Proceedings of Symposium on Ultrasonic Electronics, Vol. 34 (2013) pp. 9-10
20-22 November, 2013

Optimization of the Measuring Condition by the Ultrasonic Visualization
超音波伝搬の可視化による計測条件の最適化

Shun Mikami†, Yuusuke Tanaka, Katsumi Ohira, Yukio Ogura, (Japan Probe Co., Ltd.)
三上瞬†，田中雄介，大平克己，小倉幸夫 (ジャパンプローブ株式会社)

1. Introduction

It is difficult to estimate the ultrasonic propagation because the receiving waveform includes longitudinal wave, shear wave or edge wave etc. It is possible to experiment efficiently by determining measuring conditions that are frequency, setting position and the focal position of the focus type probe. We have developed ultrasonic propagation simulator "SWAN21" with FIT(Finite Integration Technique) proposed by Nakahata [1], and also we have visualized ultrasonic propagation. In this paper, we compared the simulation results with the experiment results, and determined the optimal measuring condition by ultrasonic visualization.

2. V-transmission method

The bottom signal of the test piece is obtained by V-transmission method in air-coupled ultrasonic testing. The optimal distances of transmitting probe and receiving probe were determined by simulation, and these distances were compared with simulation results and experimental results. Figure 1 shows the simulation model by V-transmission method. Steel blocks being 20 mm or 30 mm thick were set. The probe: 20 mm wide was placed on the steel block of 5 mm thick and 4 degree beam angle in air in order to obtain 42 degree of the refraction angle in steel. The probes were driven by 800 kHz. The probe distance L was set from 35mm to 70mm at thickness t = 20 mm, the probe distance L was set from 35 mm to 90 mm at thickness t = 30mm. The right side probe was driven, and the left side probe was received in Fig.1.

Figure 2 shows the ultrasonic propagation of V-transmission method. Figure 3 shows the relation of the probe distance L and the intensity of receiving signal. Figure 2 was result of the 20 mm thick steel block, and the probe distance was 42 mm. Figure 3 was normalized, therefore the maximum amplitude value was 1. With the 20 mm thick steel block, the receiving signal was maximum at 42 mm of L. With the 30 mm thick steel block, the receiving signal was maximum at 62 mm of L. Figure 4 shows the result of experiment under the

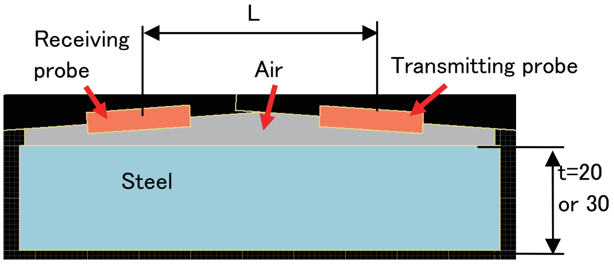

Fig. 1 Simulation model of V-transmission method.

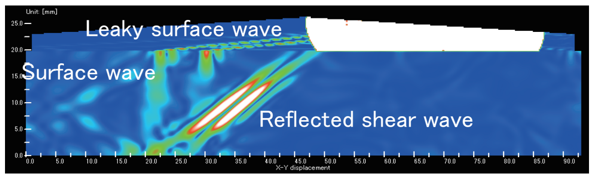

Fig.2 Animation of propagation

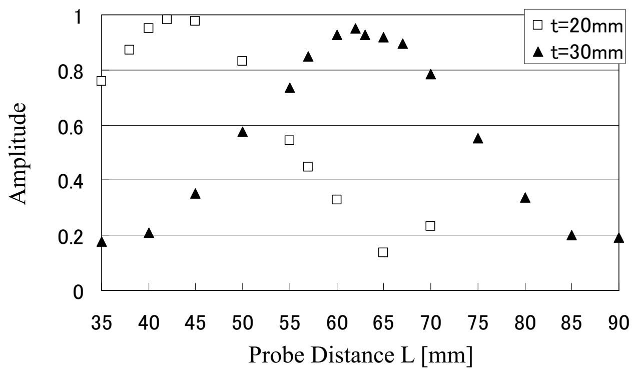

Fig.3 Simulation results.

