

# Remote Operations – Shadow Robot (Stage 2, Part A)

Project Code  
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## Project Description

This project is a proof-of-concept example of robots being used to replace personnel in bandsaw meat cutting, where the robot is controlled by a remote operator. The work has been undertaken in response to a call from AMPC for a staged programme of development work on Remote Operations/Shadow Robots. This work covers improving the Proof-of-Concept for selected aspects of useability and robustness (Stage 2, Part A).

## Project Content

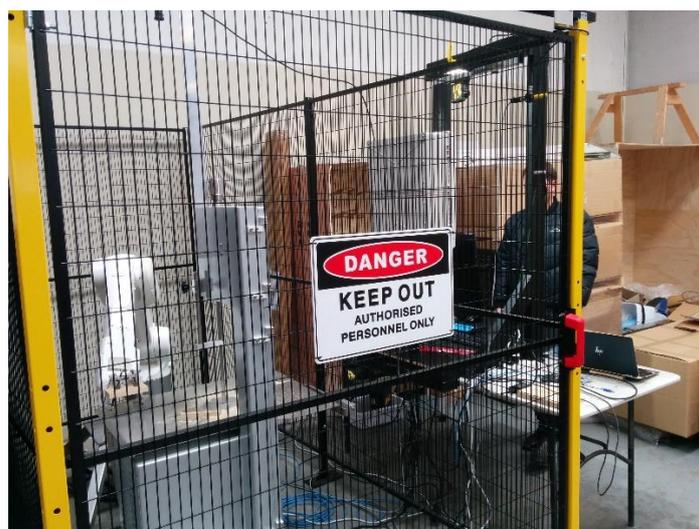
The objectives of Stage 2, Part A were to improve system robustness and useability by:

- Restructuring the code, improving the robot control for speed and accuracy, and adding safety features
- Add operating modes, specifically semi-automated and operator-informed modes, and
- Demonstrate the system to AMPC

The system included the following equipment:

- A robot, controller, and robot control software
- Bandsaw
- Cameras
- Object Tracking Table
- Safety equipment
- Laser pointer for remote operator guidance.
- Control Software/interfaces
- User Interface
- A simple clamp to hold the meat

The Shadow Robot system has a robot situated adjacent to the bandsaw and the meat to be cut is held by the robot, see Figure 1. The position of the robot is controlled by an operator who is situated at an operator's workspace out of reach of the robot and bandsaw. The operator moves a tracked object within the operator's workspace. The robot end-effector "shadows" the motion of the tracked object in real-time such that the operator can manipulate the meat to be cut by the bandsaw.



**Figure 1** – Photo of the set-up including the safety fencing within which sits the robot and bandsaw.

## Project Outcome

Completion of Stage 2, Part A has been successfully completed. The restructured code, robot communication through the RSI, safety improvements and different operator modes have markedly improved the control and accuracy of the shadow-robot cutting system.

With the current configuration, the operator-informed and semi-automated modes will perform 10 cuts in 20 seconds with a cut width accuracy of  $\pm 0.5\text{mm}$  from the desired cut width. However, with some further work to the robot control software, we are confident that the cutting speed can be improved to exceed the target of performing 10 cuts in 15 seconds.

In the process of completing this work we have focused on the very simple application of cutting lamb chops, a simple 2D cutting task. Next, we seek to move to 3D cutting and for this we welcome industry input.

A provisional patent has been filed for this concept.

## Benefit for Industry

This proof of concept has shown there is good potential for using remote operations and shadow robots for cutting with a bandsaw.

The benefits of this approach include:

- Removing staff from dangerous operations, via Hands-Off processing, and
- Improving Safety and Wellbeing, via reducing the high-risk nature of processing operations.

The addition of selectable operating modes:

- increases the useability and permits the speed of the robot to be utilised, and
- allows personnel skill and experience to be used in cutting with the shadow-robot.

Further work is required to convert this concept to a commercial product. Ultimately the system could enable operational staff to undertake bandsaw cutting operations remotely e.g. from a control room.