Snapshot Report

Beef striploin fat removal - Stage 2B:

Controlled variable thickness robotic fat trimming

Project Code
2023-1038

Prepared by
Koorosh Khodabandehloo

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Project Description

Trimming to achieve a specific fat thickness on a beef striploin primal is a highly manual process requiring significant human skill and judgement. The sensory processes that allow determination of the fat thickness and the positioning of the striploin in the geometric space relative to a work datum are essential to automation developments.

With the use of ultrasonic measurements in a manner that determines beef striploin profile data in the robot frame of reference, the process of fat trimming automation may be realised (Figure 1).

Once the capability is reached commercially, the level of control to perform trimming to target fat cover specification will be beyond what is achievable manually as human sensors could not have the possibility to gauge fat thickness within the striploin, except in a notional manner by feeling the top of the fat over the profile. Moreover, the control over the manual trimming process removing fat is limited to the accuracies that may be achieved by the manipulation of a knife or a cutting tool being driven through the fat along the path that removes variable fat thickness to leave a known specific thickness of fat behind on the lean meat.

Stage 2B has extended the work to date to develop a trimming tool which has been tested in trials as an integrated set up, and trialled adjacent to a beef striploin processing line at a plant in Australia.

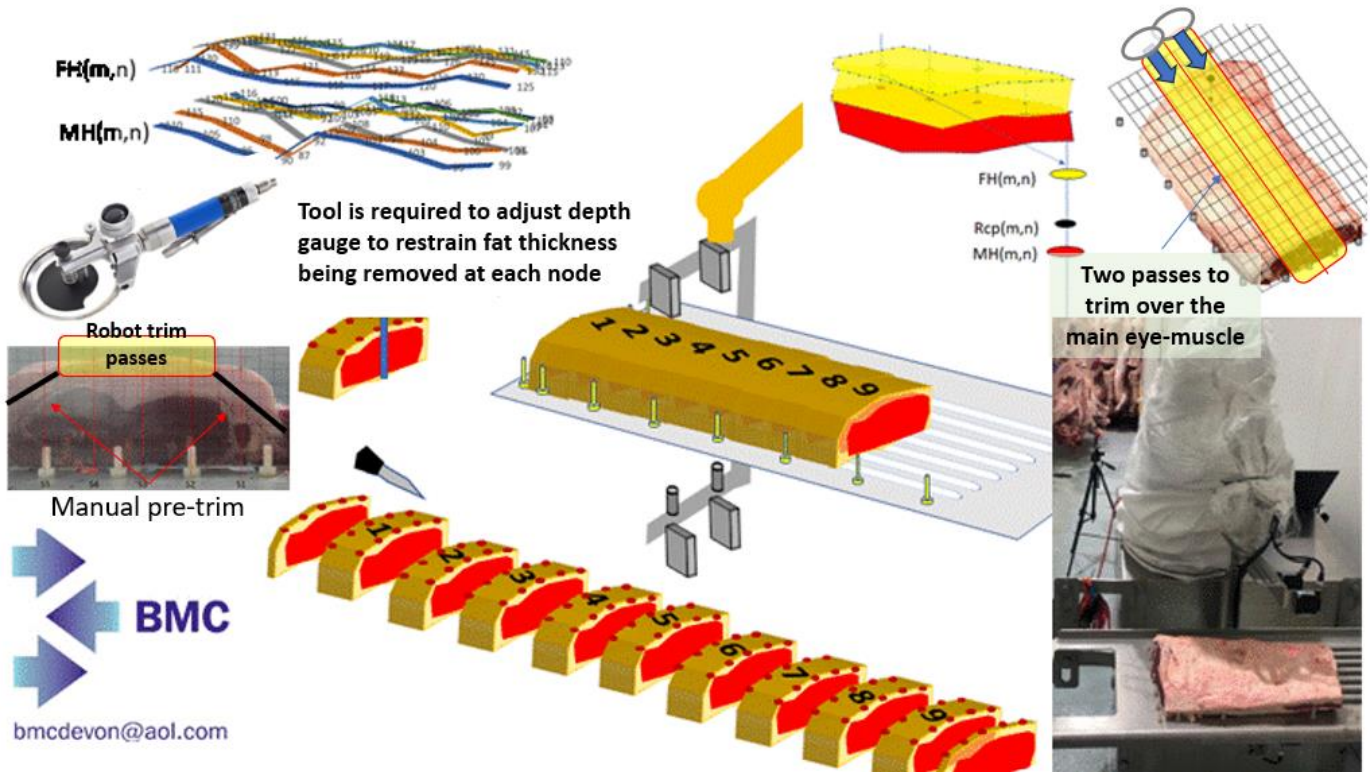

Figure 1: Robotic profile measurement of meat and fat heights in a robot workspace.

Project Outcome

Figure 2 presents a snapshot image of the process and trimming test, prior to start of trials.

