

Principles and Applications of Digital Image Processing

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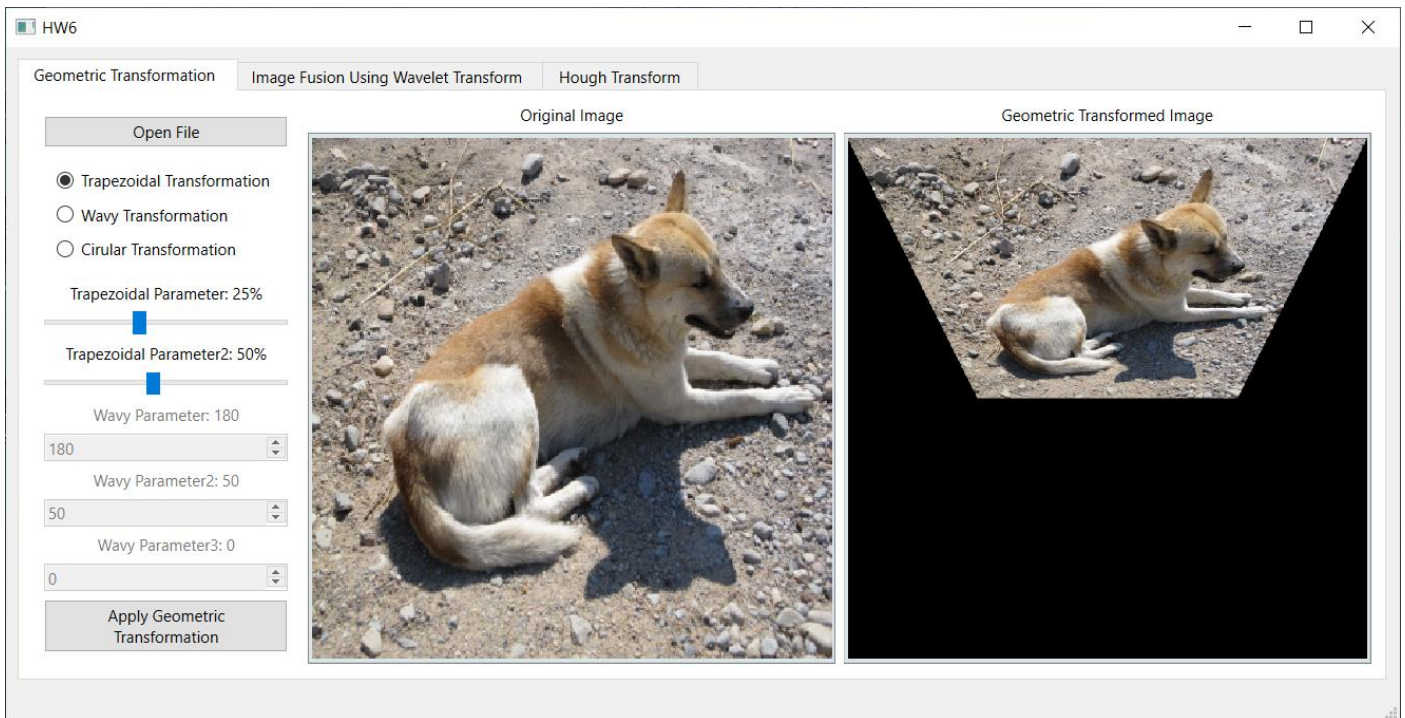
HW6

- UI:

