

## ДЕРМАТОГЛІФІКА: ІСТОРІЯ РОЗВИТКУ І СУЧАСНІ ТЕНДЕНЦІЇ

Мішалов В. Д., Кривда Г. Ф., Бачинський В. Т., Войченко В. В.

**Резюме.** У статті розглянуто історичні відомості стосовно використання дерматогліфіки при проведенні ідентифікації невідомої особи. Накреслено нові перспективи використання сучасних розробок в галузі судово-медичної криміналістики у вивченні шкірних візерунків та розробки алгоритмів діагностики загальних фенотипічних ознак людини.

**Ключові слова:** судова медицина, дерматогліфіка.

## ДЕРМАТОГЛИФИКА: ИСТОРИЯ РАЗВИТИЯ И СОВРЕМЕННЫЕ ТЕНДЕНЦИИ

Мишалов В. Д., Кривда Г. Ф., Бачинский В.Т., Войченко В. В.

**Резюме.** В статье рассмотрены исторические сведения об использовании дерматоглифики при проведении идентификации неизвестных лиц. Намечены новые перспективы использования современных разработок в области судебно-медицинской криминалистики при изучении кожных узоров и разработки алгоритмов диагностики общих фенотипических признаков человека.

**Ключевые слова:** судебная медицина, дерматоглифика.

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## NEURAL NETWORKS AND PERSPECTIVES OF THEIR USE IN FORENSIC MEDICINE

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**Abstract.** This paper presents the trends and tendencies of modern computer processing data obtained during forensic investigations. Examined the system of artificial neural networks, principles and characteristics of their work. Prospects using artificial neural networks when dermatoglyphics data processing research.

**Keywords:** Forensic medicine, neural networks.

**Introduction.** One of the open questions in forensic medicine, remains a question posed by the problem of identifying an unknown person and conduct identification of corpses of unknown persons, fragmented and impersonal corpses. Today, the most popular method for DNA identification, which, despite the initial accuracy of results is expensive and all available diagnostic methods. Therefore, in recent years all dermatoglyphic method as more popular, simple and cheaper to use. Studying their heritage of dermatic patterns of fingers and toes westerlies with goal to ascertainment congeniality at forensic examination unknown persons. Dermatoglyphic method to be able has marked advantage in questions of determination relationship as another genetic methods. In particular in availability computer program it can be widespread routine method of diagnosis in forensic medicine. Unfortunately, today analogous programme for the present is still not exist. Its closest analogues can be fingerprint computer programs which used in crymnalistic with purpose automated fingerprint identity. Similar programs today already exist. With appropriate software revision, they probably could be useful in medical genetics and anthropology. In particular, Fokyn V.A. and co-author. (2002) was created program "KYBERINFORM" Medical Genetic purpose to analyze the main dermatoglyphics parameters that can complement the programs implemented their automatic recognition, such as kriminalistychnoyi fingerprint program "Songdo" (version 4.2 of "Pathfinder") which is widely used for Forensic purposes since the early 90's. and well proven. This program "Songdo" capable, in particular, automatically identify and classify basic types of papillary patterns terminal phalanges of both hands. She distinguishes 19 types of such pictures and classifies them into arches, loops and curls on System Galton-Henry. Results of identifying of each person can be seen on the computer screen. To push off on these images, it is possible to assess quantitatively the degree of asymmetry of the right and left hands, to compute basic indices for the control and research groups, which may be useful for the mass population anthropometric and genetic research [1]. Last years big popularity obtained artificial neural networks base on which are created identification programs, including and forensic [2]. The aim of our study was to investigate the current state of computer identification applications, such as artificial neural networks. Results and discussion. An artificial neural network (ANN) - a software - hardware complex built on a mathematical model that resembles the principle of operation of biological neural networks This concept formed the study of processes occurring in the brain [3]. An artificial neural network (the neural network) is a system of connected and interacting processors (neurons). Neuron (basic neural network element) is a simple computer processor which can handle perceive and transmit simple signals (information). When you combine a large number of neurons in a network, the system can solve non-trivial task. Neural network equally well appropriate for solving both linear and nonlinear problems. Neural network, depending on your architecture [4] can be divided by level of difficulty. The basic

type of neural network is a network of direct distribution - that is network to which signals propagating only in one direction (for complex problems using recurrent neural network model). Neural networks have been widely applied in various types of complex problems needing analytical calculations of similar to those that the human's brain does. Among the major classes of problems for neural networks can be distinguished classification and prediction. Under classification refers a search and the partition of the database on several parameters, in anticipation - the opportunity to provide some event or step for a given array of input data.

