Snapshot Report

Robotic Hydraulic Saw Cutting Trials

Project Code
2021-1219

Prepared by
Jonathan Cook

Date Submitted
05/10/2022

Project Description

AMPC (and the industry) have an innovation vision, and support R&D program, to eliminate all WHS incidents from processing operations. Where possible, dangerous tasks will be fully automated. Where automation is not currently viable (either due to technology limitations or return on investment), semi-automated/remote solutions will be developed that will remove the operator from dangerous tools and implements. Where semi-automated solutions are not viable then the remaining hands-on tools will be made as safe as possible (i.e. BladeStop and Guardian).

This project will involve performing trials and characterising the risks, challenges, and design considerations needed for a robust robotic solution in the Australian red meat industry. Such considerations will include the impact and handling of the motion control by the robot, hydraulic hose management, and handing of the reaction forces experienced by the robot. How the performance changes with sharp vs blunt blades will also be assessed.

Project Content

The methodology for conducting the project was as follows:

- Lease a robot for the project and develop a trial setup to enable mounting of a hydraulic saw tool for cutting
- Setup a trial to perform dry movement and cutting trials to assess the behaviour and implications with respect to the robot
- Analyse trial results to assess feasibility of the robot selection
- Perform trials on-site examining the performance of the selected saw technology over a large range of carcases to assess its feasibility for selection in a scribing system, and what factors and considerations may impact the system's design

Project Outcome

Trials were performed where the robot was setup to cut through rib bones at various speeds. Some bones were also cooked to simulate older, harder, ribs. The robot was able to cope with the external inertias of the saw blade spinning and cutting of the bone without any trip out issues. This was even the case when the cut was run at full robot speed into a cooked bone, resulting in the saw blade stalling. The robot was also able to cope with the moving mass of the hydraulic hoses when performing repetitive dry cycles of cut routines. Through the trials, as the blade had become blunt and the cut quality decreased, saw stalling was observed, albeit at faster robot speeds than would be utilised. The robot though was able to cope with the wear of the blade successfully without tripping. After these trials, there was a high degree of confidence that the robot would be suitable for an automated beef scribing system.

With the robot shown to be suitable for performing cutting tasks without any issues, the focus was shifted towards selecting the ideal saw technology for scribing. Processors were consulted regarding their experiences trialling numerous scribing saws (pneumatic, hydraulic, and electric). A particular electric saw was named which had not presented any issues of stalling. The benefits of using electric versus hydraulic are significant, primarily due to removing any risks related to high pressure hydraulic fluid in an automated system with potentially no human supervision. An electric saw would be more widely accepted across the industry if used for an automated scribing system. After careful consultation with AMPC, it was agreed that a pivot should occur to examine this saw option more closely as the primary goal is to understand the best saw technology to use.

A site trial was performed where a current probe and data logger was used to examine the saw's performance across approximately 24 hours of production. This trial covered approximately 1740 carcase sides across the main carcase types the processor processes, and varying maturity levels. There was no indication of stalling by the saw across this period, with the saw operating well within its bounds throughout the trial. Critically, there was also **no** indication that the saw was slowing down and nearing a stall – something which an operator can 'feel' and adjust for

to prevent a stall, but a robot cannot. There was no significant difference in performance across the carcase types, maturity, or whether a new or old blade was on the saw, in the context of operating close to its limits. It should also be noted that the manual operators currently take ~5s to perform the brisket rib cut and ~1-2s for spine cuts, which is faster than the cutting speed for the currently designed automated cutting system.

Given the results of the trials, and the broader industry desire, it is felt that the correct path for automated scribing is to proceed with an electric saw. This electric saw has thus been designed into the scribing system which is to be installed at a processor's plant.

Benefit for Industry

AMPC's 2020-2025 Strategic Plan identifies both within the Advance Manufacturing (pages 5 & 6) and People and Culture (pages 10 & 11) programs that:

- Removing staff from dangerous operations, via Hands-Off processing (Adv. Mft.),
- Carcase Primal Profitability Optimisation, via acc, and urate processing (Adv. Mft.)
- Digitisation, via acquiring product information and leveraging data insights (Adv. Mft.),
- Attraction, via demonstration and developing a wide range of operations (People & Culture),
- Retention, via improving working conditions and making tasks exciting (People & Culture),
- Development, via developing tasks that require higher skills and intellect – operational & technical (People & Culture),
- Safety and Wellbeing, via reducing the high-risk nature of processing operations (People & Culture),

are all foci of AMPC, and that this one innovation theme will aim to make a significant impact upon all seven by acting as an enabler for wider roll-out of automated robotic cutting.