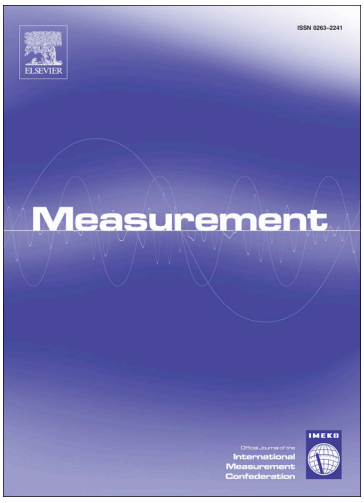

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Proposal and Verification of a Methodology for the Measurement of Local Muscular Load via Datalogger

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Abstract

Workers are under increasing pressure to perform, and an encouraging working environment must be created so as to help ensure that workers meet their performance goals. Despite the growing trend of automation and robotics, the human factor remains important. This paper studies occupational diseases stemming from long-term, excessive, and unilateral muscular load in employees. The paper's aim is to evaluate the "local muscular load" that is measured in Czech and Slovak businesses, and to verify the local muscular load measuring methodology's status as a valid and recognized measurement in order to subsequently strengthen the prevention of occupational diseases among workers. A very necessary part of the research was the development of a new SW application for datalogger data analysis. This application provides the datalogger's user with a clear graphical output. A graph within it specifies the level of local muscular load.

This paper presents a theoretical and experimental evaluation of the equipment being developed (the datalogger) and its validation with the existing certified methodology called electromyography (EMG). The results of the correlations of both measurements while evaluating the local muscular load are analyzed within this article.

Keywords: datalogger, ergonomics, local muscular load, carpal tunnel syndrome, integrated electromyography (EMG).

1. Introduction

Most digital technologies have been spent some time "brewing." Some are not yet ready for application at scale [1]. Industry 4.0 is based on information science and on pillars of technology and automation. But in this article, we have focused on the human factor. The human factor is companies' most important factor. Therefore it is essential to create healthy and supportive working conditions.

A number of authors worldwide are working specifically on the issue of measuring local muscular load in various parts of the human body. Amplitude electromyography (EMG [2]) is often used as an estimator of muscular load. Surface electromyography (EMG) has been used extensively to estimate muscular load in studies of work related musculoskeletal disorders [3]. One of the first pioneers was Konno [4], who simultaneously recorded and analyzed the muscular strength with load and its myogram. Here a new apparatus, consisting of a strain gauge and a carrier amplifier, was devised for measuring. This apparatus was applied for analyzing myogenic disorders related to muscular fatigue or pain.

Öberg [5] examined the influence of fatigue on the amplitude parameters of the EMG. His results showed that the amplitude rise due to muscle fatigue during calibration measurements may seriously jeopardize these measurements unless the duration of the load is kept limited.

Only a few projects have been undertaken, and little is understood regarding the muscle activity used during bowing on string instruments. Rickert et al. [6] aimed to measure the muscle activity at the bowing shoulder of a cellist when playing the cello and to establish