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MDPI

Architecture of a Piezoelectric Acoustic Detector for Applications in Tissue and Soft Material

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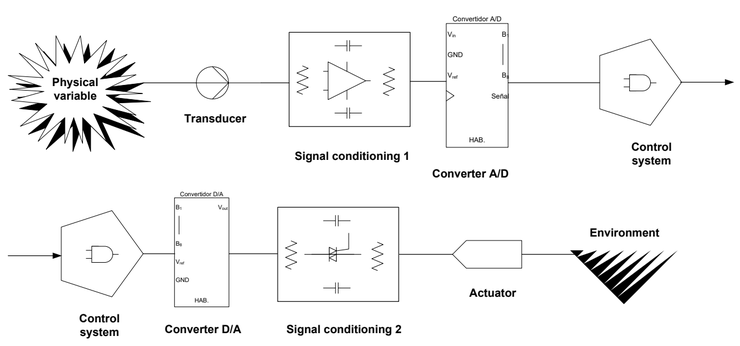
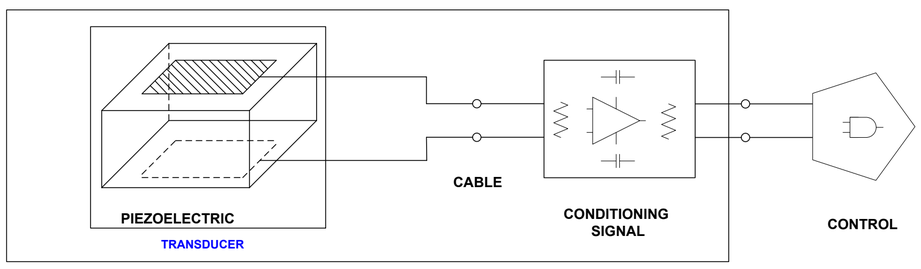
INTRODUCTION & AIM



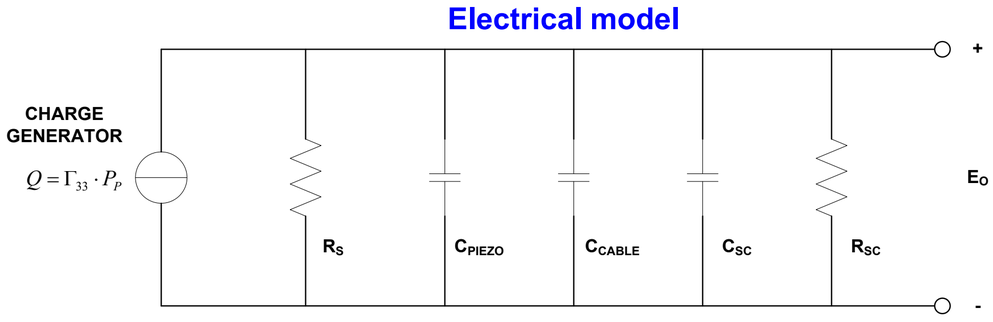
Develop the architecture of an acoustic detector in the ultrasound spectrum, using PVDF and applying it to soft matter.
Perform tests usisng pulse-echo techniques and pulsed photoacoustic spectroscopy.

