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Pseudo-linear-frequency-modulation pulse emission and signal matching in ultrasound computed tomography system

Background:

Pseudo-linear-frequency-modulation pulses (pseudochirps) is widely applied as transmitted signals in conventional ultrasound imaging system because of the low cost of the signal generation hardware and better depth of penetration. The spectrum of the pseudoshirps can be modified for better matching to the transducer. Echo signals of pseudochirps after pulse compression may last similar time comparing to the pulse wave but with higher SNR, which has the potential to increase the image quality of the ultrasound computed tomography .

Material and Method:

The Lucid system developed in Medical Ultrasound Lab consists of a 2048-elements ring transducer of which the diameter is 220mm and the center frequency is 3.0MHz with 70% bandwidth. The pseudochirp wave lasts for 10us and the frequency ranges from 780KHz to 5.1MHz. The imaging object is the rectal scan phantom (MODEAL ATS 540) made by CIRS. The phantom has a full 360° acoustic window, and contains five groups of circular targets of varying sizes and depths and five levels of gray scale targets.

Results:

The duration of the echo signal of pseudochirp after pulse compression is about 2us, as for the echo signal of two-cycle square wave is about 1.8us. The amplitude of the transmissive waves is higher than the two-cycle square wave. The reconstructed B-mode images show that pseudochirps bring better resolution and contrast.

Conclusion:

The results show that the pseudochirp has good potentials in ultrasound computed tomography because of its low cost of hardware, good depth of penetration, high SNR after pulse compression. We will modify the wave and match filter of pseudochirp for better imaging in the future.

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