



T. E. G. Álvarez-Arenas, J. Camacho, L. Diez

Institute for Physical and Information Technologies, Spanish National Research, Council (CSIC). Serrano 144, Madrid, 28006, Spain.

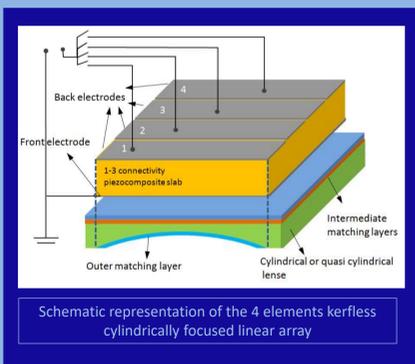
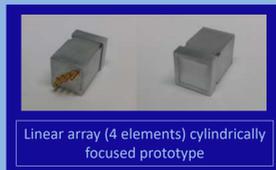
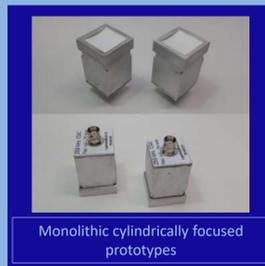
Abstract: This paper describes the design, fabrication, characterization and test of cylindrically focused air-coupled piezoelectric monolithic and linear-array transducers. The objective is to obtain transducers that present a similar performance compared with conventional flat transducers, but more robust for applications involving curved surfaces and/or generation/detection of Lamb waves and a better spatial resolution. Moreover, a linear array configuration is proposed and tested as a means to improve spatial resolution in the non-focused direction. Results show that, compared with conventional flat transducers, it is possible to obtain similar peak sensitivity figures (-22 dB) and bandwidth (75% at -20 dB), though frequency band is slightly displaced towards lower frequencies, with cylindrically focused transducers so there are no apparent reason for quasi-cylindrical configurations. The linear array realization is an effective way to increase spatial resolution along the non-focused direction.

I. Transducer design and construction.

I.a Monolithic flat transducers
(for comparison purposes)

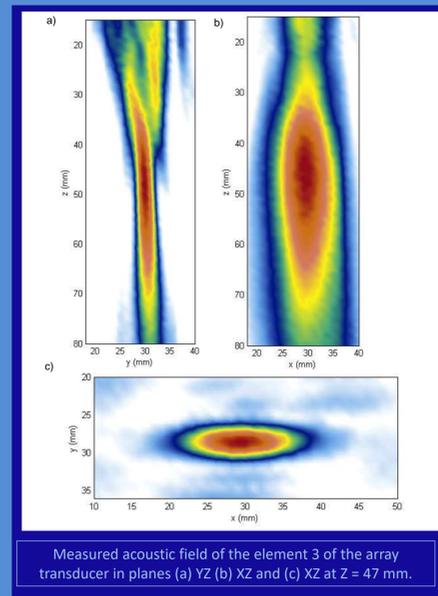
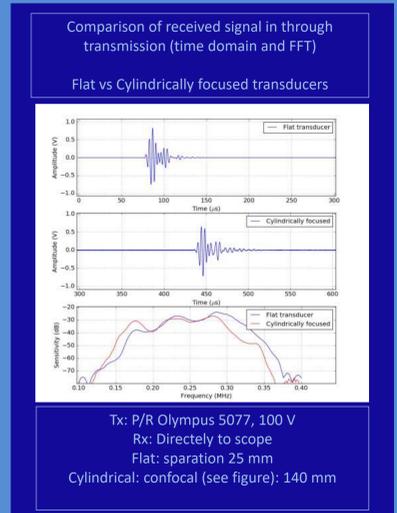
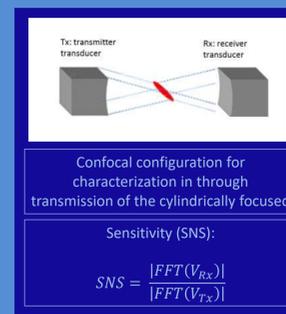
I.b Monolithic cylindrically focused transducer

I.c. Cylindrically focused linear array.



II. Transducers characterization.

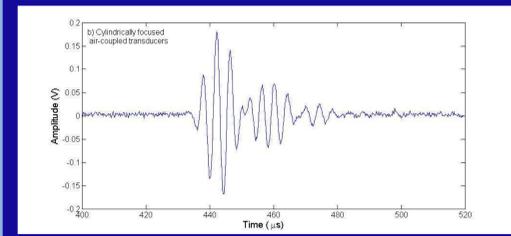
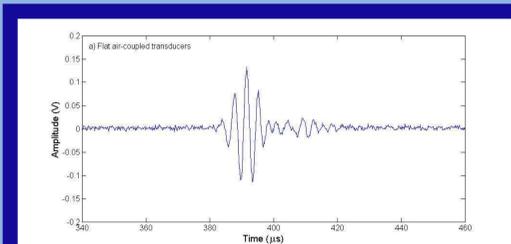
II.a Sensitivity and bandwidth



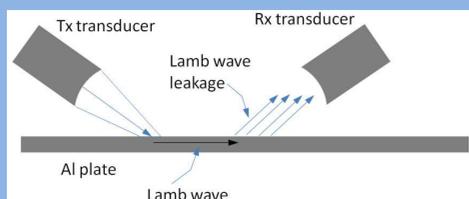
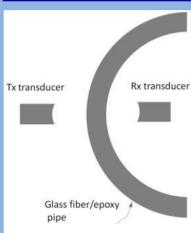
II.b. Acoustic field

III. Transducers test.

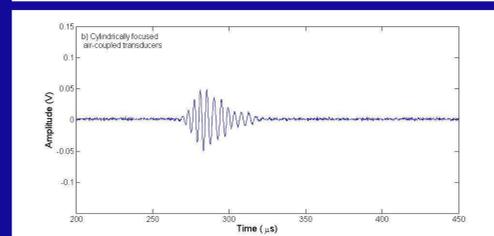
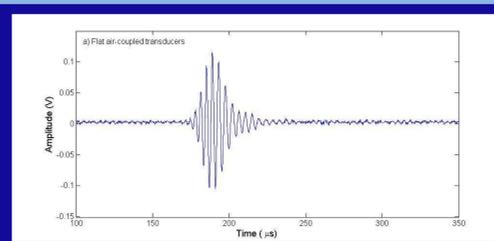
III.a. Inspection of curved elements



Transmission through a cylindrical pipe wall.
7.a. Flat air-coupled transducers.
7.b. Cylindrically focused air-coupled transducers.



III.b. Generation/detection of Lamb waves



Generation and detection of A₀ mode in Al plate.

VI. Conclusions.

Comparison of cylindrically focused vs flat transducers reveals that the inclusion of a cylindrical lens have a very small effect on the transducer performance (bandwidth and sensitivity).

The study of the acoustic field of the linear array prototype with four elements reveals that this is an effective means to reduce focal spot in the non-focused direction, while keeping the other properties of the cylindrically focused geometry. Transducers were tested to perform through transmission in cylindrical pipes and to generate/ receive A₀ Lamb mode in an aluminum plate. Cylindrical pipe: Larger transmitted signal amplitude, which allows for better SNR. Lamb waves: Smaller signal amplitude but more robust to variations in the incidence angle (±5 degrees)

