REPORT

ISSN 1174 - 1406

Volume 24 No. 11 1999

Using Video to Improve Sweep Recognition in Mechanised Processing

Tony Evanson
Forest Engineering Researcher

Figure 1 - Two cameras mounted on the harvester head. Images were displayed on two black and white screens within the machine cab

Summary

Getting the best value recovery from stems is often affected by the identification of log sweep. Log sweep can be hard to see from the cab of a processor because of limited vision, and the distance from the log.

This project was aimed at seeing how well video cameras could help the operator to recognise log sweep from the cab. Two operators were tested for their value recovery using a vertically

The camera system was tested on swept stems. Details were recorded of logs that were rejected for sweep defect.

For Operator 1, the camera system helped reduce reject logs by 80%. For Operator 2, there were 50% less out-of-specification

Liro Forestry Solutions

(rejected) logs. Operator 1 (who was also more experienced) used the camera system more.

The effect of the reject logs on the operators' value recovery was examined. Using the camera system, Operator 1 improved the value of swept stems by 4%, because fewer rejected logs were produced.

The use of the camera did not improve overall value recovery from the 18 stems used. A longer training period might help.

Other suggestions :

- use of a colour camera
- putting the camera higher above the log
- mounting the camera to show a bigger picture.

The operators said the camera helped them see parts of stems they could not see before.

The cost of a camera system is less than $2000. It would pay for itself by helping reduce reject logs.

Introduction

Many logging operations in New Zealand use machines for log-making. Many of these processors are single-grip grapple-processors, such as those made by Waratah N.Z. Limited.

The operators of these machines often cannot do the best job because they cannot see the stem properly. Sweep and branch size are not easy to see from a cab through windows and operator protection structures (OPS). Not being able to see defects possibly leads to poorer value recovery as well as reject logs.

One of the ways to help an operator see the stem better, is to use a video camera.

Video cameras have not been used a lot in logging machines. They have been used in Australia in Koehring processors to help operators cut pulp logs lengths accurately. In the United States, they have been used by researchers to record how machines work (Corley and Green, 1990). In New Zealand they have been used by researchers to see how operators use seat belts (Sullman, 1994).

With grapple processors, log sweep can be seen in the vertical plane, (where it is also affected by the stem bending under its own weight). The operator cannot easily see sweep in the horizontal plane.

A video camera mounted on the processing head might help the operator see sweep in the horizontal plane. Seeing log sweep may reduce the number of reject logs. Also, more long length logs might be produced because the operator does not "play safe" by cutting short logs.

Acknowledgements

LIRO acknowledges the assistance of Waratah N.Z. Limited, and the owner, and operators of the processor used in this study.

Study Methods

A camera, and lengths of plastic pipe were used in static tests to show that small amounts of sweep could be seen. The camera used in the study was designed for giving drivers rear views when reversing. It was suitable because it was self-focusing, light adaptive, strong, and weatherproof. The system included a small solid-state monitor with a 10cm screen. A small monitor was useful because there was not much available space in the cab. Camera and monitor specifications can be obtained from Liro.

After discussion with Waratah N.Z. Limited, a second camera and monitor were bought. These units were used as spares, and to give a stem-vertical view (side-mount).

Waratah N.Z. Limited also helped the project by suggesting a suitable contractor/machine, and by making two camera-mounting brackets for a Waratah HTH 22 Super harvester head. They also helped with wiring the camera system.

The height above the centre of the log for the trialled camera was approximately 100cm. The mount was about 50mm in front of the log end as it exited the processor head.

Because of the use of a wide-angle lens (f2.8), the image in the monitor showed some distortion towards the edges of the viewed area. There was also some distortion of the log shape due to perspective. However, log sweep could be seen from changes in the straightness of the log's centre-line, and by the curve of the edges.

The height above the log-centre gave a view of the log length to a maximum of 6 metres. This showed a complete "s" grade log length - no 12m logs were included in the evaluation.

Interpine Forestry Limited provided two sets of Log Value Recovery (LVR) assessments - one before camera use, and one with camera use. In these assessments, an operator's logmaking decisions are compared with that of the auditor. The auditor uses a TimberTech log-optimising tool. Two operators were tested, each processing 18 stems without the camera, and a further 18 stems using the camera system. Thirty-one of these 36 stems were judged to be swept enough to be included in the analysis.

