

Centrifuge Camera Control Application Analysis – Cake Thickness

Objective:

- Examine the capability of the Cauty process camera to monitor / measure cake thickness during the filling process.

Equipment / Method:

The objectives were attempted using a Cauty process camera / light combination unit and Cantyvision Client Software.

The cake thickness, and over standing water level were monitored / measured using the Cauty “Edge Tool” in the Cantyvision Client Software. The “Edge Tool” has the ability to track any edge based on the difference in colour / grayscale of 2 materials / components (centrifuge base plate and cake product). Initial Calibration Points were set up as 0mm (centrifuge drum wall) and 234mm (edge of base plate).

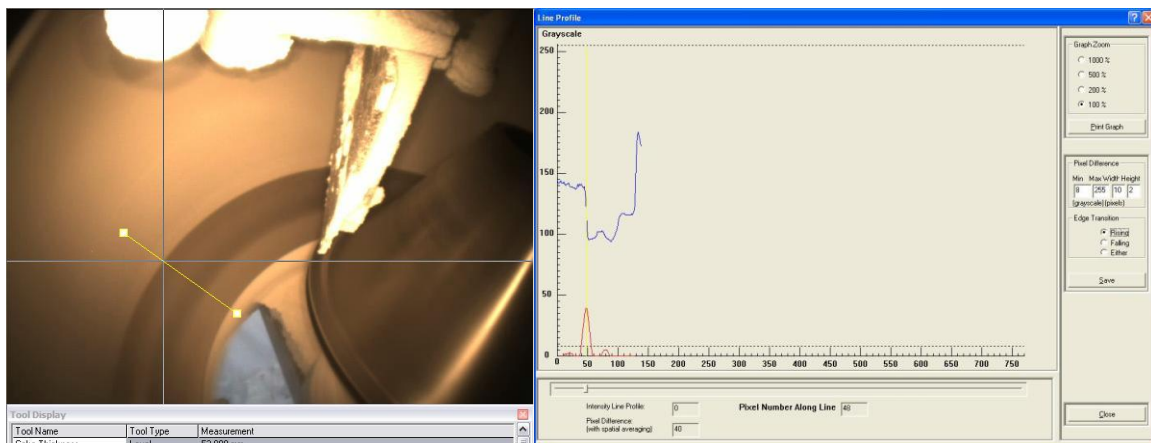


Figure 1: Edge Detection Software

Run 1

For Run 1 the process would be; filling phase 1, filling phase 2, washing, dewatering, with a stoppage between each phase of the process

Filling Process:

Fill 1 and Fill 2 were carried out, during which the thickness was monitored in Cantyvision. It was verified that the software was capable of tracking the edge (cake thickness) during the filling process.

After the filling process was carried out, a manual measurement of the cake was taken (52mm) which then became a third calibration point, for future runs.

