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Research of Pulse Signals Mutual Influence in Polysphygmography of Radiary Arteries

Ye. V. Storchun[1*], Ye. I. Yakovenko[1], and V. V. Boronoev[2***]**

[1]*Lviv Polytechnic National University, Lviv, Ukraine*
[2]*Institute of Physical Materials Science of the Siberian Branch of the RAS, Ulan-Ude, Russia*
**ORCID: 0000-0002-0704-7122, e-mail: storchun.ev@gmail.com*
***ORCID: 0000-0001-9065-5649, e-mail: yevheniia.i.yakovenko@lpnu.ua*
****ORCID: 0000-0003-1516-0528, e-mail: vboronojev2001@mail.ru*

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Abstract—The independence estimation results of synchronously recorded pulse signals in distal parts of human radial arteries are presented in this paper. The study is carried out by the methods of structural-functional and simulation modeling in approximation of an equivalent planar movement of the biological object structural elements. Their elastic characteristics are taken into account using by electromechanical analogies. The correctness of the proposed mathematical model of pulse signals at transducer input is confirmed experimentally. The experimental studies are carried out using a device that represents piezoelectric and piezoresistive transducers connected in series (mechanically). The stiffness and the operating frequency range of the device are equal to 5217 ± 430 N/m and 0.04–32 Hz, respectively. Measurement results for a pulse signal of the piezoelectric transducer (pelot diameters are equal to 6 and 8 mm) and the piezoresistive force sensor show that in the range of transducer to zone surface pressing up to 2 N, the length of arteries areas, forming pulse signals, does not exceed 13 mm and is situated within zones accepted in oriental medicine.

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1. INTRODUCTION

The methodology of heart rate monitoring is widely used in diagnosis of human body functional state [1]–[6]. Various methods, in particular, based on mechanical oscillations of body surface areas are used for the pulse signals registration. The number of single-channel signal pickup devices is proposed [6], [7].

The synchronous signals registration in three zones of radial artery is more informative. For this purpose, three-channel signal pickup devices were developed [8]. The synchronous registration method provides a dense arrangement of primary transducers along the radial artery projection on body surface and a change in their pressing to pulse zones surface, determining the requirements for instrumentation. Technical features of the pulse signals synchronous registration were analyzed in [9].

Mutual influence of pulse signals through the biological object structures during their synchronous registration is the problematic question. The research of possible pulse signals mutual influence in the polysphygmography method with three transducers, located within a 4 cm long zone, is the aim of this work.

2. MATHEMATICAL MODEL

Transmission of the radial arteries pulse oscillations for an area with cross section presented in Fig. 1 is investigated in this work.

According to the schematic (Fig. 1), the radial artery *3* is separated from the bone structures (*1*, *2*, *4*) by soft tissues, and is pressed against the bone *1* during the pulse signal registration. In this regard, there are two systems of electromechanical analogies accepted in this work. They are represented by mechanical (Fig. 2a) and equivalent electrical circuit (Fig. 2b) of the heart rate monitoring biotechnical system in the region of radial artery distal parts (Fig. 1). These models are development of models [10].

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ADDITIONAL INFORMATION

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