The number of "s" grade logs produced was noted. The sweep restriction for this grade was the most restrictive of all the log types being cut (< SED/5). Minimum SED of these logs was 20cm.

In the LVR assessments, skid, or operator results only considered sweep defects. There was no checking if the operator noticed other defects such as large branch size, spike knots, scarring, etc.

After fitting the cameras, a one week period was allowed for the operators to get used to them.

Both operators used the camera system to give the "final word" as to whether a log of a given grade was cut.

The LVR data was analysed and results are presented.

Results

The results concern only the top-mount camera (showing horizontal sweep). The side-mount camera, showing vertical sweep, was damaged shortly after being fitted.

Table 1 shows the results of the second assessment (with camera) compared to those of the first (no camera). Thirty-one of the total 36 stems were included in the analysis. These stems had a sweep index greater than 3.5. The sweep index was calculated by averaging the TimberTech operator's sweep barrier codes, which describe a stem in terms of sweep. Operator 1 reduced value loss, due to rejects, by 4% (Operator 2 increased this value loss by 1%). Both operators produced fewer reject logs.

	Operator	
	1	2
No. of stems in pre-camera audit	7	5
No. of stems in camera audit	10	9
Effect of video on reject value loss	-4%	+1%
Effect of video on number of rejects	-80%	-50%

Table 1 - Change in % value loss due to reject logs (from stems with an average sweep code > 3.5)

Statistical analysis of all stems showed that, having included the differences in stem shape between the two assessments :

- there was no difference in overall value recovery performance between the two operators
- overall value recovery was not increased as a result of fitting the camera
- there were significantly fewer (P>0.5) reject logs when the camera system was used.

When the camera was used, Operator 1 recovered 38% fewer "s" logs (than selected by the auditor) than when processing without the camera. Operator 2 recovered only 6% fewer.

Discussion

Different kinds of stems were processed in the two assessments. The second evaluation was more demanding than the first - because of the number of stems affected by, and the extent of, log sweep. This difference also showed in the number of "s" grade logs selected by the auditor. In the first evaluation (for Operator 1), there were 3.4 "s" logs/stem selected. In the second only 2.4 logs/stem were selected. This result shows that the stems were "harder" to process when the camera was used.

One reason for this would be the short training period, and the difficulty the operators had in seeing the difference between different "amounts" of sweep

Operators' comments

1. The side-mounted (vertical view) camera allowed too much light into the lens. This camera, it was suggested, might also be damaged in the course of grappling stems for processing (this prediction came true).

2. The top-mounted camera should be mounted higher above the log, and further to the rear.

3. The camera was found to be useful for site-safety. The operators could view the whole site without slewing the cab and boom. They could see, for instance, the manual workers carrying out QC operations (occasionally, processing and QC happened at the same time).

4. A colour camera would be better for picking out the shape of the stem.

5. The monitor should be larger, and guide markings could be used to make sweep easier to see.

6. When one of the operators was getting used to the camera, it was used to reject a number of logs with tight sweep specifications. Shortly after, as a check, a log was cut that he might have considered rejecting using the camera. On a closer look afterwards, this log was out-of-specification for sweep (by 2cm).

7. The camera system was useful because it reduced the numbers of logs rejected for sweep (the contractor agreed with this).

8. The operators felt that more practice time would have helped (and produced an improved result).

9. If a camera was fitted as an option, both operators said they would use it.

Conclusions

The addition of a processor head-mounted camera to enable an operator to see horizontal-plane sweep led to fewer reject (sweep) logs being produced.

The trial was unsuccessful in terms of improving overall log value recovery, mainly because the training period was not long enough.

Further development of a sweep detection system should involve:

- selection of a suitable colour video camera, fitted as high as possible above the log

- positioning of the camera to provide the largest possible log picture on a monitor

- a longer, more intensive training period to enable operators to tell the difference between degrees of sweep. Guide marks on the monitor screen might help.

- An automatic sweep detection system, using a colour video camera, and digital signal processing, is feasible. This should be investigated as a solution that would give an operator objective, rather than subjective, information for decision-making.