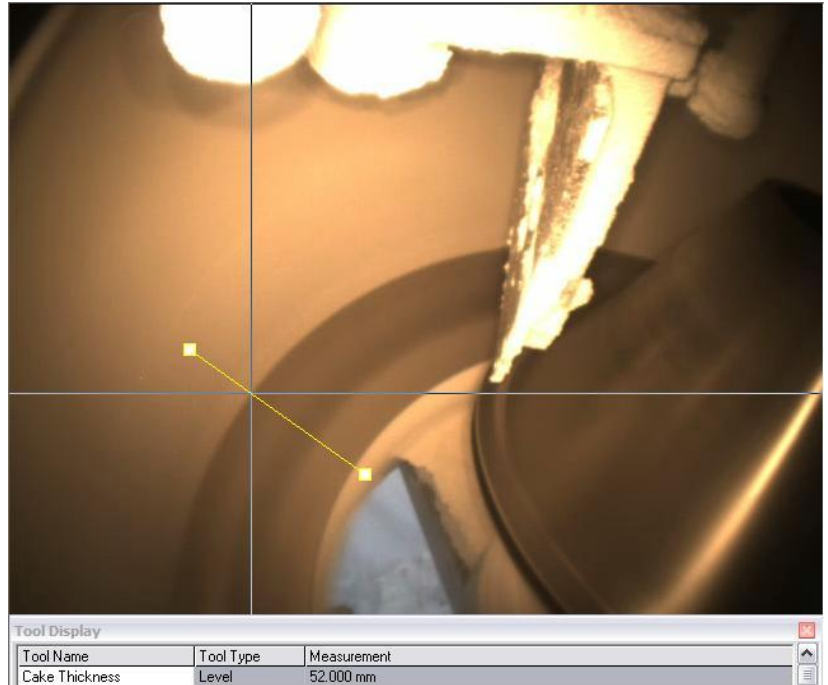
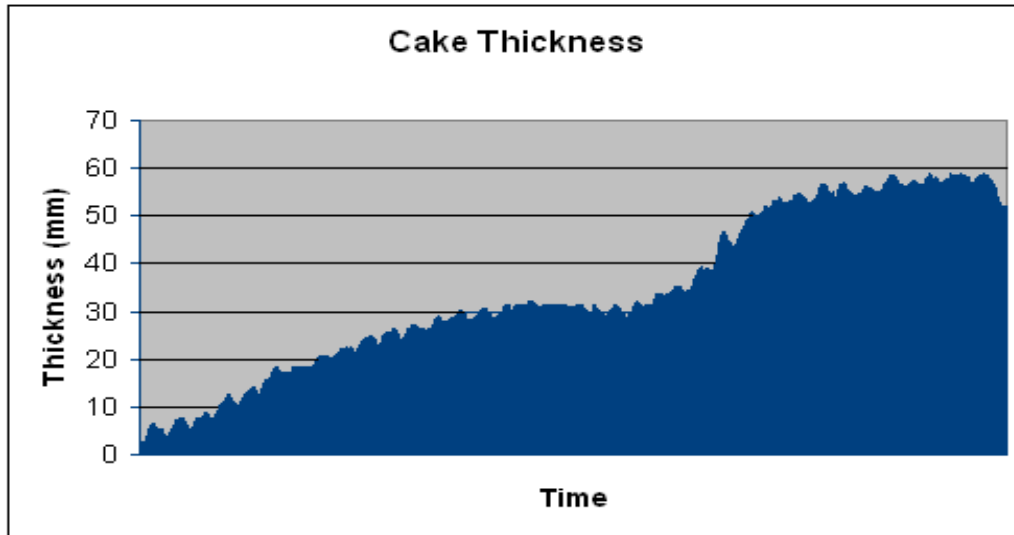


Figure 2: End of Fill Process

The fill process was graphed so the cake thickness could be monitored throughout the process. Note the area of consistent thickness measured at approximately the half way point. This is due to there being a break between the 2 stages of filling, and the data from 2 separate output files being combined to produce one graph.



Graph 1: Run 1 Fill Thickness During Process

Washing Process:

The washing process was carried out with deliberate over loading to monitor the effect of over standing liquid on the measurement, and to verify if the software was capable of tracking the wash water edge.

Figure 3 shows the washing process. It was observed that the software had the capability to track the edge of the wash water on the centrifuge base plate. It was also the case that the level of the wash water on the cake was larger than had been expected. The measurements taken by the software, were visually verified by images which showed the edge of the wash water significantly closer to the edge of the centrifuge base plate than expected (figure 3).



Figure 3: Washing Process

Dewatering Process:

The cake thickness was monitored throughout the dewatering process video, and initially it was expected that the final cake thickness would be back in the region of the 52mm as seen at the end of the filling process.

However, the software showed an increased thickness in cake by 13mm. Manual measurements were not taken at this point as the cake had been scraped from the centrifuge. This would be done in later runs.



Figure 4: Dewatering Process

Run 2

At the beginning of Run 2, some adjustments were made to the camera image to try to increase the white balance of the image, in an attempt to make it easier for edge tracking. For Run 2 the process would be; filling phase 1, filling phase 2, washing, dewatering, with a stoppage between each phase of the process

Filling Process:

At the end of the fill process, the software measured a thickness of 61.10mm.

4 manual measurements were taken from the centrifuge at 90° to one another. The 4 measurements were 60mm, 63mm, 60mm and 58mm, the average of which is 60.25mm.

