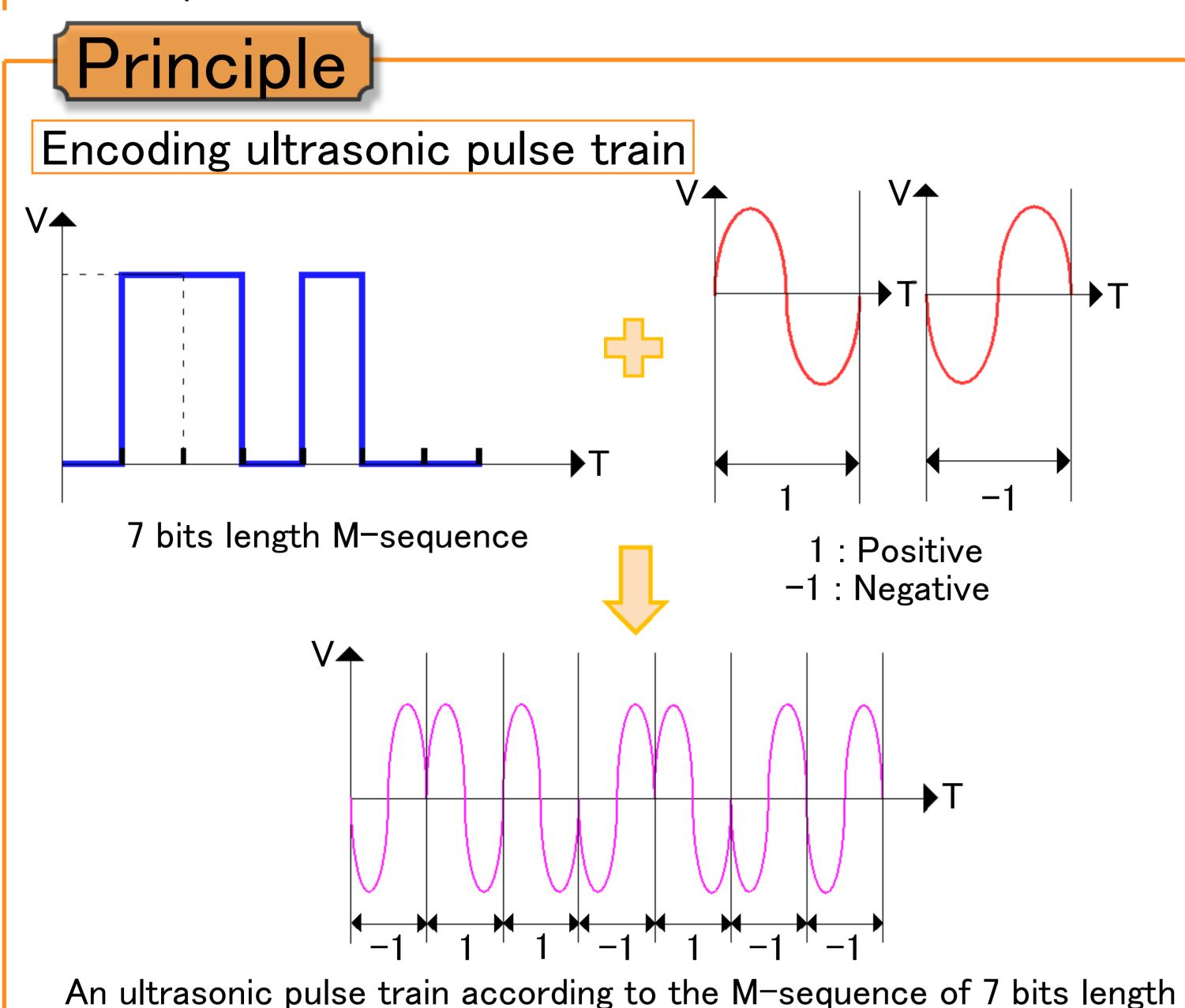
Study on Pulse Compression Ultrasonic Transducer Made with Piezoelectric Copolymer Films

Hiroshi Yonenaka^{1†} and Yorinobu Murata²

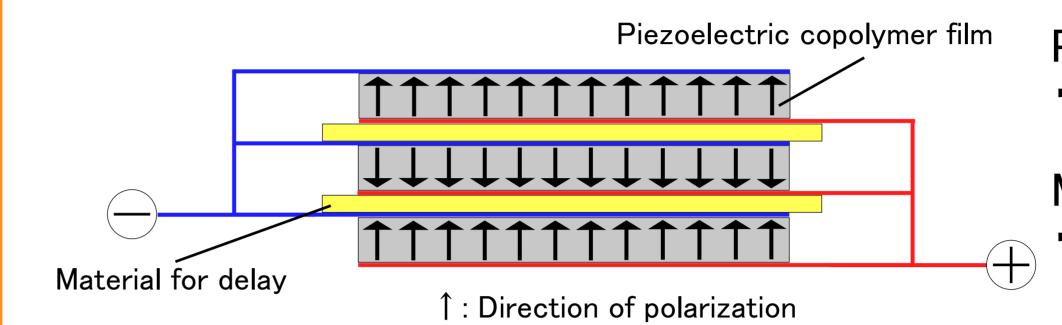
Introduction (1 Grad. School of Systems Eng., Wakayama Univ.; 2 Faculty of Systems Eng., Wakayama Univ.)

