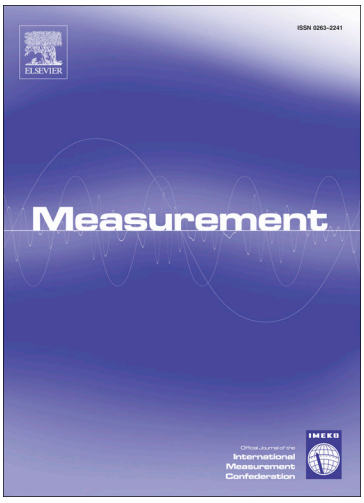

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A low-cost platform based on a robotic arm for parameters estimation of Inertial Measurement Units

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Abstract

Calibration of Microelectromechanical (MEMS) Inertial Measurement Units (IMUs) is required to obtain a reliable measurement due to environmental and instrumental errors. Positioning systems are widely applied to inertial sensors calibration and testing. The most commonly used systems include nonmagnetic turntables, nonmagnetic rotating platforms, or robotic arms. Robotic arms provide a fast and accurate sensor positioning, but some aspects such as high-cost, non-portability, construction features, and kinematic should be considered. This paper presents a novel low-cost platform to estimate the calibration parameters of a MEMS magnetometer and accelerometer. The platform is based on a robotic arm of three degrees of freedom (DoF) using standard low-power servomotors with affordable prices and readily available. The kinematic model of the robotic arm is represented using a Denavit-Hartenberg parameters. The platform is placed in different positions to collect a dataset of points evenly distributed. The replicable design of the platform is described and the estimation of calibration parameters is developed to validate the functionality of the platform.

Keywords: Robotic arm, IMU, magnetometer, accelerometer, calibration parameters

1. Introduction

MEMS IMUs are used for attitude and heading determination in several engineering applications [1]. Calibration is required to obtain a reliable measurement due to environmental and instrumental errors [2]. Various calibration methods employ error models using as parameters the bias, the scale factor, and the non-orthogonal misalignment [3]. An error models for magnetometers are found in [2, 4], and some accelerometer and gyroscope error models are described in [5, 3, 6].

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