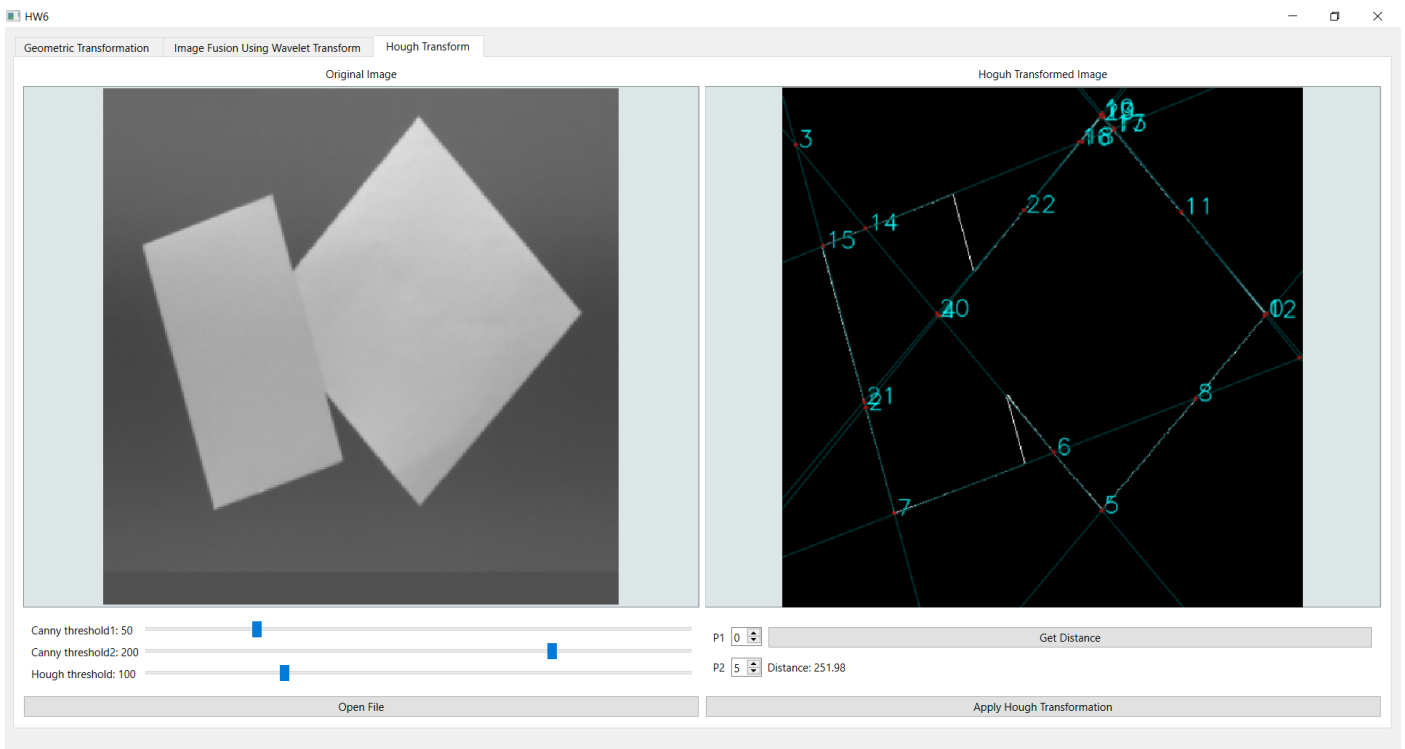
Use tab to switch between parts. All the QPixmap in the application would fit into the QGraphicsView when the window is adjusted. The beep sound in HW5 is now disable because it does not work on Linux system: the sound would be added back when I find the cross-platform solution.



For DWT part, the user can fuse image through DWT, the button would be disabled at first, and enabled when the image is ready. The DWT order can only be up to three, a more general order implementation is under construction.



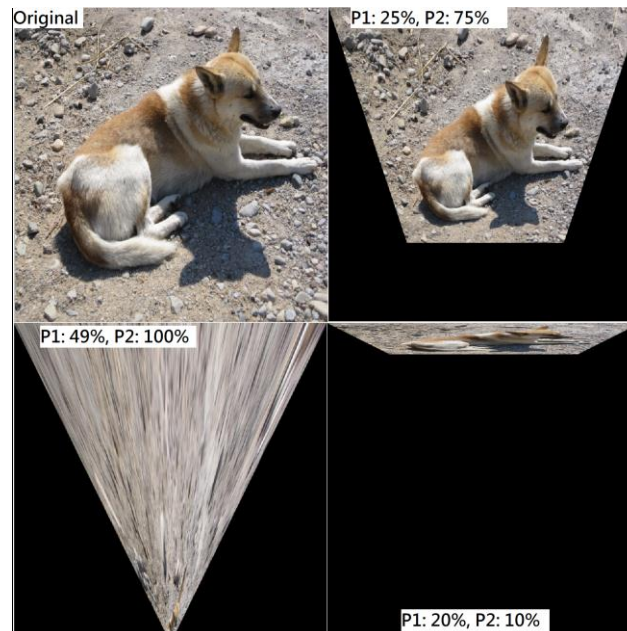
For geometric transformation, the user can adjust some of the parameter of the transform. The parameter would be enabled once the corresponding transformation is selected.