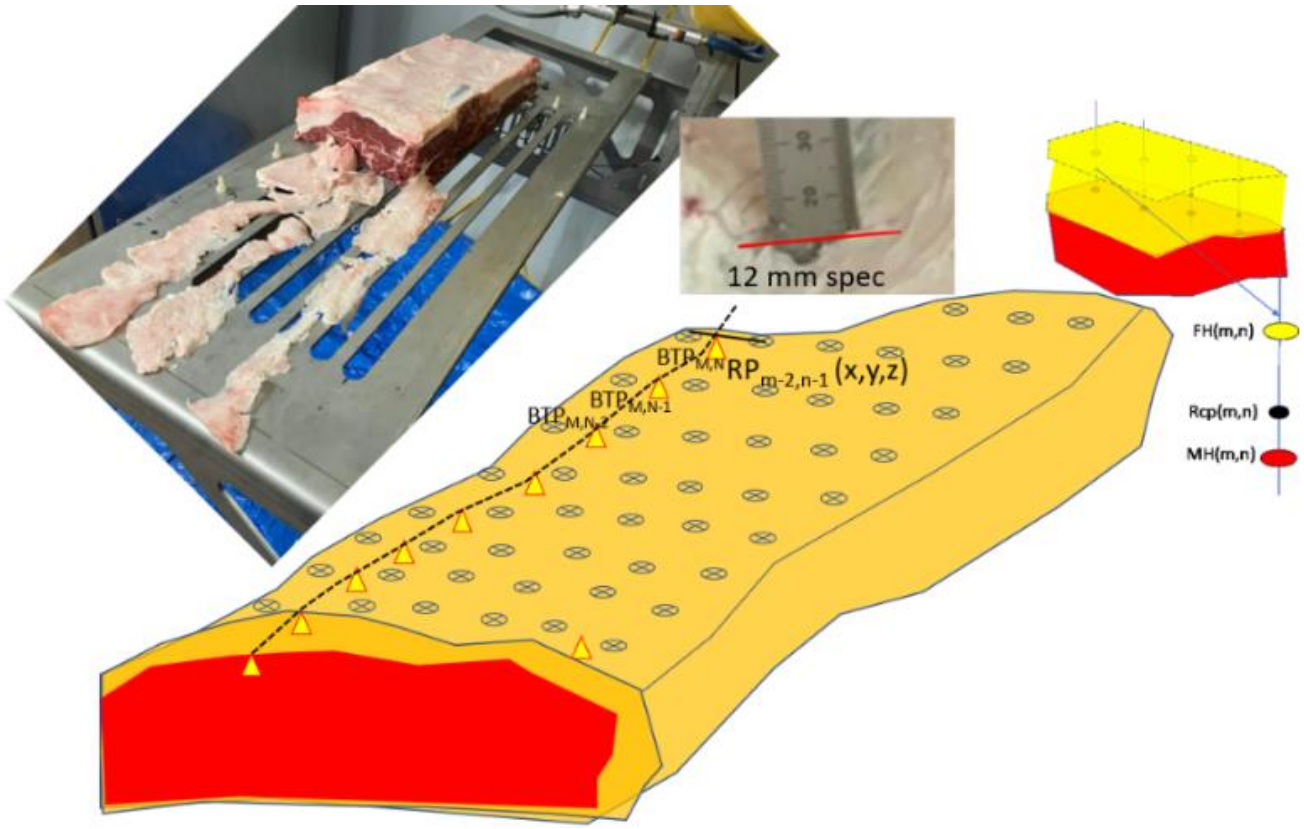

Figure 2: Trimming test prior to trials.

Robot programming has provided for the sensor positioning at nodes (see Figure 1) over the body of the striploin, measuring:

- fat height (FH) above the slotted plate,
- meat height (MH),
- meat base (MB) relative to the top surface of the slotted plate on which the striploin rests.

The measurements, digitally stored within the robot controller are referenced to determine robot trimming paths.

The robot system with specific motion control program, as the first world implementation, has been used with the integrated controllable powered trimming tool, to perform trials adjacent to a processing line. Table 1 presents the results of the trials trimming 51 striploins over the main fat cover above the eye-muscle, where control of uniformity of fat thickness to specification is critical.

		mm after trim			Correction
		Measured			OR
No	Spec.	M1	M2	M3	Damage
1	**10**	10	12	10	None
2	**10**	10	10	11	None
3	**10**	10	12	10	None
4	**10**	10	10	9	None
5	**10**	13	10	12	None
6	**10**	11	12	10	None
7	**10**	10	12	10	None
8	**10**	10	10	10	None
9	**10**	9	10	10	None
10	**10**	10	10	10	None
11	**10**	10	10	10	None
12	**10**	10	10	10	None
13	**10**	10	10	10	None
14	-	15	15	13	None
15	**10**	10	10	10	None
16	**10**	10	10	10	None
17	**10**	10	12	11	None
18	**10**	10	11	10	None
19	**10**	10	10	14	None
20	**10**	10	10	12	None
21	**10**	12	12	12	None
22	**10**	10	10	10	None
23	**10**	(15)	(15)	(10)	None
24	**10**	10	10	10	None
25	**10**	10	10	10	None
