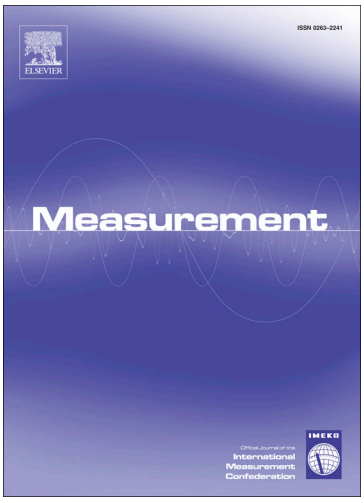

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Abstract

In this paper, a method for measuring resonator chamber volume and acoustic neck length by modifying chamber volume is presented. This method measures frequency changes caused by volume changes to determine core system volume and resonator neck length. Experimental measurements and data are presented along with measurement statistics. This method reduces the need for accurate resonator geometry knowledge by instead using external volume modification devices, where geometry is much easier to control.

This method serves to enhance existing volume measurement methods such that sources of inaccuracy are minimized. Results indicate that resonator volume and acoustic neck diameter can be measured with reasonable accuracy (less than the 1% error associated with liquid-volume measurement techniques) when neck diameter and change in volume are known in advance.

Keywords: Resonance, Signal Processing, Measurement Systems, Volume, Effective Length, System Dynamics

1. Introduction

In many industries, internal volume is a critical parameter in process control. For example, in internal combustion engine thermodynamics, fuel efficiency, performance, and combustion are acutely sensitive to combustion chamber volume [1]. In biomedical applications such as artificial hearts, chamber blood volume can indicate cardiovascular system blood flow rates [2]. Unfortunately, measuring internal volume with accuracy can be difficult, which inhibits reductions in process control variations and tolerances.

Helmholtz resonance is a phenomenon where a gas-filled cavity will audibly resonate in the presence of other acoustic noise sources [3]. In Helmholtz resonance-based systems, modeling natural resonant frequency with accuracy can be difficult due to non-linear

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