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PARAMETER OPTIMIZATION AND NUMERICAL CALCULATION FOR GIANT MAGNETOSTRICTIVE TRANSDUCER

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Abstract. *In the study of piezoelectric ceramic transducers, a lot of high quality papers are published in journal NATUR. In this paper, a new type of transducers is developed with rare earth giant magnetostrictive materials (GMM). The transducers are good at solving the ultrasonic nondestructive testing of the large components in concrete. For the transducers, the impedance characteristics, the vibration velocity and the stress of the rare earth GMM transducers are calculated by a new method of Four-Terminal Network Method (FTNM) combined with the Fourier Transform (FT). Experimental results prove that the results numerically calculated by the new method are correct. In addition, the pre-stress, the electrical parameters and the geometric dimensions are optimized, and thereafter, the rare earth Giant Magnetostrictive Transducer (GMT) with longitudinal vibration is developed based on the optimal parameters. The studied transducer has the advantages of the larger power, higher frequency and minimum residual vibration in non-destructive testing. The testing results show that the ultrasonic nondestructive detection of bridge and the massive concrete (length: 6m∼10m) with internal quality can be carried out.*

Keywords: Giant magnetostrictive transducer, Nondestructive, Concrete, GMM transducer, Optimization

1. **Introduction.** Piezoelectric ceramic materials have been developed rapidly in the world currently [1], and the materials can be used to produce the ultrasonic transducers with good directivity, and it is suitable for the parametric measurement of speed and distance [2]. At present, many piezoelectric ceramic transducers are used for nondestructive testing [3] and diseases diagnosis [4], but the main usage of such transducers is in the low-power status, only for the electromechanical transformation with lower efficiency. The piezoelectric chip with the high Q value that causes narrow bandwidth, is difficult to meet the need of the large components for nondestructive testing [5], and the piezoelectric ceramics made of lead zirconate titanate (PZT) is currently still in dominant. And the content of PbO and PbO3 in the lead-based piezoelectric ceramics is about 70% of the raw material, which causes serious harm to human health and environments in the process by using and disposing the transducers [6]. For the KNN-based piezoelectric ceramics, Saito (2004) published two papers in the NATURE journal [7,8]. Although Saito (2004) successfully developed a kind of the KNN-based piezoelectric ceramics [7], in which the electromechanical properties are comparable with PZT, it is still difficult to apply into industrial applications [8] due to the shortage of the KNN ceramics manufacturing method,