MODEL

Principal model

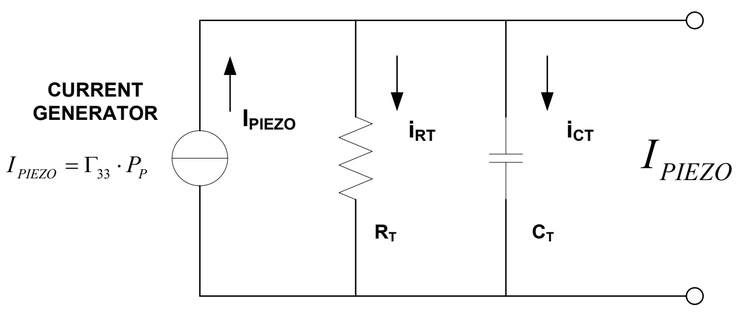


Electrical model



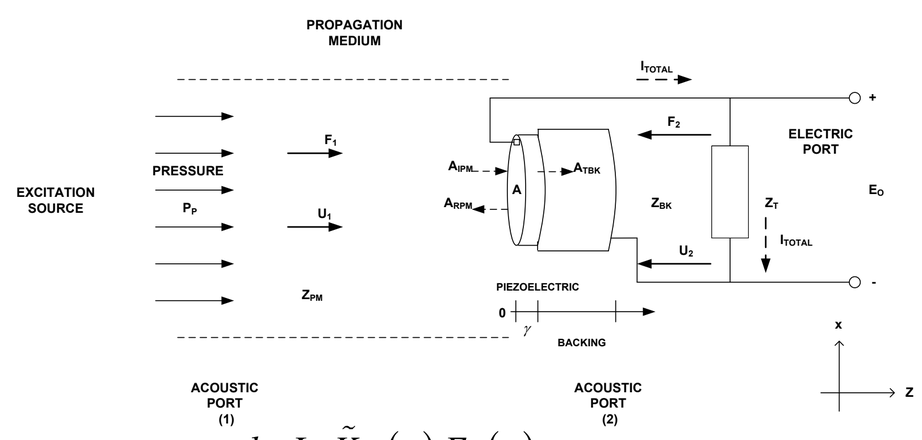
$$Q = \Gamma_{33} \cdot P_P \qquad \Gamma_{33} = g_{33} \cdot \gamma \cdot C_0$$

Reduction of the electrical model



$$I_{PIEZO} = \frac{dQ}{dt} = \Gamma_{33}\left(\frac{dP_P}{dt}\right)$$

General model



$$\tilde{V}(s) = \frac{\dfrac{-h_{33} L_F \tilde{K}_F(s) E_0(s)}{sZ_P}}{1 - \tilde{Z}_F(s)\left(\dfrac{K_F(s)L_F}{2} + \dfrac{K_B(s)L_B}{2}\right)\dfrac{k_t^2}{s}}$$

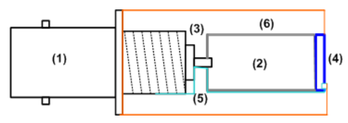
$$\tilde{K}_F(s) = \frac{\left(1 - e^{-s\xi}\right)\left(1 - e^{-s\xi} R_B\right)}{1 - e^{-2s\xi} R_F R_B}$$

$$\tilde{K}_B(s) = \frac{\left(1 - e^{-s\xi}\right)\left(1 - e^{-s\xi} R_F\right)}{1 - e^{-2s\xi} R_F R_B}$$