The measurement taken by the software correlates very favourably with the manual measurements taken, indicating it is a viable method for cake detection

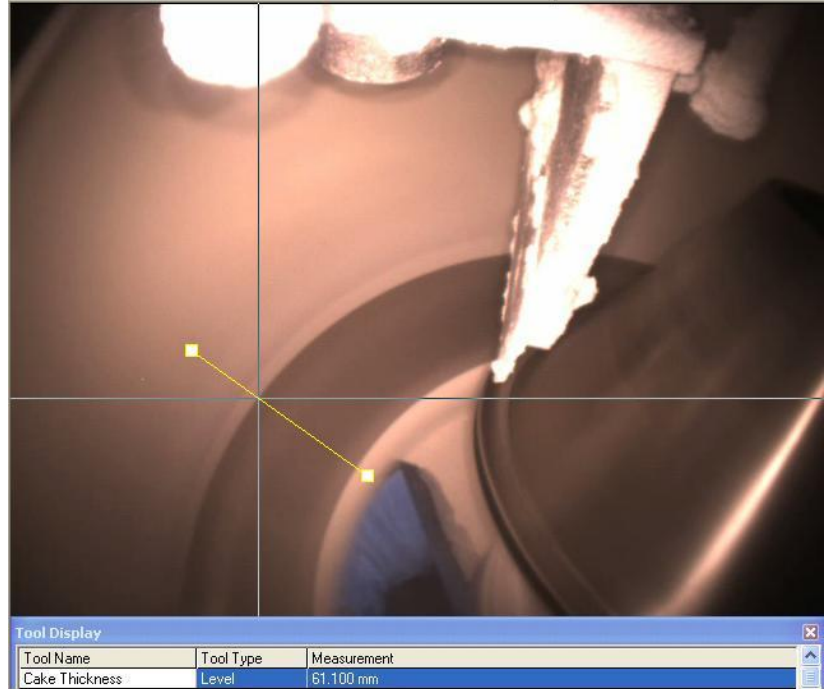
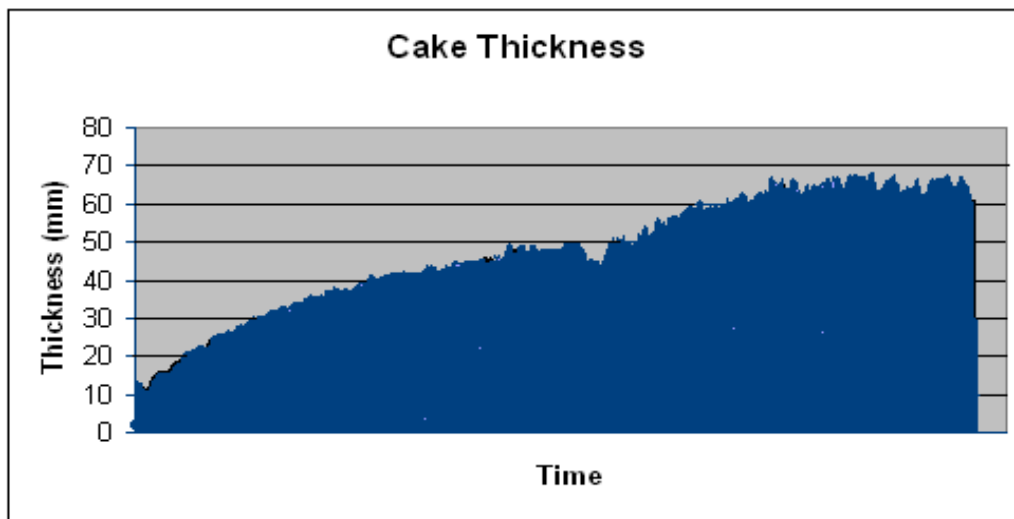


Figure 5: End of Fill Process

The fill process was graphed so the cake thickness could be monitored throughout the process.



Graph 2: Run 2 Fill Thickness During Process

Washing Process:

The washing process for Run 2 was again carried out with deliberate over loading to monitor the effect of over standing liquid on the measurement, and to verify if the software was capable of tracking the wash water edge.

Figure 6 shows the washing process. It was observed that the software had the capability to track the edge of the wash water on the centrifuge base plate. It was however noted that the edge was not tracked as easily with the newer camera settings, as the wash spray made it difficult to threshold on the wash edge.

