfectly. The experiment verified the accuracy and application potential of proposed algorithm.

The contribution of this research has three folds:

- a) The latest research and application of automatic grapevine pruning is reviewed;
- b) A novel automatic grapevine pruning algorithm using computer vision technique to automatically identify important grapevine features, locate the pruning points, and derive their three dimensional coordinates is proposed, researched and developed;
- c) The proposed algorithm can be also applicable to other agricultural operation automation other than grapevine pruning.

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Statement of Originality

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Publications

1. Ming Gao and Tien-Fu Lu, “Image Processing and Analysis for Autonomous Grapevine Pruning”, proceedings of the 2006 IEEE International Conference on Mechatronics and Automation June 25 - 28, Luoyang, China.

2. Ming Gao and Tien-Fu Lu, “Autonomous Grapevine Pruning- A Computer Vision Approach”, February 2011 submitted to Australian Journal of Agricultural Engineering