ISSN 0735-2727, Radioelectronics and Communications Systems, 2019, Vol. 62, No. 1, pp. 23–33. © Allerton Press, Inc., 2019.
Original Russian Text © K. Vonsevych, M.F. Goethel, J. Mrozowski, J. Awrejcewicz, M. Bezuglyi, 2019, published in Izvestiya Vysshikh Uchebnykh Zavedenii, Radioelektronika, 2019, Vol. 62, No. 1, pp. 30–44.

Fingers Movements Control System Based on Artificial Neural Network Model[1]

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Received March 30, 2018
Revised December 19, 2018
Accepted December 26, 2018

Abstract—Surface electromyographic (sEMG) signal is used in the various fields of applications where the need exists to measure the activity of body muscles, such as brain-computer interfaces, game industry, medical engineering, and other practical spheres. Even more, the use of sEMG signal in the field of active prosthesis industry has become traditional for many years. However, despite the fact that the question of using it in the field of fingers prostheses is still open, in general, the sEMG signal required multichannel measuring devices or massive, voluminous equipment for precise recognition of hands or fingers movement. That is decreasing the possible portability and convenience of prostheses and as a consequence is increasing their final price. In this paper we propose a method of organizing the controlling and measuring unit of the prosthetic device based on artificial neural network (ANN) model and one-channel microcontroller based sEMG measuring system. The proposed ANN model works with only 4 input time-domain features of sEMG signal and provides an accuracy of 95.52% for classification of 6 different types of finger movements that makes it a good solution for next implementation in the system of prosthetic fingers or wrist devices.

DOI: 10.3103/S0735272719010047

INTRODUCTION

Daily life involves different types of interactions between persons and also between humans and objects. Almost every day people take part in a whole set of different tasks such as drinking, washing face, food preparation, eating, dressing, using a computer, etc. For successful performing of most daily life activities (DLA) a hand movements are playing the fundamental role. Moreover, in the case of precision-guided tasks such as writing, the availability of the wrist and fingers is a necessity. However, not every person has a possibility to perform DLA in a usual way [1–3].

Unfortunately, there is a horrible statistics of upper-limbs amputations and congenital deficiencies all over the world. Worldwide estimates of upper-limbs reduction amount to approximately from four to five persons per 10000 [4], without taking into account subjects with different levels of acquired amputations. A significant number in this statistics takes account of the absence of fingers that in some cases iccounts for more than 60% of all defects of hand [5]. The lack of the upper-limbs or their separate parts have an influence not only on the efficiency of humans productivity [6], but also provides an essential effect on patient's stigma and some types of overuse problems [7, 8].

[1] The work has been supported by the National Science Centre of Poland under the grant OPUS 9 No. 2015/17/B/ST8/01700 for years 2016–2018.

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