Study on the Effect of Focused Ultrasound Excitation on Image Resolution Based on Computer Technology

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Abstract. With the continuous development of modern science and technology, ultrasonic testing is applied in various fields, and plays an important role in the field of detection. Ultrasound imaging is mainly used in medicine to detect the health of internal organs and to defect fetal development in obstetrics and gynecology. In addition, ultrasonic wave is widely used in welding inspection in the mechanical industry, and the downhole ultrasonic imaging is used in tunnel engineering. With the development of ultrasonic testing technology, there are many kinds of ultrasonic testing methods at present. This paper mainly discusses the influence of focused Based on Computer Technologyultrasonic’s excitation on imaging resolution, and finds out the law to perfect the ultrasonic testing means and improve the final imaging resolution. Focused ultrasonic excitation, also known as ultrasonic phased array detection technology, is an emerging non-destructive testing technology that has been developed and popularized in recent years[1]. Discussing and studying the influence of focused ultrasonic excitation on imaging resolution is of great significance to optimize this new technology. In the development of ultrasonic imaging technology, it is the responsibility of every relevant researcher to constantly explore ways to optimize the technology.

Keywords: Focus, Ultrasonic Excitation, Imaging Resolution

With the continuous development of modern science and technology, not only the function of the product has become more and more advanced, but also the maintenance of the product, that is, the inspection and maintenance has become more and more advanced. Traditional means of detection will cause certain damage to the product itself more or less, and for the modern technology derived from non-destructive testing methods, it can be carried out om the surface and inside of the product without damaging the structure of the product itself. There are two kinds of common non-destructive testing methods, namely, radiation detection and ultrasonic testing. Among them, ultrasonic testing is a
widely used non-destructive testing method, especially in medical ultrasonic testing. Compared with radiation detection, ultrasonic testing has no radiation and is less harmful to the human body. Although the current ultrasonic testing technology is widely used, the accuracy of its imaging needs to be improved[2]. The study of the influence of ultrasonic excitation on imaging can better understand the influence principle and law of focused ultrasonic excitation on ultrasonic imaging, to continuously improve the ultrasonic testing technology or improve the existing ultrasonic imaging. The technology is flat or improved by existing ultrasonic testing instruments, making ultrasonic testing more precise and convenient. This paper starts from ultrasonic testing and discusses the influence of ultrasonic excitation on imaging resolution[3].

1. Concept of ultrasonic imaging

Ultrasonic phased array detection technology is a new non-destructive testing technology developed and widely used in recent years. It excites the ultrasonic pulse signal by using the array elements of the line array or area array that arranged smoothly according to a certain timing. The ultrasonic front can focus at a certain point in the sound field and enhance the sound field. At the same time, a large range of sound beam scanning can be realized by forming different spatial positions in the sound field by different excitation timings of the array. Therefore, a wide range of high-sensitivity dynamic focusing scanning can be realized under the premise that the ultrasonic phased array transducer does not move, which is the superior characteristics of ultrasonic phased array detection technology[4]. This technology is usually used in the field of medicine and engineering materials testing. For medical applications, ultrasound imaging scans the human body through ultrasonic beams, and obtains images of internal organs by receiving and optically processing the reflected signals. The supernatural detection of engineering material detection and surface damage of components is also the result of flaw detection by transmitting ultrasonic beams, receiving the reflected signals, and optically processing the reflected signal.

Ultrasound imaging involves a variety of knowledge. In addition to imaging and physics, medical ultrasonic imaging equipment also needs to gather medical knowledge to specifically set the wavelength and intensity of ultrasound adapted by the human body. The ultrasonic imaging equipment used in engineering should also set the wavelength and intensity according to the construction knowledge of the related engineering materials to prevent the internal molecular structure of the material from vibrating together with the ultrasonic wave, which makes the material invalid[5].

2. Current situation of ultrasonic imaging resolution

Ultrasonic imaging technology is characterized by its ability to perform non-invasive detection, but the imaging resolution of ultrasound imaging is low[6]. The best way for ultrasonic imaging to judge is the spatial resolution of the imaging, but the current ultrasonic imaging technology is limited by the low lateral resolution, resulting in a decline in overall spatial resolution, which in turn leads to poor imaging results. In addition, another major reason for the low resolution of ultrasound imaging is the technical limitations of ultrasonic detection itself.

3. Improvement measures and feasibility analysis
Through the study of the influence of focused excitation on ultrasonic imaging, it is found that the main reason for the low resolution of ultrasonic imaging is the low lateral resolution. Therefore, in order to improve the imaging resolution of ultrasonic imaging, the main way is to improve the lateral resolution of the method. In order to improve the lateral resolution, researchers usually use two methods, namely, improving, updating the hardware and improving the accuracy of the algorithm.

3.1. Ways to improve and update hardware

Improve and update hardware. There are many ways to deal with this method, such as focusing the ultrasonic signal to improve the intensity of the ultrasonic signal; changing the aperture, improving the directivity of the transducer, and getting the best imaging results. The algorithm improvement of the final signal processing system and the improve of the accuracy of the algorithm can improve the final signal processing effect, and then achieve the purpose of improving the lateral resolution[7].

However, there are too many restrictions on the method of improving and updating hardware. In addition to being limited by the state of the art, the cost of replacing hardware is higher, and for complex machinery, the hardware replacement is required[8]. The cycle is longer. Therefore, at present, for improving the imaging resolution of ultrasonic imaging, the optimization algorithm, using data soft processing method to help improve the imaging resolution of ultrasonic imaging is the best choice and scheme. In this paper, two methods of improving the resolution of ultrasonic imaging by data soft processing are introduced, and the feasibility of these methods is analyzed.

The first method is micro-scanning imaging. The so-called micro-scanning imaging refers to that the sampling is performed multiple times for the same scene, and the sampling results are arranged according to the chronological and spatial order, and the overlapping parts are processed to obtain the final image. However, this method relies on scanning micro-elements with high positioning accuracy, that is, scanning micro-sources with a separation distance of millimeters or even micrometers, so that the final image effect of the micro-scanning imaging method can be guaranteed[9].

3.2. Multi-frame resolution reconstruction

Multi-frame super-resolution reconstruction technology is based on micro-scanning imaging technology. It depends on the different pixels in low-resolution imaging at different frame rates to combine to obtain a high-resolution imaging. The essence of multi-frame super-resolution reconstruction technology is an algorithm optimization technology, which optimizes the final image processing algorithm for the existing conditions, so that the final ultrasound imaging resolution is improved[10]. Many experiments and data show that the multi-frame resolution reconstruction technique can be optimized by combining the reconstruction constraints, the learned prior knowledge and the smoothness prior knowledge into the ultrasonic resolution reconstruction process using the MAP estimation framework.

4. Conclusion

Based on the concept of ultrasonic imaging, this paper introduces the concept of ultrasonic imaging in detail and the current development of focused ultrasound imaging technology in China. It points out the immaturity of current ultrasonic imaging technology, and then discusses in detail. The impact of focused ultrasound excitation on ultrasonic imaging and the improvement methods are also discussed.
Besides, the feasibility of the improved method in the development of ultrasound imaging technology is discussed. Every new technology has to go through a long process of research and exploration. The exploration of the influence of focused ultrasound stimulation on ultrasonic imaging is an important content in the process of improving ultrasonic imaging technology, and is also an inevitable problem in the development of ultrasonic imaging. So the relevant researchers should dare to innovate, constantly find problems and solve problems.

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