In ultrasonic testing, in order to raise the ability in flaw detection, it is necessary to use an ultrasonic probe with a broadband and high sensitivity. The pulse compression techniques using M-sequence and LFM (linear frequency modulation) wave have been reported as a method improving the SN ratio and resolution in ultrasonic testing. However, in order to generate M-sequence or LFM wave, a special hardware like an arbitrary waveform generator is needed, and a power amplifier must be also prepared.

In this study, it aimed to develop a novel ultrasonic transducer which can generate M-sequence wave by only a general pulser without such a special device.



M-sequence pulse compression transducer



Piezoelectric copolymer film PVDF film(52 μ m • 10MHz)

Material for delay •Polyimide(175 µ m)

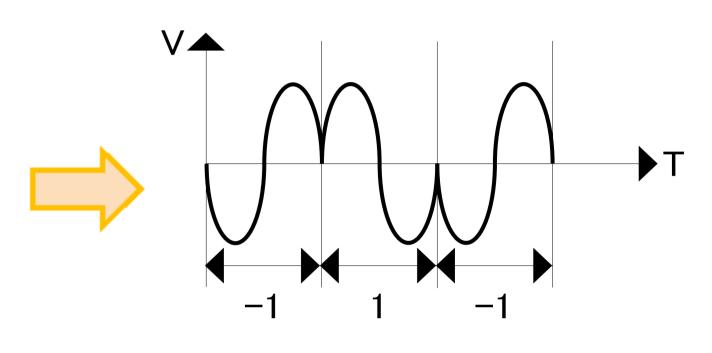
•The polarity of generated ultrasonic wave is determined by the polarization direction.

polarization direction.

•In order to delay the phase for one

wavelength, a delay layer was inserted

between each piezoelectric film.