$$L_F = \frac{2Z_P}{Z_P + Z_{PM}} \qquad L_B = \frac{2Z_P}{Z_P + Z_{BK}}$$

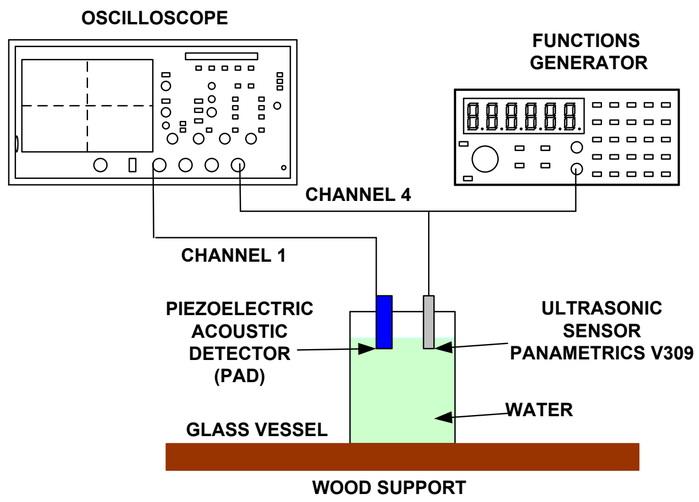
RESULTS & DISCUSSION

Piezoelectric acústic detector

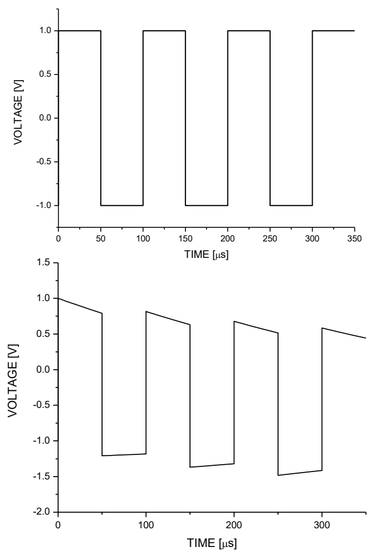


Piezopolymer 110μm thick
Working frequency were 5 and 50MHz

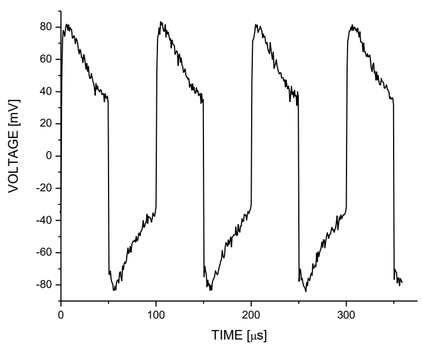
Pulse – echo technique

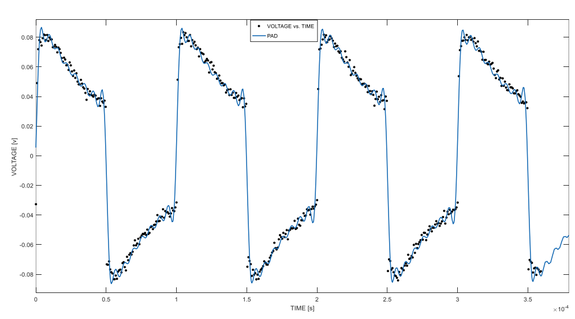


Simulation

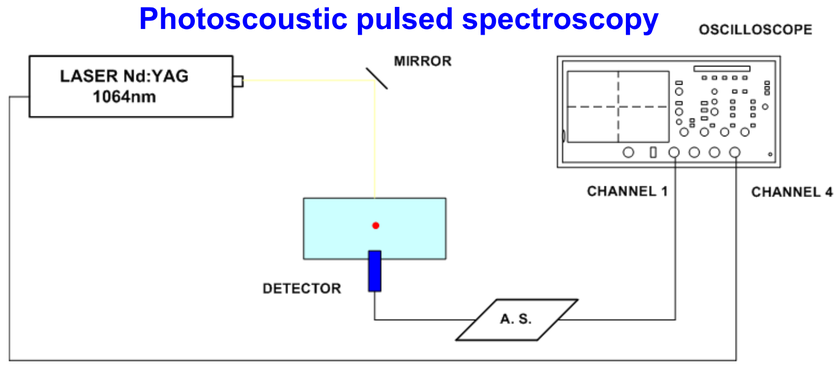


Pulse – echo signal response

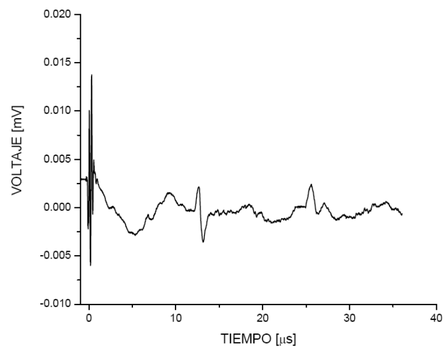




Photoscoustic pulsed spectroscopy



PPS signal response



CONCLUSION

This proceeding has presented the study and development of a piezoelectric acoustic detector (PAD) that could be used in soft matter.
The study involved the determination of an electrical equivalent system considered the propagation medium, the acoustic detector (external and internal parameters) and the peripheral connections.

FUTURE WORK / REFERENCES

Development of a Piezoelectric acoustic detector with a multilayer structure.

- Wilson, J.S. *Sensor technology handbook*, 1st ed.; Elsevier: USA; 2005.
- Hayward, G. MacLeod, C.J. Durrani, T.S. A system model of the thickness mode piezoelectric transducer, J. Acoust. Soc. Am. **1984**, 76, 369-382.