For understanding the work of neural networks just look how they are composed of and what settings in this using. The main object of the neural network is a neuron course - a logical unit that is working out information.

Neurons are divided into reentrant (Fig. 1, blue), latent (Fig. 1, red) and outbound (Fig. 1, green).

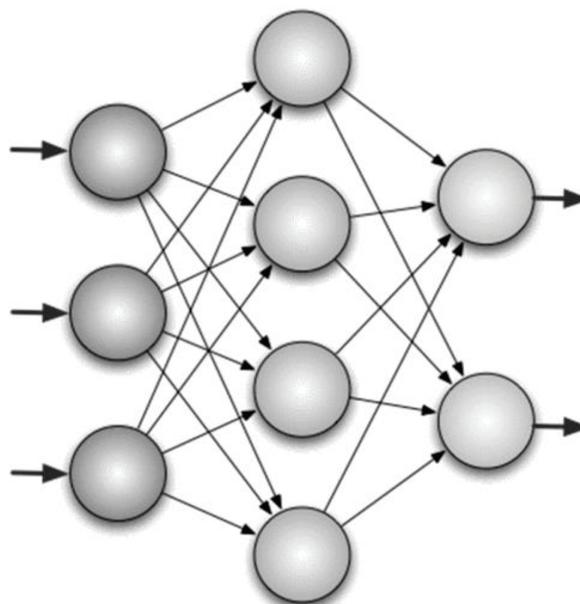


Fig. 1. Scheme connections in a simple neural network

In the construction of large neural systems introduces the concept of layer - ie there is an reentrant layer (a set of neurons which receive information), n -latent layers (the set of neurons will process that information, usually  $n \leq 3$ ), and the outbound layer (neurons which deduce the result). Neurons operate the numbers - usually those numbers are in the range  $[0,1]$  or  $[1,1]$ . Each neuron has two parameters: input and output data (input data and output data). In the input field (input) is entered summary information of all neurons in the previous layer. After receiving normal data information by using the activation of a function  $f(x)$  then it gets to the field of output data (output). It should be noted that the input layer neuron input information is equal output level (input = output).

Neurons are integrated into the network by using synapses. Synapse - it is connection between two neurons which is characterized by weight (weight of synapse) [5]. Actually, due to the weight of the synapse, changing the input information during transmission from one neuron to another (Figure 2). Assume that we have three neurons, each of which transmits information of a certain color. Each of these neurons has a the synapse by weight  $w_1 = 0.1$ ,  $w_2 = 0.3$ ,  $w_3 = 0.2$ . At processing input data (mixed colors) we get the result in which will play a crucial role synapse with the greatest weight. The totality all the weights of synapses all of neurons allow the system to make decisions.

An important element of neural network is function of the activation (activation functions [6]) - a function which normalizes the input data (ie a function that allows to interpret the data as numbers that belong to a range of 0.1). In the activation function for determination of the initial data, the total amount of input data and weighting coefficients is compared with some threshold. When the amount is greater than the threshold value, the processing element generates a signal, otherwise the signal is generated (or inhibitory signal is generated). Often is used for simple tasks function of appearance sigmoid function (Figure 3):