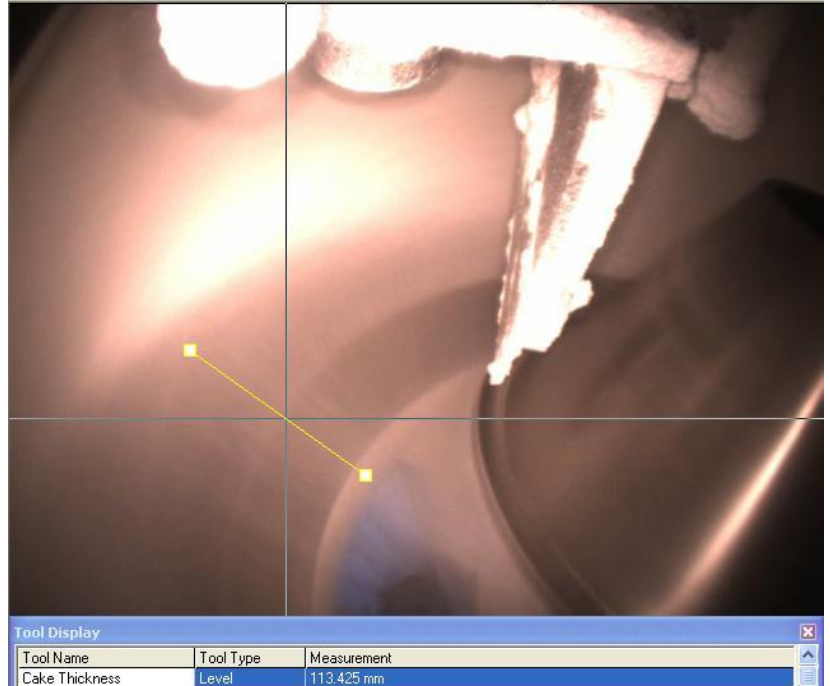


Figure 6: Washing Process

Dewatering Process:

The cake thickness was monitored throughout the dewatering process video. Before the results of Run 1, it would have been expected that the final cake thickness would be back in the region of the 61.1mm as seen at the end of the filling process. However, after monitoring Run 1 it was investigated if the cake thickness had actually increased during washing & dewatering (perhaps due to settling out of product).

The camera software showed a reading of 65.6mm after the dewatering, indicating that it had noted an increase in cake thickness. Manual measurements were taken at 4 points in the centrifuge at 90° to each other. These measurements were 63mm, 65mm, 65mm and 68mm, the average of which is 65.5mm.

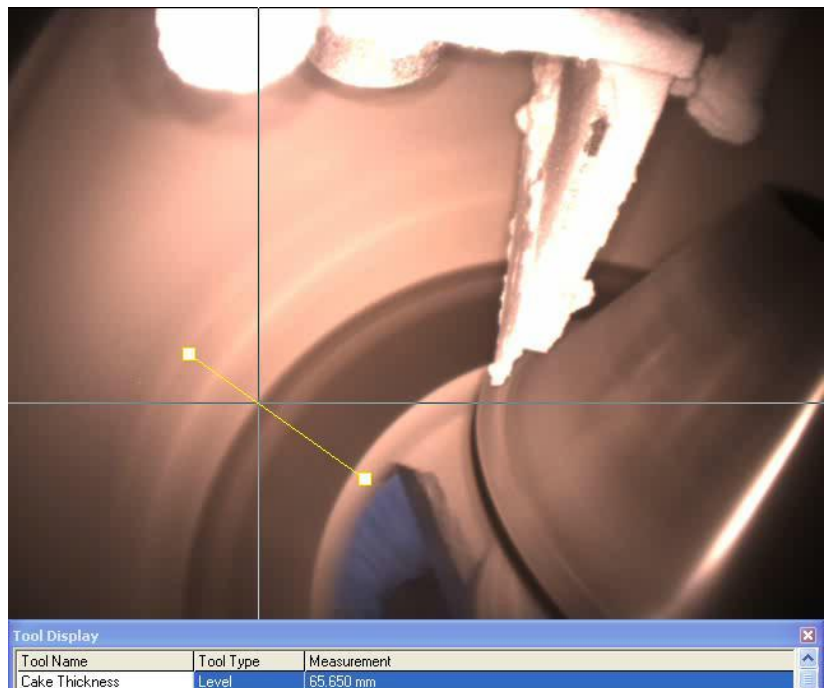


Figure 7: End of Dewatering Process

This compares very favourably to the measurements taken by the camera, further indicating its ability to be used for measuring cake thickness.

Run 3

For Run 3, the camera settings were kept constant. For Run 3 the process would be; filling phase 1, filling phase 2, washing, dewatering, with a stoppage between each filling phase, but no stoppage between washing and dewatering (to investigate change in intensity during transition from one phase to another).

Filling Process:

At the end of the fill process, the software measured a thickness of 54.73mm.

4 manual measurements were taken from the centrifuge at 90° to one another. The 4 measurements were 55mm, 54mm, 53mm and 53mm, the average of which is 53.75mm.