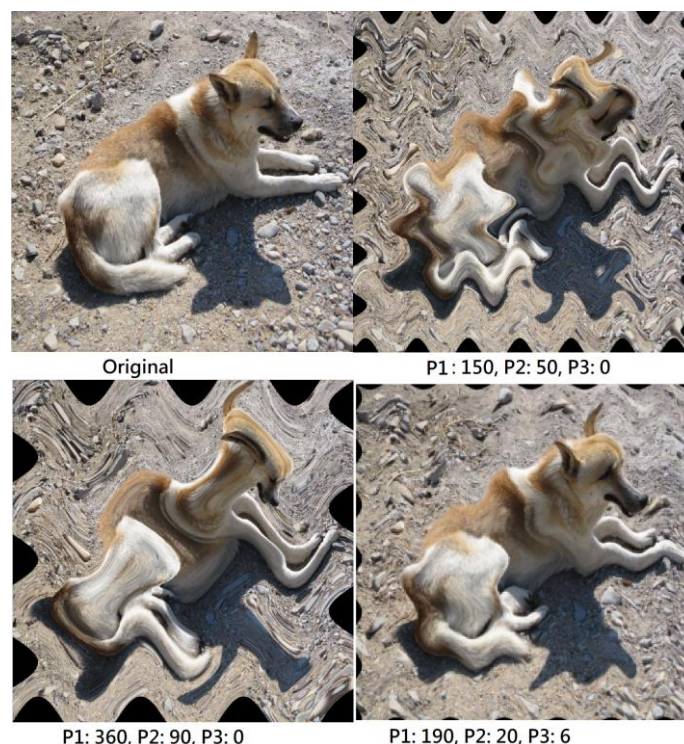
For Hough transform, the user can specify two points in the image, and get the pixel distance. If the user wants to calculate the area and the perimeter of the rectangle, the user would have to multiply the ratio of mm/pixel himself. I design this way to provide a more flexible usage: the user can use the pixel distance information at his own will, not always calculate the area or perimeter of the rectangle.

■ Discussion

- ◆ For trapezoidal transformation, the user can specify the percentage of the shrink in both direction, P1 means the shrink in horizontal, 25% means the SW corner is at the 25% of the image width. The shrink is in symmetry, so the SE corner would be at the 75% of the image width. For P2 it means the shrink in vertical, 100% means no shrink and 10% shrink mean the bottom of the image would be at the 10% of the image height. The (25%, 75%) is the closest to the example image.



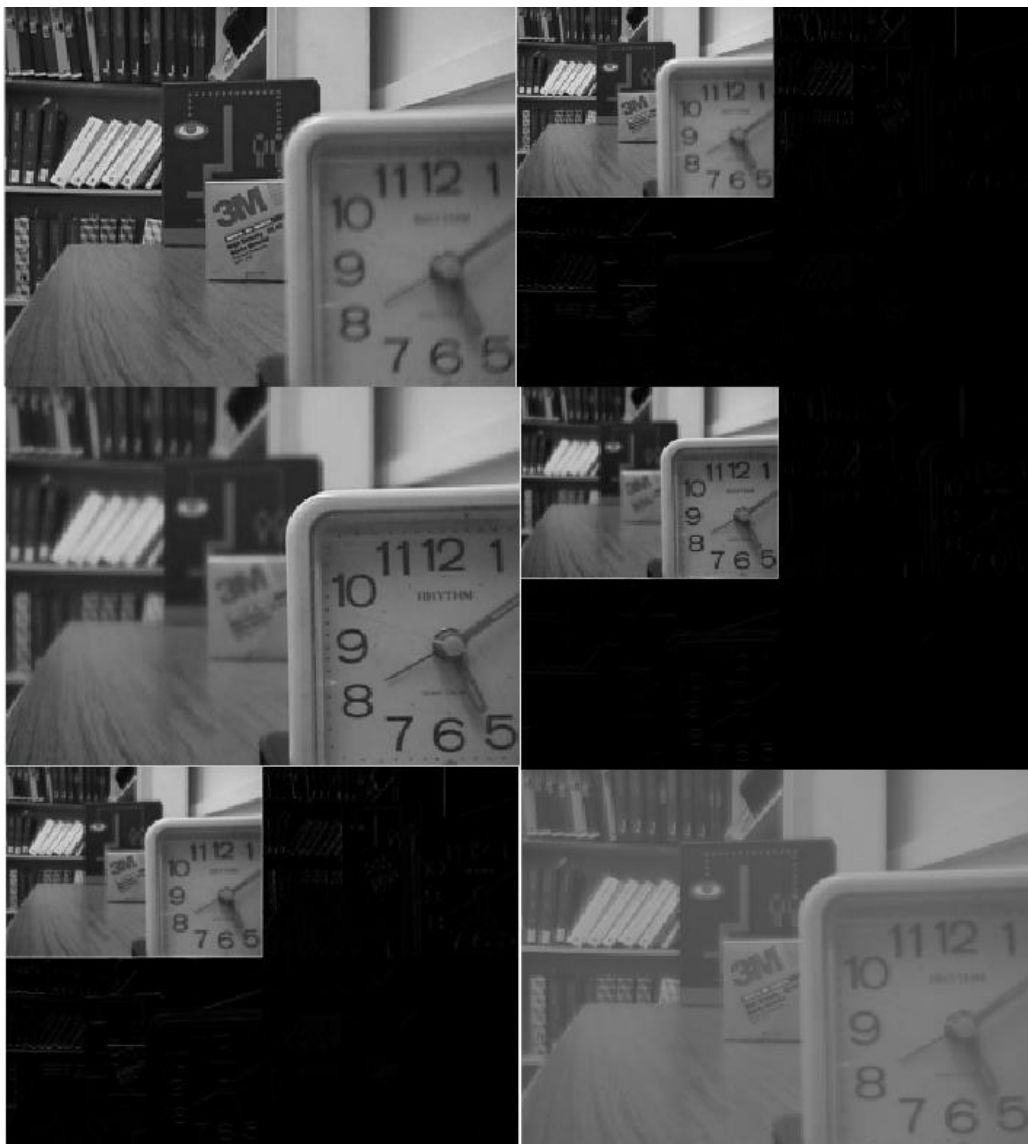
- ◆ For wavy transform, the user can modify the amplitude, frequency and the offset of the sin wave; the offset is controlled in resolution of 30 degree. The (190, 20, 6) is the closest to the example image. When P1 is larger, the freq. of the wave is low. When P2 is large, the distortion effect would be obvious because the amplitude is large.



