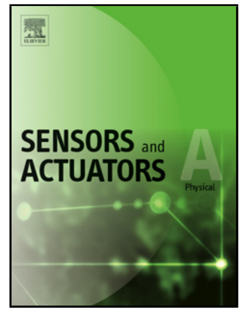

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Fast Time-Domain Laser Doppler Vibrometry Characterization of Surface Acoustic Waves Devices

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Abstract

This paper explores experiments and an in-depth analysis of surface acoustic waves (SAW) imaging using scanning laser Doppler vibrometry. Optical measurements allow visualization of wave propagation and resonance patterns in SAW devices as well as the detection of loss sources and undesired responses, such as escaping acoustic beams, unwanted reflections and acoustic crosstalk. We also report the characterization of a gas sensor based on electro-acoustic delay lines operating at 78.8 MHz and featuring a maximum SAW amplitude of 0.6 nm due to 33 dBm burst excitation. In addition to conventional full C-Scan (3200 points) of the structure, we report a series of B-Scans (430 points) referenced to the device geometry. The latter provides the same valuable information on SAW device operation with more versatility for graphical analysis and more than 10 times faster measurement times. Such capabilities have implications for the engineering of acoustic and sensor applications. In order to extend the analysis of the performance of SAW sensors, we discuss different experimental approaches using numerical simulation, radiofrequency and interferometric measurements. The present study highlights several approved SAW device characterization techniques and methods, the means of their optimization as well as applications for improving SAW device performances.

Keywords: SAW sensors; radio-frequency (RF); laser doppler vibrometry; interdigital transdusers; crosstalk.

1. INTRODUCTION

Surface acoustic wave (SAW) devices [1] such as SAW filters, delay lines and resonators are widely used in mobile, spatial and wireless communications due to their high performance, small size, and good reproducibility [2, 3] . At the same time, SAW technology provides a platform for sensing physical parameters (e.g., temperature, pressure, and stress) as well as chemicals in the gaseous and/or fluidic states [4, 5]. Important advantages of SAW sensors include high sensitivity, short response time, low cost, compatibility with modern fabrication technology, and planar structure [6].

Furthermore, the operational frequency of SAW devices can be set in a wide range (MHz –GHz) which aids the sensitivity tuning and opens the possibility of wireless operation [7, 8]. These sensors are expected to fulfil the

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