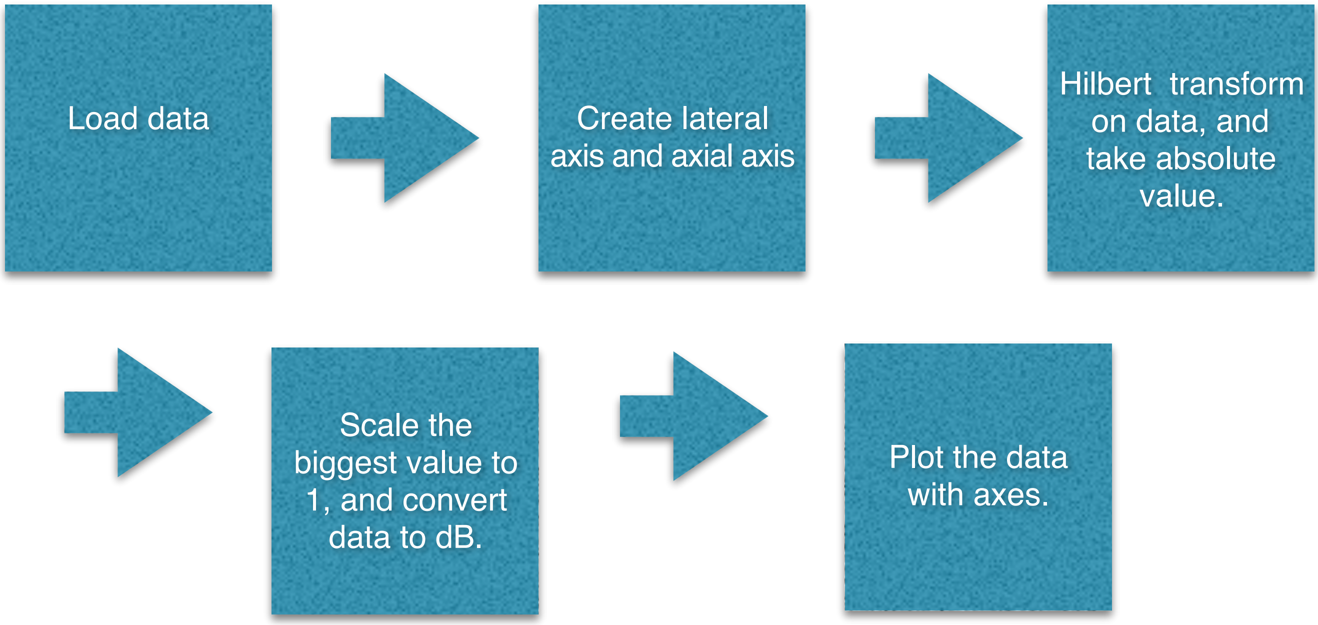
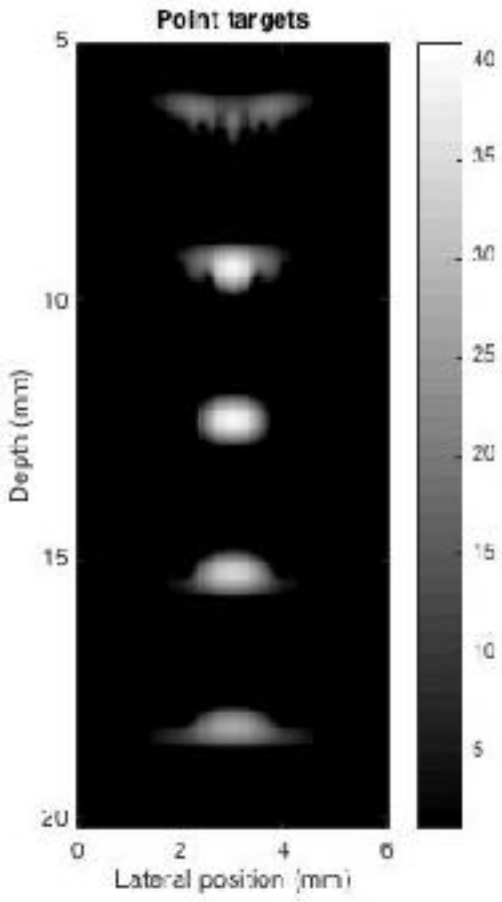
EE 441000 Yi-Chun Hung 103061145 HW1 Part1 11/05/2016

(a)

The procedure is like the block diagram blow.