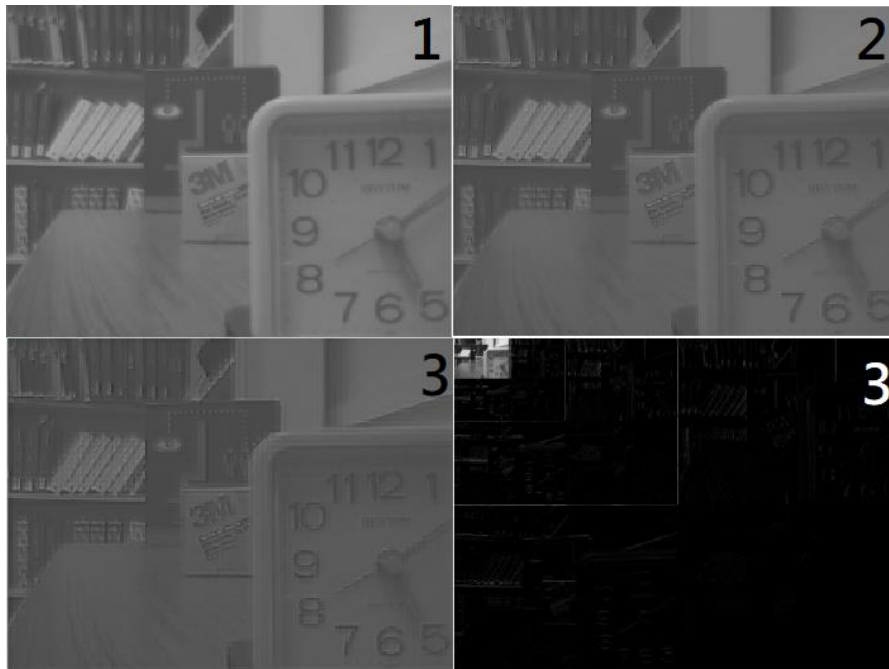
- ◆ For Circular Transformation, further improvements are needed, but the algorithm is assign pixels to the circle, when a pixel is already there, do not assign. We can see there are some small black dots, means the assign is failed.



