3P5-20

Proceedings of Symposium on Ultrasonic Electronics, Vol. 34 (2013) pp. 529-530
20-22 November, 2013

Effect of PRF on Microcalcification Detection in Color Flow Imaging

CF モードにおける微細石灰化検出に対する PRF の影響

Masayuki Tanabe[1‡], Yu Naito[2], Masahiko Nishitmoto[1], and Lei Liu[3] ([1]Grad. School Sci. and Tech., Kumamoto Univ.; [2] Dept. Eng., Kumamoto Univ.; [3]GE Healthcare Japan, Ultrason. Eng.)

田邉将之[1†], 内藤優[2], 西本昌彦[1], 劉磊[3] ([1]熊本大院 自然科学研究科, [2]熊大工, [3]GE ヘルスケアジャパン 超音波製品開発部)

1. Introduction

"Twinkling Sign" is a phenomenon "rapidly alternating color pixels behind a stationary strongly reflecting medium where an acoustic shadow is expected" in Doppler mode [1]. Many researchers indicated that twinkling sign had a potential in clinical diagnosis. Although a lot of researchers have investigated this phenomenon, the occrucence mechanism of this phenomenon is not clarified yet [2-4]. In the most recent research, Liu et al. experimentally confirmed the relationship between TS and the ultrasound radiation force induced micro oscillation of the micro particles [5].

In this study, we performed *in vitro* experiment to confirm the effect of pulse repetition frequency (PRF) of ultrasound on the echo of the micro glass bead.

2. Method

An experimental setup is described in **Fig. 1**. A single transducer (Olympus Inc., V312-SU, center frequency 5 MHz, focal length 6.35 mm) is used. Pulses are excited at regular intervals and echo signals are obtained using a pulser/receiver (JSR Ultrasonics, Inc. DPR300). Through a preamp included in the pulsar receiver, a digital oscilloscope obtains echo signals. The excited pulse is shown in **Fig. 2**. The PRF is set at 200, 400, 600, 800, and 1000 Hz. A tissue-mimicking phantom had two gelatin gel layers to sandwich a glass bead. Concentration of the gelatin gel is set to 10%. In the phantom, a glass bead which diameter is 1114 μm, was placed on the surface of the first layer. With each PRF, eight successive echoes from the glass bead are obtained with sampling rate of 125 MSa/s.

In this study, we examine a variance of echo signals with various PRFs. Each echo signal is transformed into I/Q signal r_i

$$r_i = I_i + jQ_i \quad (1)$$

where I_i is ith in-phase component and Q_i is

mtanabe@cs.kumamoto-u.ac.jp

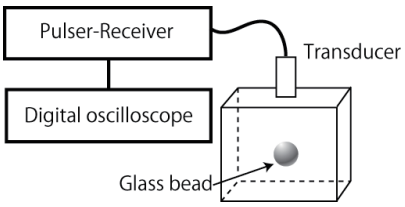

Fig.1 Experimental setup.

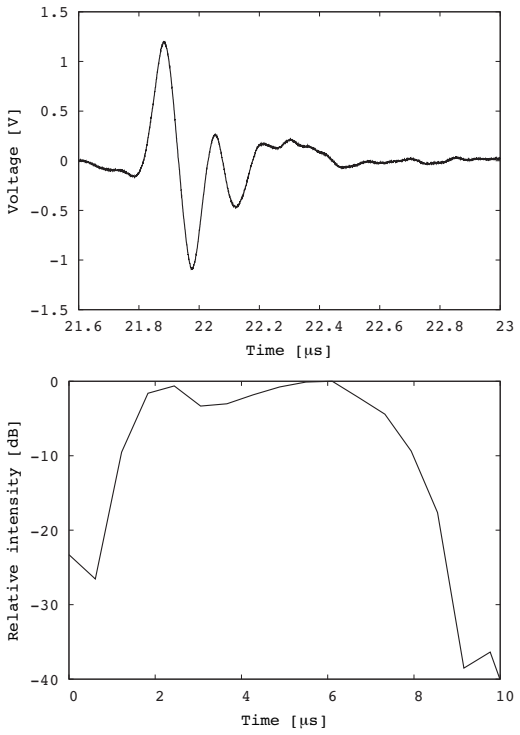

Fig.2 Echo signal from steel reflector in (upper) time and (bottom) frequency domain.