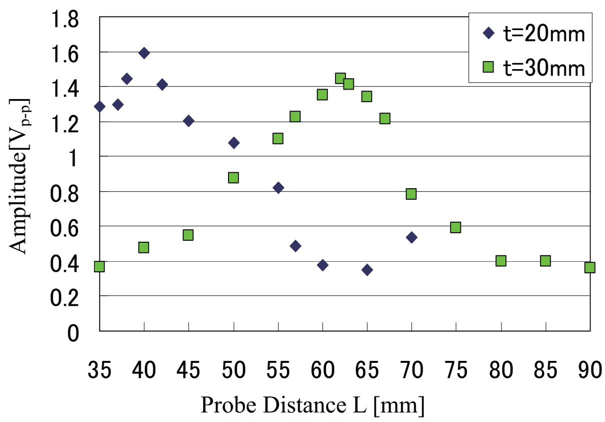

Fig.4 Experimental results.

----
yuusuke.tanaka@jp-probe.com

same condition. The test result was similar with the simulation, when the steel block was 20 mm thick, the receiving signal intensity was maximum at the near 40 mm probe distance. When *t* the steel block was 30 mm thick, the receiving signal intensity was maximum at the near 60 mm probe distance. Therefore, it was possible to determine the optimal probe distance by simulation at V-transmission method.

3. Focus probe

We simulated in the model of Fig.5 to examine the focal point of focus probe. The 2.5 mm diameter void in front of the 90 mm curvature radius probe was set, and the reflecting signal from void was simulated in changing the probe distance to the void. The result of simulation is shown in Fig.6. The amplitude of reflecting signal was maximum when the probe distance to void was 60 mm. We experimented to measure the reflecting signal from steel wire of 2.5 mm diameter which was set in front of the probe with 90 mm curvature radius. Figure 7 shows the relation between the distance of the probe to steel wire and the intensity of receiving signal from steel wire. The intensity of receiving signal was the largest at the distance 60 mm from the probe, and the similar result was obtained with the simulation. Therefore, it is able to determine the focal point of focus probe by simulation.

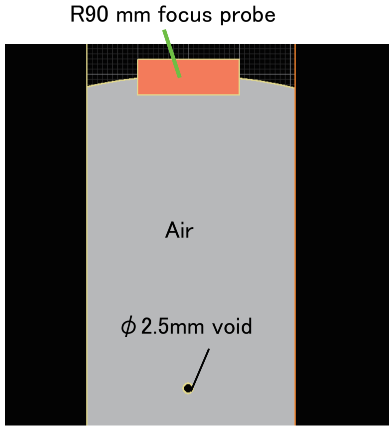

Fig. 5 R90 mm simulation model of focus probe

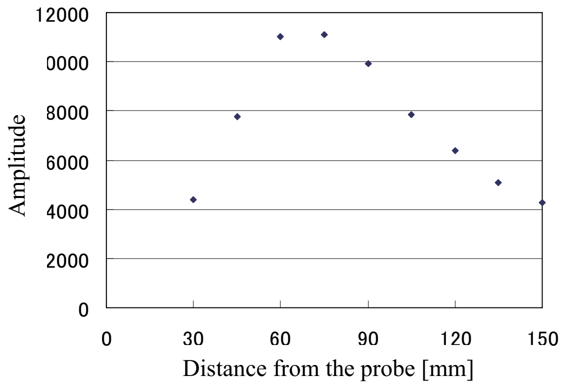

Fig. 6 Simulation of reflect wave from 2.5 mm diameter void.

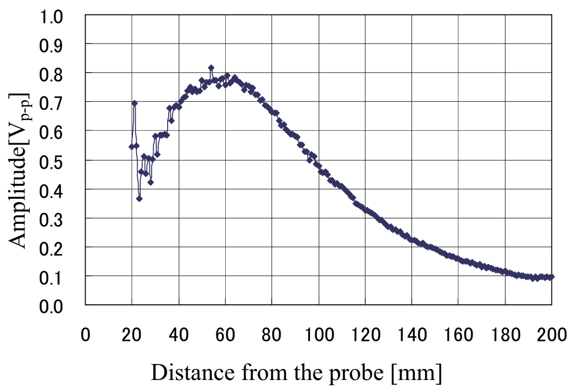

Fig. 7 Experimental result of reflect wave from 2.5 mm diameter steel wire.

4. Conclusion

The distance of the transmitting probe and receiving probe at V-transmission method was simulated, and the focal point of focus probe was simulated. These results were compared with experimental results. Experimental results were similar with simulation, and the optimal measuring condition was determined by simulation.

References

[1] Y. Tanaka, J. Chang, K. Ohira, Y. Ogura, T. Kanazawa, and S. Ido: Reports of the JSNDI fall-symposium (2012) 53 [in Japanese].