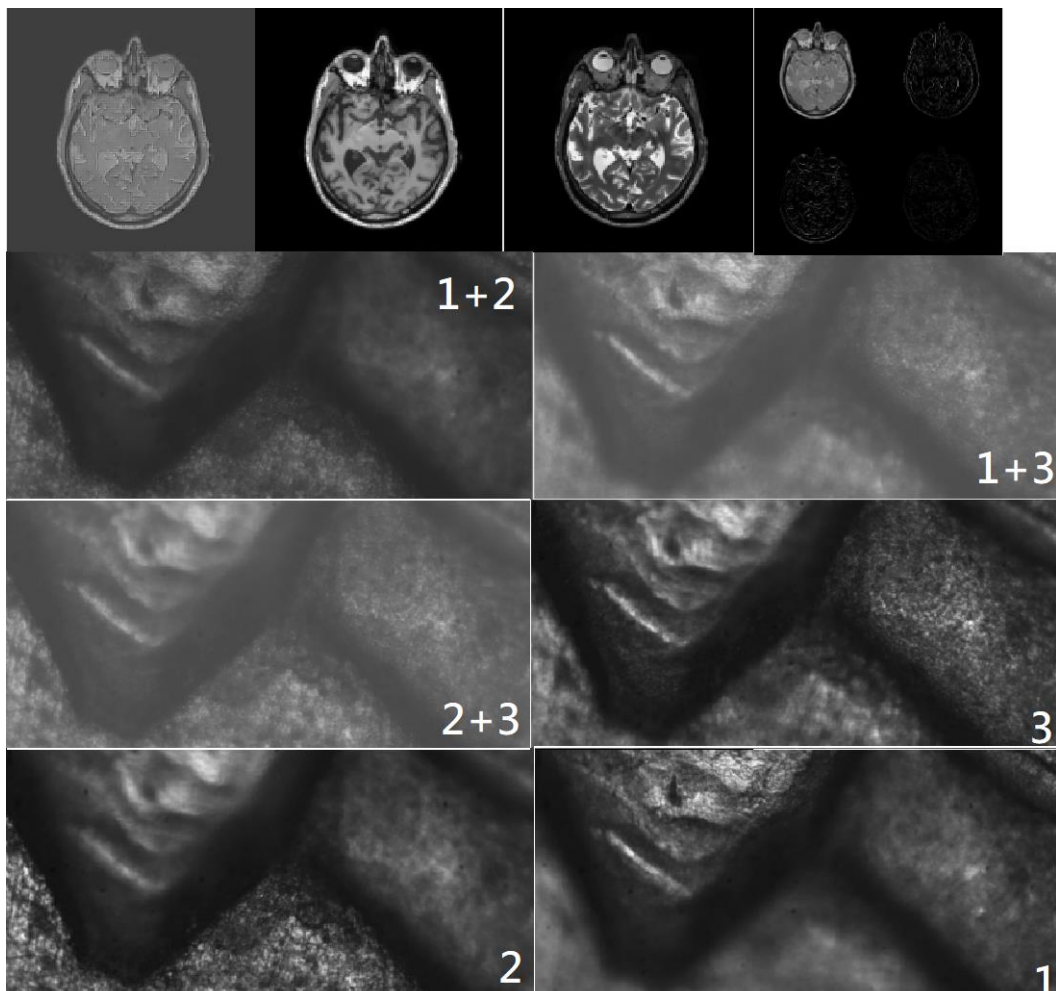
- ◆ For DWT, the user can specify the order of the DWT up to three. Below is the result of 1st order image fusion. We can see the focus of the image is improved but the image becomes coarse, and the contrast of the image is damaged.



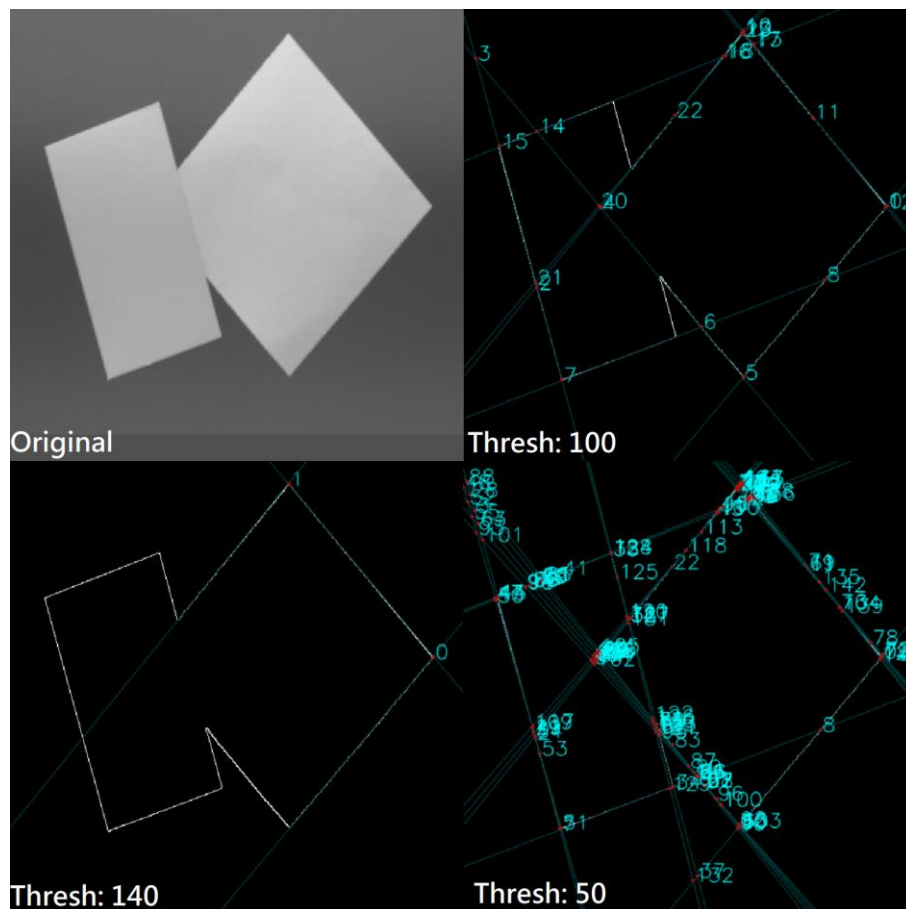
- ◆ Below is the comparison of different order of DWT fusion. The fusion result of the 3rd order is really coarse, I think this effect comes from the down-sampling and the up-sampling of the image. At the SE corner is the fusion result of 3rd order.



