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MODERN SCIENCE, PRACTICE,  
SOCIETY

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**XVIII**

SCIENTIFIC AND  
PRACTICAL  
CONFERENCE  
BOSTON, USA



DOI 10.46299/ISG.2020.XVIII  
ISBN 978-1-64871-446-7

# **MODERN SCIENCE, PRACTICE, SOCIETY**

## **Abstracts of XVIII International Scientific and Practical Conference**

Boston, USA  
25-26 May 2020

## Library of Congress Cataloging-in-Publication Data

UDC 01.1

The 18 th International scientific and practical conference « MODERN SCIENCE, PRACTICE, SOCIETY » (25-26 May 2020). Boston, USA 2020. 514 p.

ISBN - 978-1-64871-446-7

Published on **Bookwire**<sup>™</sup>  
by Bowker  
<https://www.bookwire.com/>

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The recommended citation for this publication is:

Aleksandrova N.,the role of managerial culture in the educator's professional growth // Impact of modernity on science and practice. Abstracts of XVIII International Scientific and Practical Conference. Boston, USA 2020. pp. 14-18 pp..

URL: <http://isg-konf.com> .

## **ONLINE EMG SIGNAL ANALYSIS FOR PARKINSON'S TREMOR DETERMINATION**

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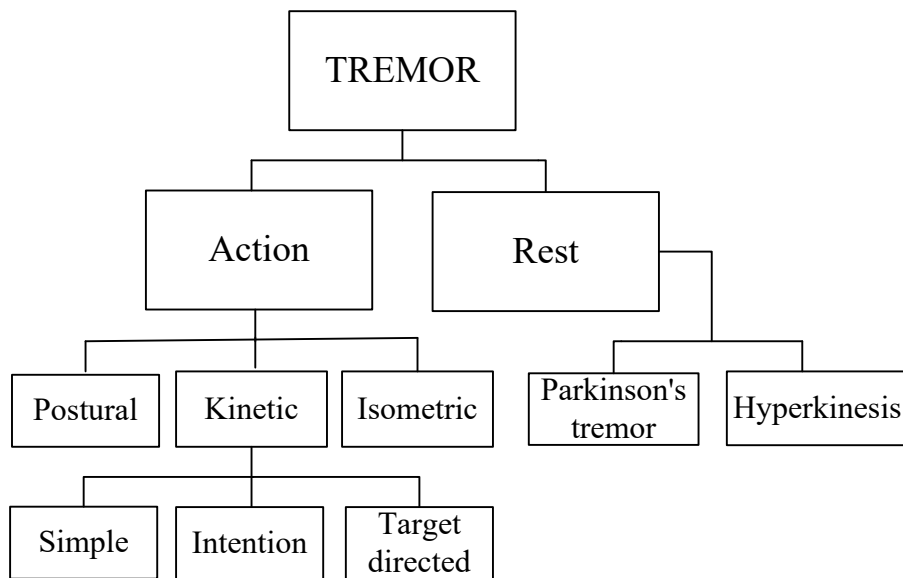
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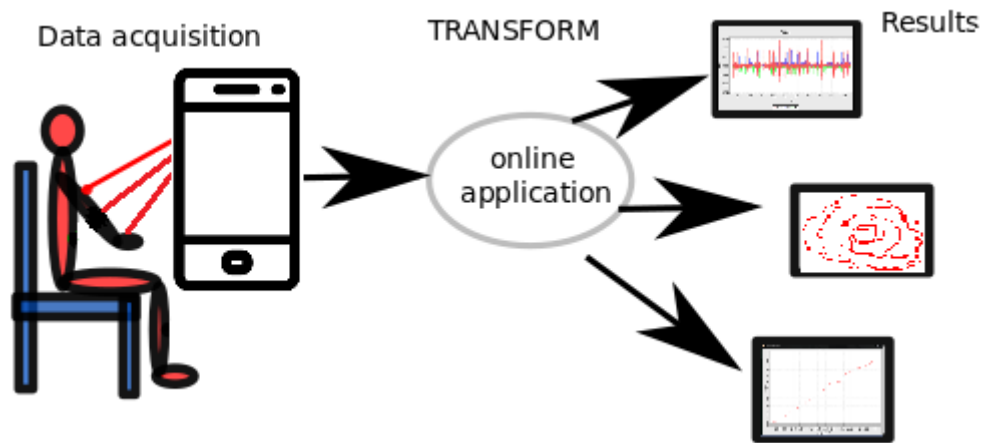
It is known that tremor is one of the most common symptoms that occur in isolation or in combination with other symptoms in various lesions of the nervous system, as well as often accompanying endocrine, somatic diseases and various intoxications [1]. An international research group defines tremors as rhythmic mechanical oscillations of at least one functional area of the body [1-2]. Parkinson's disease (PD) is a common type of the pathological tremor [1-3]. In patients with Parkinson's disease, a different nature of tremor may be observed, but most often there is a classic resting tremor (40-60% of patients have it). The frequency of this type of tremor is 4-6 Hz. In some patients with Parkinson's disease, resting tremor is combined with the kinetic tremor of the same frequency. In some cases of Parkinson's disease, the frequency of postural tremor is higher than resting tremor (up to 9 Hz) sometimes postural tremor prevails over resting tremor. This type is observed only in 15% of patients and some of them had postural tremors long before the onset of resting tremors, causing difficulties in the differential diagnosis with essential tremors [3]. Parkinson's disease is more common in the people older than 50 years [3-4]. The purpose of this paper is the development of an application for an online analysis of the electromyogram signal for Parkinson's tremor detection. Fig. 1 shows general information of a basic division of pathological tremor.



**Figure 1 – A Basic division of the pathological tremor**

Conducting EMG study using surface electrodes allows one to identify a number of changes in EMG in patients with PD. In patients with a tremulous form of the disease, volley activity with high-voltage fluctuations in muscle biopotential at rest is recorded as volleys with a frequency of 4-8 in 1 second, which reflects the rhythm of tremor [2-6]. Electromyography registration of tremor showed that volley activity is reciprocal, that is, at the time of a pause in the agonist, there is a volley discharge in the antagonist [5-8]. In the kinetic-rigid form of the disease, EMG is a stationary type and is formed on the basis of rhythmic asynchronous stationary activity of motor units [5-9]. With the progression of BP, the amplitude of the tremor increases, and the frequency of volleys decreases [7-11]. As muscle tone increases in the late stages of the disease, volley activity is suppressed [2-11].

Today, the diagnosis of PD is based solely on the clinical picture of the disease. For the diagnosis of PD, the criteria of the Parkinson's disease Society of Great Britain are used, which include the diagnosis of Parkinson's syndrome, as well as the criteria that exclude and confirm BP. However, their use gives up to 24% of incorrect diagnoses of PD. Therefore, it is planned to develop an application for online analysis of EMG in Parkinson's disease, taking into account all features. Fig. 2 demonstrates a diagram of measurement EMG parameters, using a smartphone for online transform to a database. The data are acquired with the available hardware (surface electrodes, ADC, interface device) and then must be transformed to *.txt* files. Then the data can be processed by the online platform.



**Figure 2 – A diagram of online EMG analysis for tremor determination**

The determination of the tremor intensity was by a modeling technique using frequency characteristics. In general, the proposed application describes the relationship between tremor intensity and extracted features from EMG signals [4, 8].

Having the application that can record reliably the EMG signals and quantify the levels of tremor may contribute to the early diagnosis of the disorder online. In this paper, we introduced a general development of software for quantifying the severity of the Parkinson's tremor. The extracted features from the surface EMG of the wrist and hand muscles were the input of the designed model of the application.

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