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Low-cost electro-acoustic system based on ferroelectret transducer for characterizing liquids

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Abstract— Several industrial applications require liquid characterization during manufacturing to ensure quality in their products. Examples of such products are those related to food and oil industries in which one of the concerns regards the different concentration of liquids in a mixture. In this context, it is presented a system based on ferroelectret transducers and low-cost technology to perform liquid analysis through acoustic measurements. The developed system is composed of three parts: a piezoelectric actuator, a medium chamber and a ferroelectret transducer (acoustic sensor). The system was assembled with a ferroelectret (with open tubular channels) housed on a cylindrical aluminum case (48mm×63mm) in which a 24dB preamplifier was mounted. The specifically designed chamber was manufactured in ABS plastic using a 3D printer and the piezoelectric actuator consisted in commercial piezoelectric ceramic which is connect to signal generator configured to generate a sinusoidal sweep between 0Hz up to 50kHz during 1 second. In order to characterize the device setup and validate the suitability of the measuring system, three distinct mediums were analyzed (air, water and oil). Through the experimental tests it was identified, on time domain, distinct signatures for each medium, which were later used in a blind classification with a developed algorithm.

Keywords: Acoustic transducers, piezoelectret, liquids characterization.

1. INTRODUCTION

L IQUID characterization has a great application potential in several productive and research sectors [1-6]. For instance, liquid analysis has a major influence in the food industry, especially in milk production and its derivatives, in which it is important to ensure high quality and fresh-like products with lower processes, time and costs [1]. Another example of its relevance is observed in the oil and gas extraction and petrochemical industries [2] in which precise and reproducible measurements of oil contamination are critical. These stringent requirements are monitored in order to identify environmental hazard, e.g. discharge of water contaminated with oil into the environment [2].

Depending on the application, a liquid substance can be characterized directly or indirectly, by means of its physical,

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