The image created by the procedure.



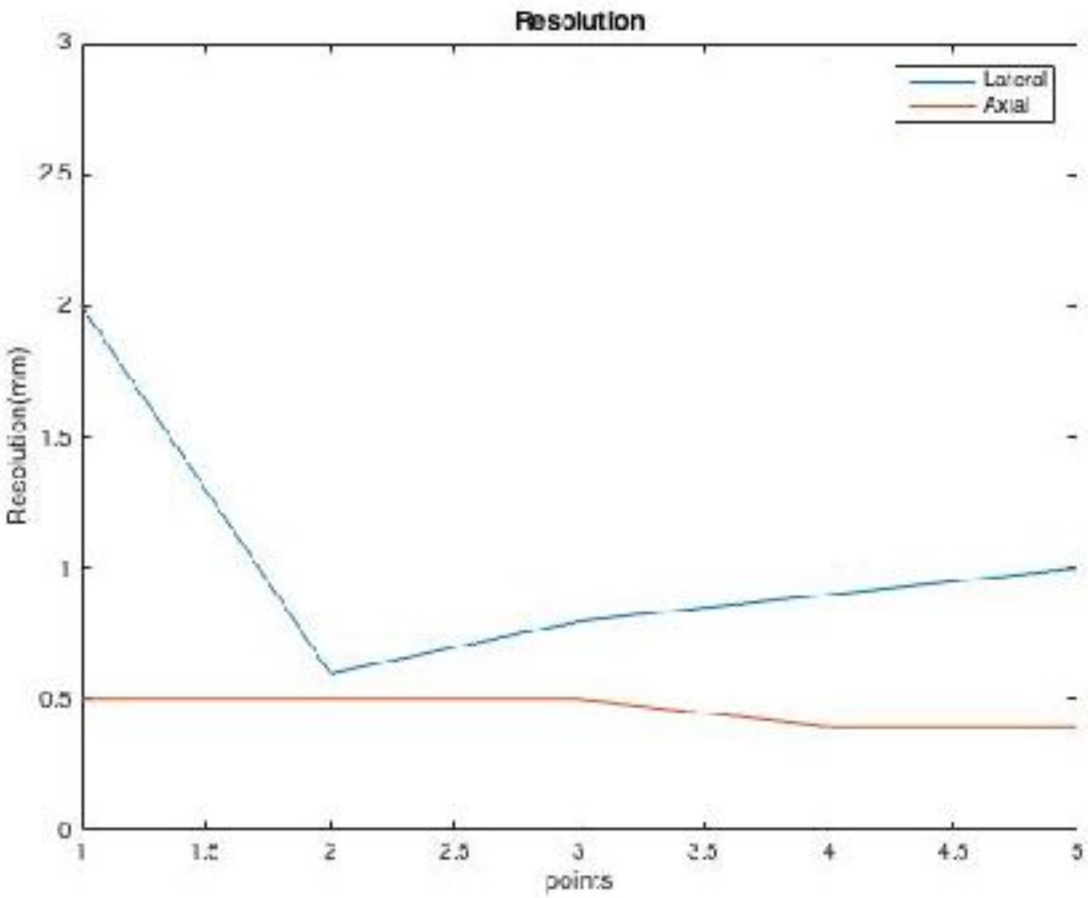
(b)

In my observation, the focal point should be at third point, so focal length = 12.4 mm. The third point has best lateral resolution from the size of PSF.

(c)

This is the resolution along two axes by the eye examination.

	Point1	Point2	Point3	point4	point5
x_axis	2	0.6	0.8	0.9	1
z_axis	0.5	0.5	0.5	0.4	0.4



I found that lateral resolution becomes much better from the second point to fifth point, and the axial resolution maintain the same.

