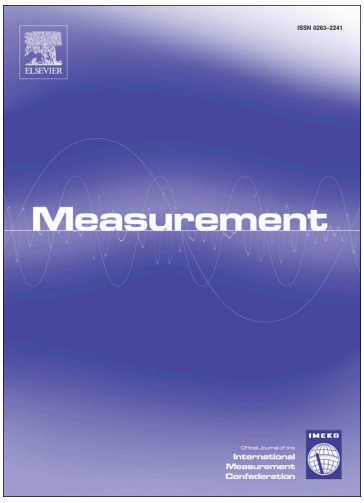


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PII: S0263-2241(17)30394-9
DOI: http://dx.doi.org/10.1016/j.measurement.2017.06.007
Reference: MEASUR 4807

To appear in: *Measurement*

Received Date: 10 April 2017
Revised Date: 5 June 2017
Accepted Date: 8 June 2017

Please cite this article as: V. Dabbagh, Ahmed. A. D. Sarhan, J. Akbari, N.A. Mardi, Design and manufacturing of ultrasonic motor with in-plane and out-of-plane bending vibration modes of rectangular plate with large contact area, *Measurement* (2017), doi: http://dx.doi.org/10.1016/j.measurement.2017.06.007

# Design and manufacturing of ultrasonic motor with in-plane and out-of-plane bending vibration modes of rectangular plate with large contact area

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**Abstract**

Ultrasonic motor working with coupled in-plane and out-of-plane vibration modes of rectangular plate is proposed and experimentally investigated. Thanks to its unique configuration, proposed motor provides large contact area between stator and rotor of motor which can reduce wear and enhance motor life-time. The proposed motor is designed using finite element method and according to the design, a prototype is fabricated and its working characteristics such as speed, normal and driving force and working frequency are measured. Overall dimension of designed prototype is 49×14×2 mm, working frequency of motor is 49.6 kHz, no-load speed and stall force of motor are 122 rpm and 0.32 mN.m at 50 V, respectively.

Reviewer 2 Comment 2

**Keywords:** Ultrasonic motor, rectangular plate, large contact area, in-plane mode, out-of-plane mode.

## 1. Introduction

Ultrasonic motors (USMs) offer various advantages relative to conventional motors including simple structure, ability of miniaturization, flexibility in design and optimization, high torque per volume, efficient even after miniaturization, fast self- locking by source diminishing,