ith quadrature-phase component. Variance of echo signal σ^2 is calculated as follows:

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}\{\tilde{r} - r_i\}^2 \quad (2)$$

where, $\tilde{r}$ is the average signal of r_i, and N is set at eight in this study. These calculations were processed using software developed in Matlab (Mathworks, Natick, MA).

3. Results

As an example, an echo signal with 200 Hz of PRF, is shown in **Fig. 3**. It is shown that long durational echo follows after first peak. **Figure 4** shows variance of the obtained signals with 200 Hz of PRF. Normalized max values of variances with various PRFs are described in **Fig. 5**; the results in each PRF were normalized by that of 200 Hz.

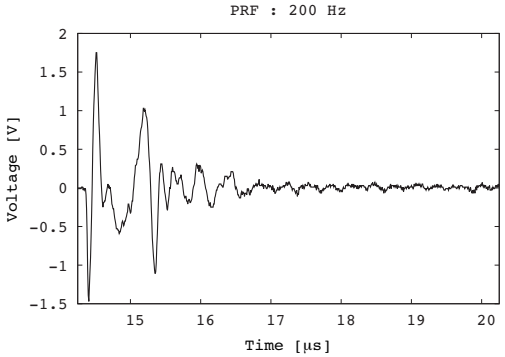

Fig. 3 Echo signal (PRF = 200 Hz).

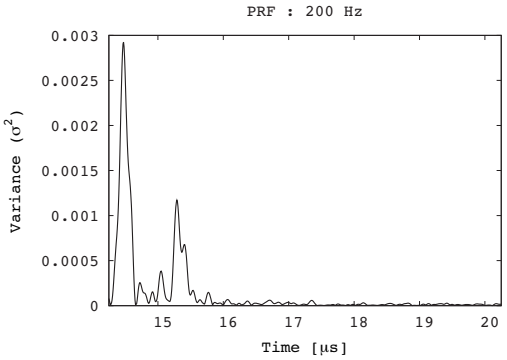

Fig.4 Variance (PRF = 200 Hz).

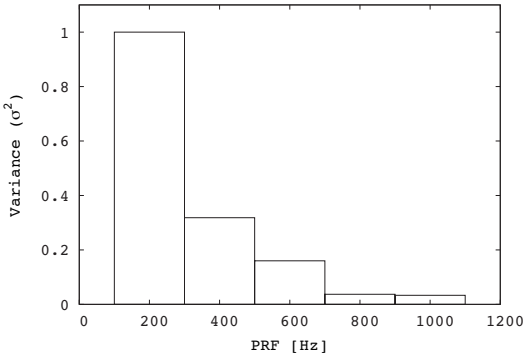

Fig.5 Normalized maximum variances in each PRF.

3. Conclusion

In this study, we examined the effective of PRF in vitro to confirm the effect of PRF on the echo signal from the micro glass bead. The result showed that the lower PRF makes much variance of the echo signals. In this study, size of the bead, ultrasound transmitting power, and stiffness of the tissue-mimicking phantom were fixed. As a future work, further investigation on these physical parameters will be conducted.

References

1. A. Rahmouni, R. Bargoin, A. Herment: J Radiology, **199**, (1996) 269.
2. L. Brunese, A. Romeo, et al.: J. Ultrasound Med. **27** (2008) 1187.
3. Kamaya A, Tutill T, Rubin JM: AJR (2003) 180.
4. L. Liu, K. Ozawa, K. Funamoto, M. Ohta, T. Hayase and M. Ogasawara: Proc. of 11th AFI/TFI, (2011) 94.
5. L. Liu, K. Funamoto, K. Ozawa, M. Ohta, M. Ogasawara: J. Med. Ultrason. 40 (2013) 197.