26	**10**	(10)	(10)	(10)	None

		mm after trim			Correction
		Measured			OR
No	Spec.	M1	M2	M3	Damage
27	**12**	12	12	12	None
28	**12**	10	12	12	None
29	**12**	12	12	12	None
30	**12**	10	12	10	None
31	**12**	12	12	12	None
32	**12**	12	12	12	None
33	**12**	12	12	12	None
34	**12**	12	12	12	None
35	**12**	10	10	12	None
36	**12**	12	12	12	None
37	**12**	12	13	12	None
38	**12**	10	10	10	None
39	**10**	10	10	11	None
40	**10**	8	8	9	None
41	**10**	10	14	10	None
42	**10**	10	10	10	None
43	**10**	10	10	10	None
44	**10**	10	10	10	None
45	**10**	10	8	10	None
46	**10**	10	10	10	None
47	**10**	10	10	10	None
48	**10**	10	10	10	None
49	**10**	10	10	10	None
50	**10**	10	10	10	None
51	**10**	10	10	10	None

Table 1: Trials reveal improved capability of better than 2 mm reduction in over trimming.

The controllable powered tool for use in robotic trimming as defined, assembled, and integrated, has been implemented under Stage 2B, and tested in the planned trials showing capability to remove fat to specification. The robotic process avoids over trimming compared with manual trimming by at least 2 mm.

Figure 3 illustrated example images of robotically fat trimmed striploins for uniform fat cover over the main eye-muscle.

Figure 3: Robotic beef striploin trimming for uniform fat cover.

Benefit for Industry

The automation under development reduces over trimming, increases efficiency, and contributes to improvements in work conditions. Potential savings are conservatively estimated at greater than A$3.00 per striploin.