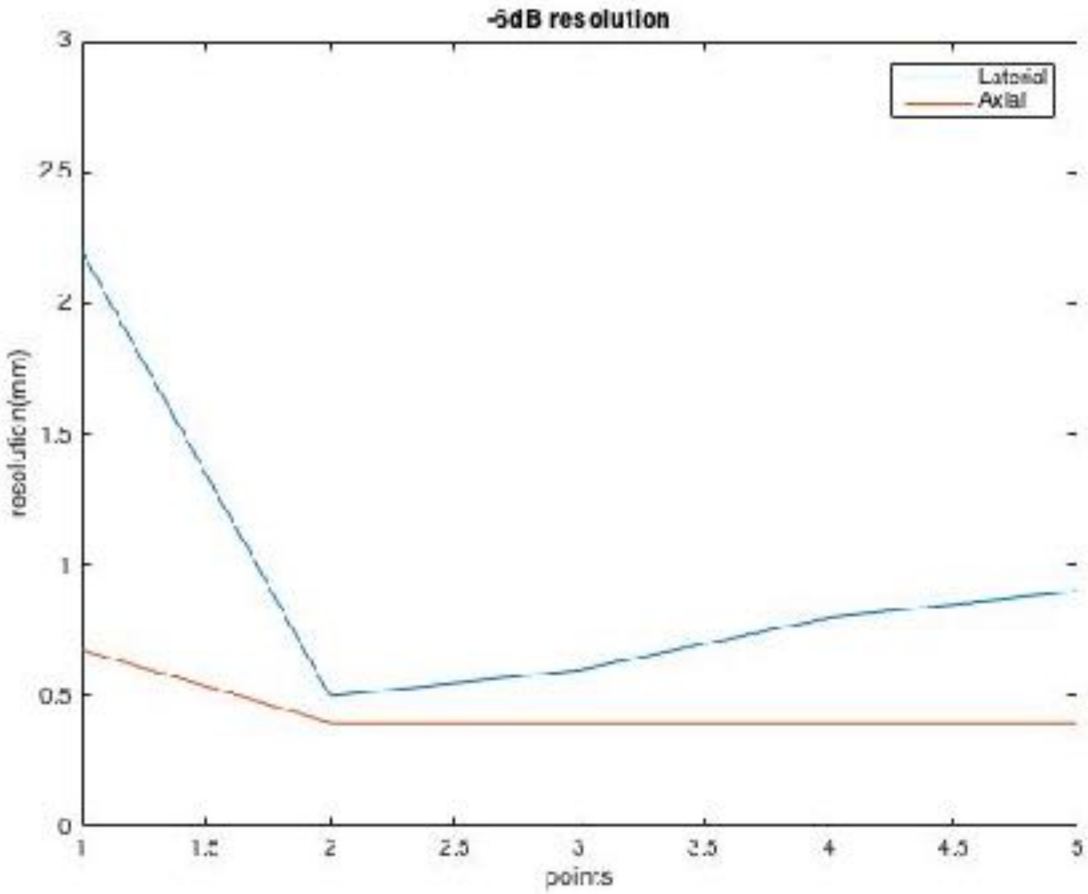
The interest part is that the focal point does not have the best resolution. I think it is caused by the shape of the PSF. The third point look like a circle, so as it overlaps, it will be hard to recognize.

The axial resolution maintains same due to the lambda of the wave.

Eye examination can be different by persons, because every one has different sense of recognition.