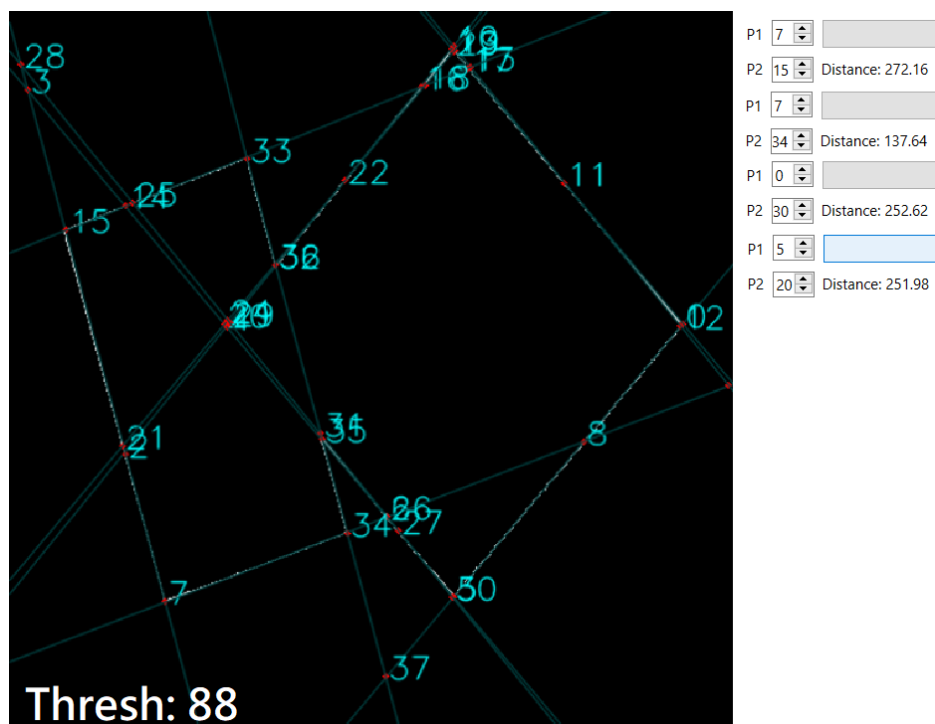
- ◆ Fusion result of other sample images. Both 1st order fusion. For MRI we can see in the result image the eye balls and the brain are fused together. For multi-focus we can see the focal region is widened.