Waveform of M-sequence of 3 bits length

Experiments

Pulse compression

Pulser/Receiver

Pulse compression transducer

PC

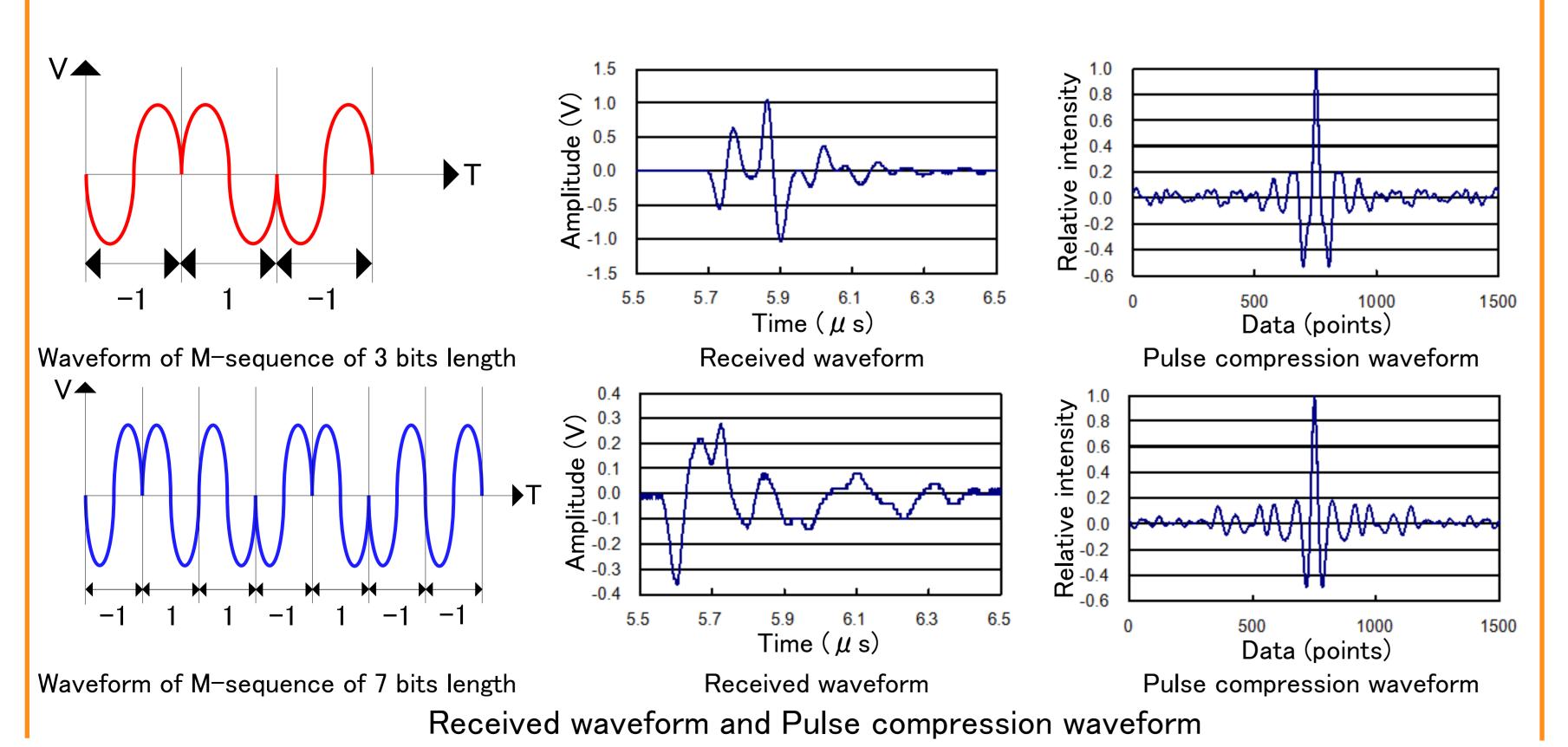
Flat type transducer

3-axis moving stage

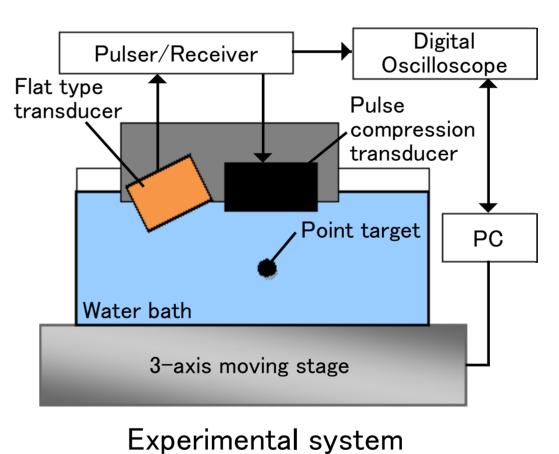
Experimental system

The performance of the transducers was evaluated by autocorrelation received wave by the transducers.

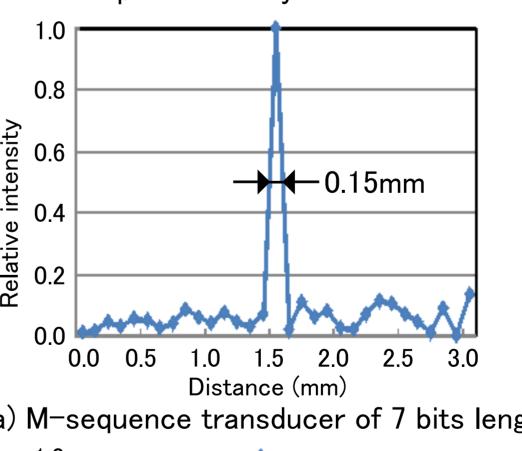
It was verified that M-sequence pulse train could be generated by the proposed method. It was confirmed that the effect in pulse compression could be improved depending on the bit length in a pulse compression transducer with M-sequence.

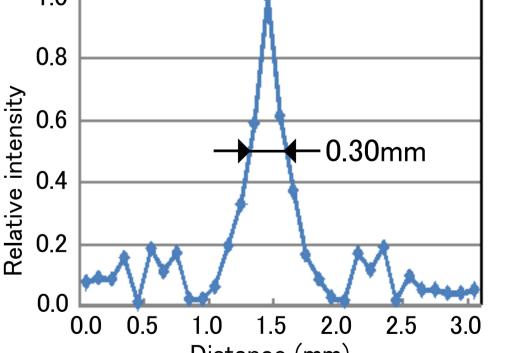


Performance of this transducer



The performance of the transducers was evaluated by 1-D PSF on the acoustic axis of the transducers. A pulse compression processing was carried out by calculating cross-correlation in received waves.





Distance (mm)

(a) M-sequence transducer of 7 bits length (b) M-sequence transducer of 3 bits length

(a) M-sequence transducer of 7 bits length of the length o

It was confirmed that the resolution along the acoustic axis could be improved depending on the bit length in a pulse compression transducer with M-sequence. Furthermore, it was demonstrated that the SN ratio in M-sequence pulse compression transducer could be higher than the commercial transducer.

Conclusions

In this study, a pulse compression ultrasonic transducer was developed in order to improve, the performance in ultrasonic measurements. The transmission of M-sequence pulse train was observed in the experiment using only a conventional pulser apparatus. It was confirmed that the developed pulse compression ultrasonic transducer with M-sequence has the performance which corresponds to a general pulse compression method and was improved depending on the bit length in M-sequence. It will be expected that the pulse compression ultrasonic transducer is useful for the ultrasonic testing because of its simple system.