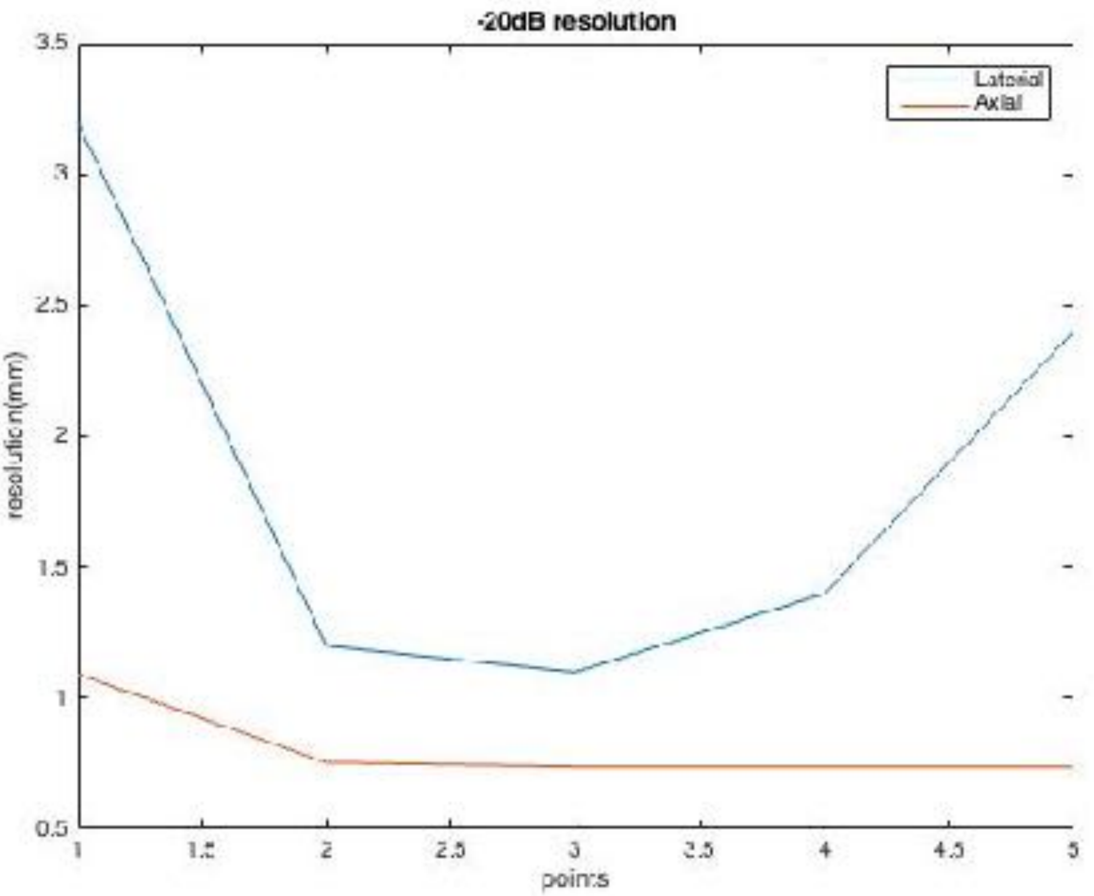
(d)

	Point1	Point2	Point3	point4	point5
x_axis_6dB	2.2	0.5	0.6	0.8	0.9
z_axis_6dB	0.6776	0.4004	0.4004	0.4004	0.4004



In the -6dB bandwidth, its shape is like the eye examination in (c). The lateral resolution becomes much better after the second point. The axial resolution almost maintains the same among last four points. The first point has a little worse axial resolution.

	Point1	Point2	Point3	point4	point5
x_axis_20dB	3.2	1.2	1.1	1.4	2.4
z_axis_20dB	1.0934	0.7546	0.7392	0.7392	0.7392



In the -20dB bandwidth, the lateral resolution becomes much better from the second point. Compare to the -6dB resolution, the third has best resolution, and the resolution becomes worse after the third point.

The axial resolution maintains the same from the second point to fifth point, and the first point has worse resolution.

To conclude, the third has highest power density, so it is the focal point. And, the axial resolution maintains almost same in every position.