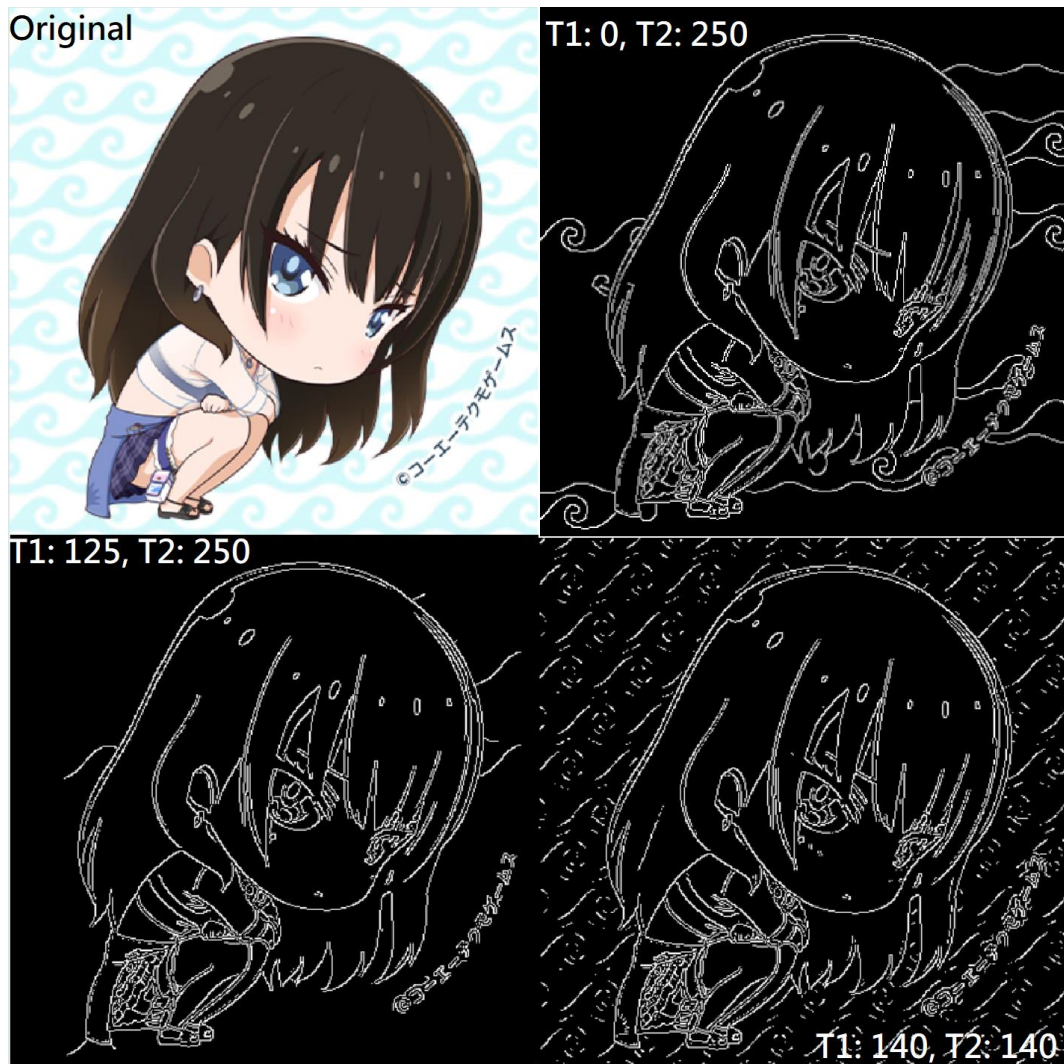
- ◆ For Hough transform, under same Canny threshold (20, 200), the Hough threshold controls the criteria of a line (how many intersects can form a line). As the threshold goes up, the line found is lessened.



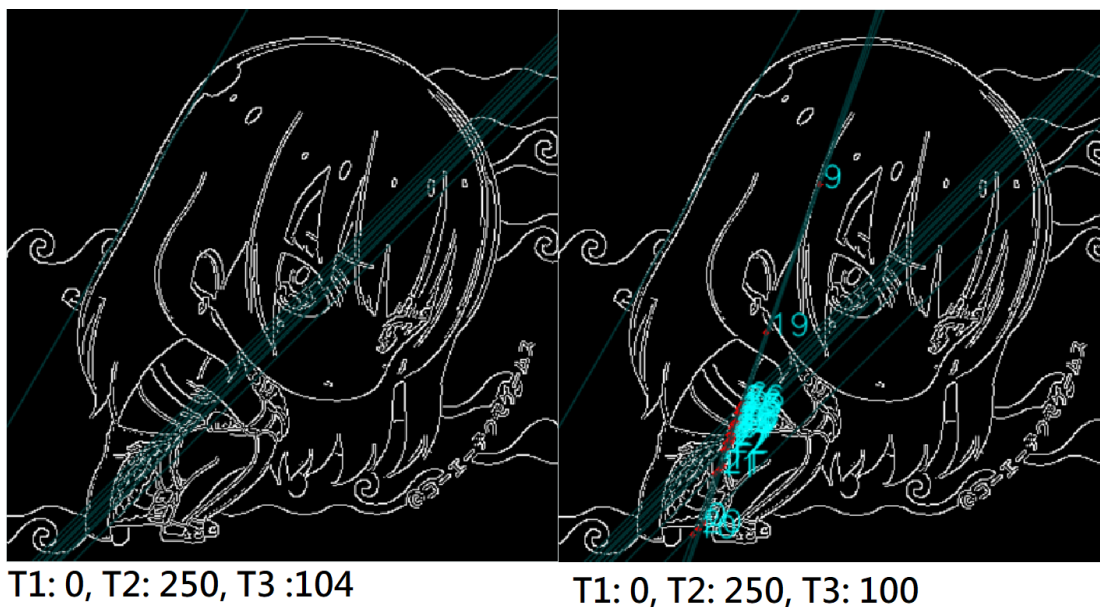
- ◆ At Hough threshold 88, the edge pixel length can be obtain using “Get Distance” button. Then we can calculate the left rectangle area is: $272 \times 0.5 \times 138 \times 0.5 = 9384 \text{ mm}^2$, perimeter is: $(272+138) \times 2 \times 0.5 = 410 \text{ mm}$; the right rectangle area is: $253 \times 0.5 \times 252 \times 0.5 = 15939 \text{ mm}^2$, perimeter is: $(253+252) \times 2 \times 0.5 = 505 \text{ mm}$.



