The effect of the bandpass filter on the confocal imaging using CMOS digital system for breast cancer detection

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1. Introduction

The most commonly used technique for early detection of breast cancer is X-ray mammography. However, it causes ionizing radiation. Therefore, the microwave mammography has been developed. In our work, a CMOS digital breast cancer detection system has been developed [1].

2. Experimental

A radar-based breast cancer detection experiment is conducted by rotating the antenna array. A series of signals can be acquired at different rotation angles. By averaging the signals from different angle, a reference can be obtained. Subtracting the reference signal from the original ones, the target signal can be extracted. Figure 1(a) shows an example of the extracted target signal. Because of the sampling error, the direct wave of the original signal and reference signal are not completely the same. Therefore, after subtracting, there are some high-frequency spikes in the signal. Meanwhile, since the input signal is Gaussian monocycle pulse (GMP), there should be no DC part and a few low-frequency parts. However, as shown in Fig. 1(b), the frequency spectrum of the target signal has DC components. Therefore, after integrating, the signal becomes unbalanced as shown in Fig. 1(c).

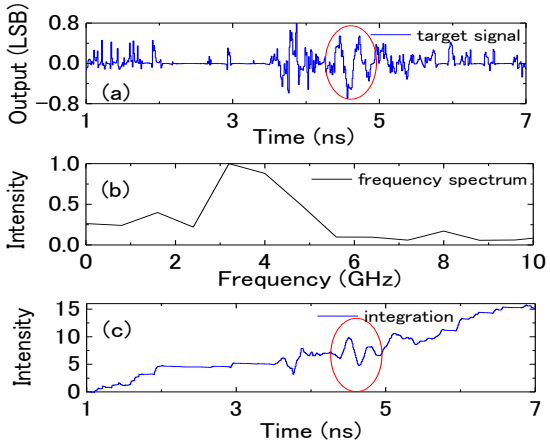

Fig. 1. The target signal in (a) time domain and (b) frequency domain. (c) The integrated signal.

In order to eliminate the low- and high-frequency components which caused by the digitalization, the band pass filter (BPF) is applied before confocal imaging [2].

3. Results

Figure 2 shows the signal and integrated signal after bandpass filtering. It is obvious that the spike noise is suppressed and the unbalance is mitigated. Applying the confocal imaging algorithm to the filtered signal, the breast image can be reconstructed as shown in Fig. 3. The SCR and SMR of different bandpass filter are shown in table 1.

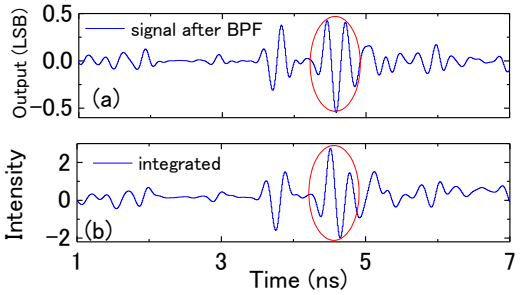

Fig. 2. Signals after bandpass filtering. (a) Original. (b) Integrated.

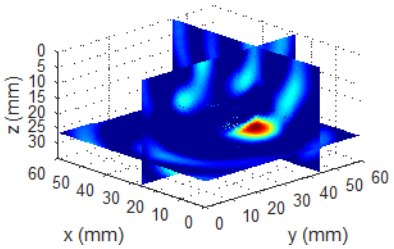

Fig. 3. Confocal imaging result.

TABLE I
SCR AND SMR OF DIFFERENT BANDPASS FILTER

	Bandpass filter range	SCR	SMR
1	No filter	2.43	21.22
2	1 ~ 5 GHz	3.76	22.95
3	1 ~ 7 GHz	4.93	24.22
4	1 ~ 9 GHz	4.68	24.14

4. Conclusion

With the bandpass filter, the noise in the subtracted signal can be suppressed. The spikes are eliminated and the integration unbalance is mitigated. The SCR and SMR of the confocal image are improved after bandpass filtering.

Reference

[1] H. Song *et al.*, *IEEE Access*, vol.3, pp.2111-2121, 2015

[2] Xu Li and S. C. Hagness, *IEEE Microwave Wireless Components Lett.*, vol. 11, no. 3, pp. 130-132, March 2001.