The measurement taken by the software correlates very favourably with the manual measurements taken, indicating it is a viable method for cake detection

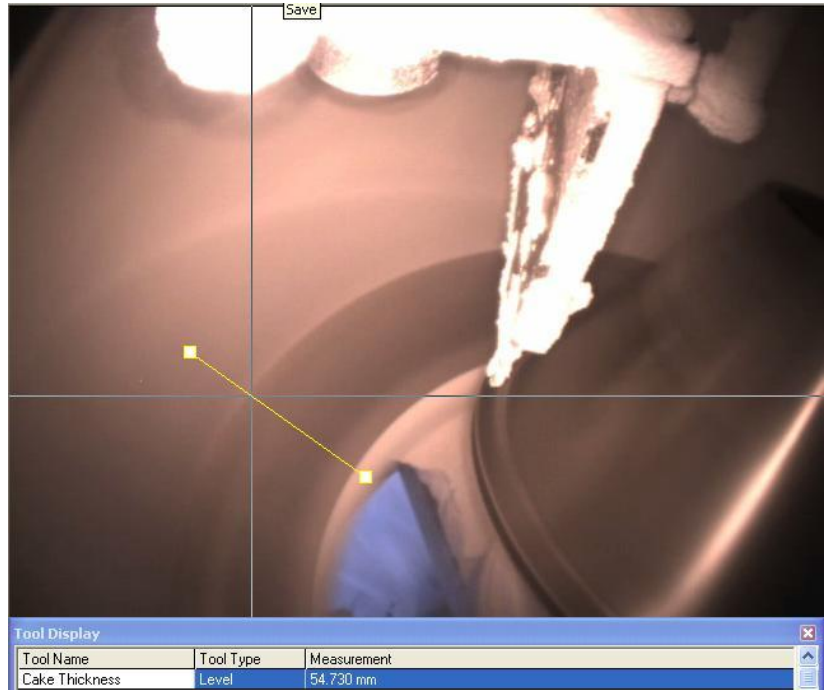
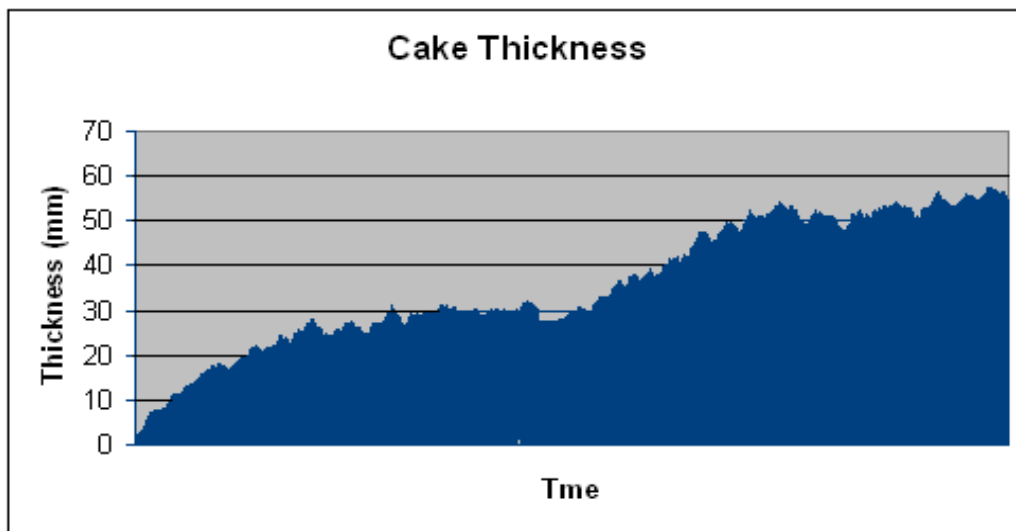


Figure 8: End of Fill Process

The fill process was graphed so the cake thickness could be monitored throughout the process.



Graph 3: Run 3 Fill Thickness During Process

Conclusions:

1. The Canty process camera together with Cantyvision Client Software can be used to accurately measure the cake thickness during filling
2. The Canty process camera provides an invaluable remote view into the centrifuge, helping to better understand the process from filling right through to scraping. It was noted during in scraping that it can be quite difficult to get the last of the product (heel) out of the centrifuge. This could be monitored from the control room using the camera rather than an operator having to go to the centrifuge to look through a sight glass.