- ◆ The Canny threshold would affect the edge number found, and thus affect the performance of the Hough transform. T1 is the canny low gradient threshold, and T2 is the canny high gradient threshold, they determine the strong edge and weak edge and the noise. Some of their variants are shown below.



- ◆ If we fix the Canny thresholds, and gradually decrease the Hough threshold, we can find out that the edge of the skirts are the first to be detected. With the hair second. They create various intercepting points.



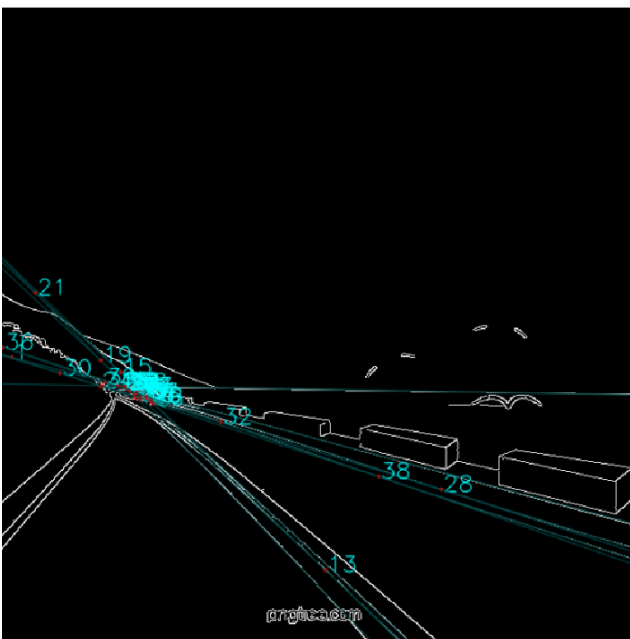
- ◆ For a more realistic scenario, if the Hough threshold is high, only a few edges are detected. If we fix the Hough threshold, and modify T2, the line detected increase because more line segments are detected by the canny.



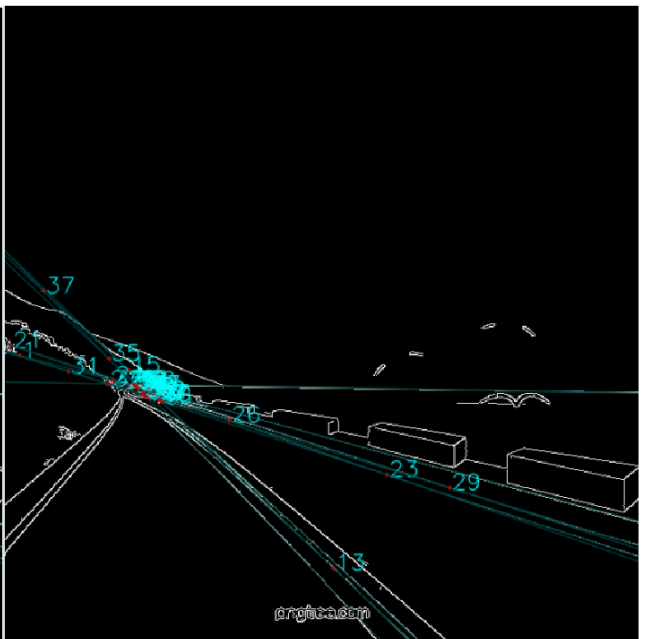
Original



50, 200, 250



50, 200, 200



50, 150, 200