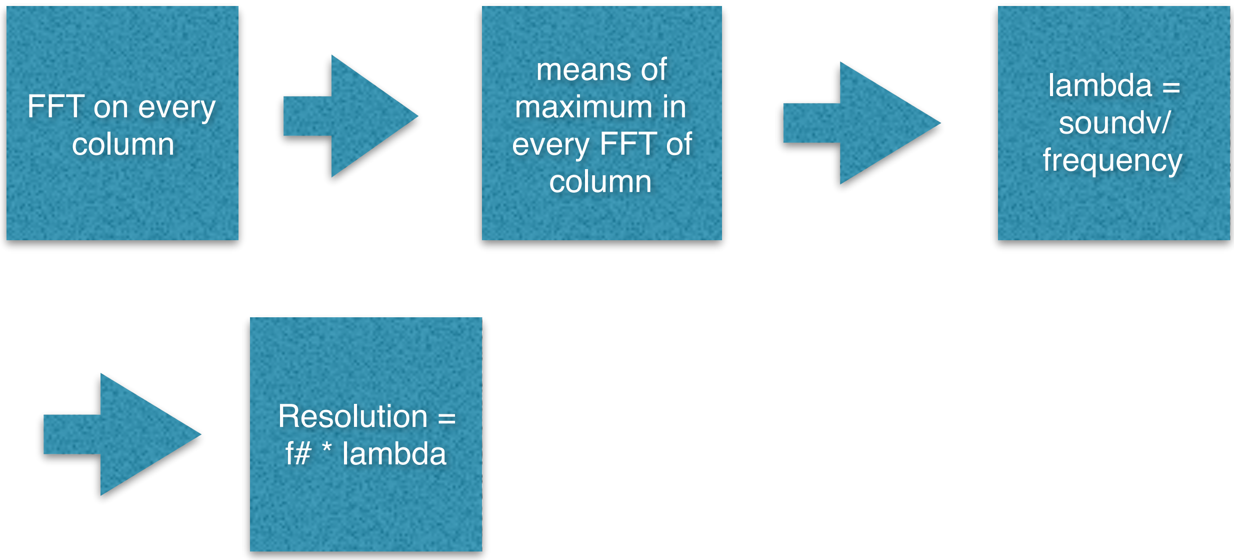
Compare to (c), the spatial resolution is similar to the -6dB bandwidth. So if we have the image of PSF, we can use spatial resolution to evaluate the -6dB bandwidth.

(e)

I do the FFT on the every column in the data, and take the means of maximum in every FFT of column. The result is the center frequency of wave emitting from the transducer. Last, we can use soundv and frequency to calculate the lambda.

I use the formula, f# * lambda, to calculate the theoretic lateral resolution.

The theoretic lateral resolution is 0.6578 mm, which is similar to the -6dB bandwidth calculated in the (d).



(f)

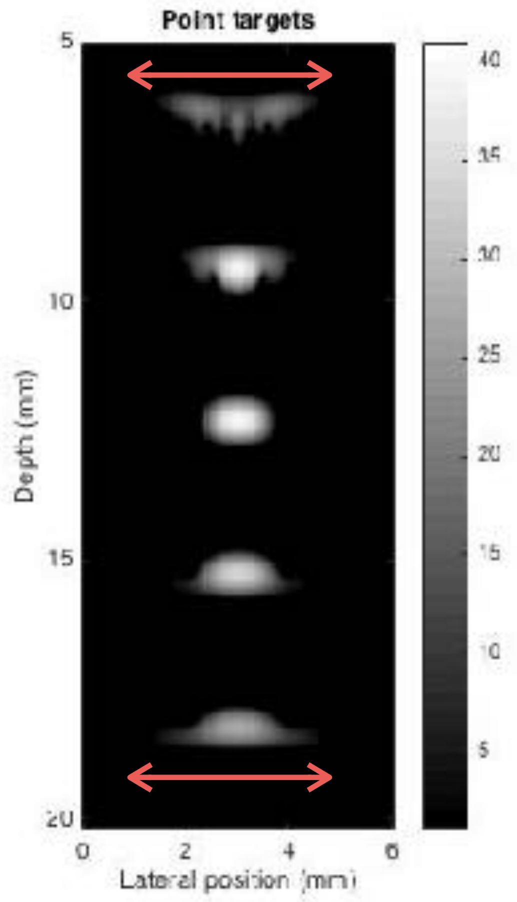
From the plot in (d), the lateral resolution is position dependent. And axial resolution is almost position independent.

The lateral resolution becomes better along the depth until it reaches focal point. Then the resolution will become worse gradually.

The axial resolution becomes better along the depth until it reaches focal point. Then the resolution maintains the same.

(g)

Yes, I could. By observation, the PSF in front of focal point has shape of trapezoid with long side on the upper. The PSF right on the focal point has the shape of circle. And the PSF after the focal point has the shape of trapezoid with long side on the bottom.



Long side of the PSF

2.

Axial and lateral resolution is determined by the -6dB bandwidth, and contrast resolution is determined by the dB of sidelobe. If the PSF doesn't have the sidelobe, we can take the same bandwidth, and see the suppression of the bandwidth we choose. The larger suppression mains the better contrast resolution.

The axial resolution means the ability of recognition in vertical spatial direction. The lateral means the ability of recognition in horizontal spatial direction. The contrast means the ability of noise toleration.