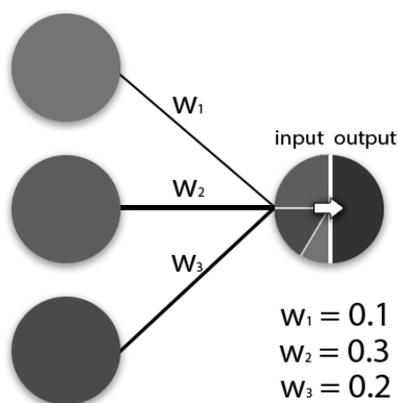


Fig. 2. Dependence the result of data processing from neuron synapse weight

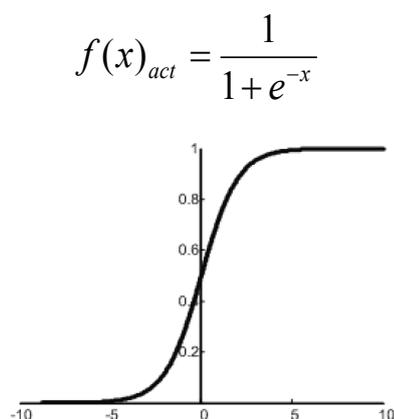


Fig. 3. Non-linear activation function which approximates the minimum and maximum values in asymptote

An important characteristic of neural networks is its ability for learning the examples included in the training set. The process of learning can be viewed as settings of architecture and connections between synapses [7]. Weight are placed according to the training set. Studies a network is divided into controlled and uncontrolled. Although uncontrolled study is a very perspective (learning computers), yet the overwhelming majority real problems using algorithms of controlled study. The basic idea the latest output data, compared with standard (Weights at the beginning of study are set at random, and in the process corrected for achievement of close correspondence between the desirable and received data).

It is understood that for complex training systems may take a lot of time (days or weeks) even with very powerful computing possibility. Also for effective study, a plurality of reference data to be quite large and contain all the necessary information regarding the characteristics and relationships among the variables in our investigated system.

**Conclusions.** Thus, the data received by us in studying literary sources allowed us to close approach to creating real systems for processing and prediction of general human phenotypic traits based on its dermatoglyphics parameters. Established that the main attention should be paid to the choice of network architecture, learning method and systematization of input data, software package in which will be established and operate neural network.

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## НЕЙРОННІ МЕРЕЖІ І ПЕРСПЕКТИВИ ЇХ ВИКОРИСТАННЯ У СУДОВІЙ МЕДИЦИНІ

Козань Н.М.

**Резюме.** У даній роботі представлено напрямки та тенденції розвитку сучасної комп'ютерної обробки даних, отриманих при судово-медичних дослідженнях. Розглянуто систему штучних нейронних мереж, принципи та особливості їх роботи. Визначено перспективи застосування штучних нейронних мереж при обробці даних дерматогліфічних досліджень.

**Ключові слова.** Судова медицина, нейронні мережі

## НЕЙРОННЫЕ СЕТИ И ПЕРСПЕКТИВЫ ИХ ИСПОЛЬЗОВАНИЯ В СУДЕБНОЙ МЕДИЦИНЕ

Козань Н. Н.

**Резюме.** В данной работе представлены направления и тенденции развития современной компьютерной обработки данных, полученных при судебно-медицинских исследованиях. Рассмотрена система искусственных нейронных сетей, принципы и особенности их работы. Определены перспективы применения искусственных нейронных сетей при обработке данных дерматоглифических исследований.

**Ключевые слова.** Судебная медицина, нейронные сети.

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## SYSTEMATIZATION OF DERMATOGLYPHICS PATTERNS MEDIUM AND PROXIMAL PHALANGES OF FINGERS

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**Summary:** In the article presents the methods obtaining and systematizing dermatoglyphics parameters of medium and proximal phalanges of the fingers. Displayed possibility of using supplemented and improved classification of dermatoglyphics parameters of medium and proximal phalanges of the fingers during forensic identification of the person.

**Key words:** dermatoglyphics, fingerprinting, dermatoglyphic parameters of identification the person.

**Introduction.** Dermatoglyphics parameters of fingers and toes and hands and feet, are unique morphogenetic phenomenon that for a long time attracted the attention of researchers of various fields of science. The above parameters are used to resolve issues of neurophysiology, forensic science, clinical medicine, anthropology, ethnology, criminology, biology, above the development of computer methods for recognition, fixation and processing of acquired images of the objects. [1, 2,3,4].

In humans there are several tens of dermatoglyphic specific differences that can be used as diagnostic markers during forensic identification of the person. Dermatoglyphic parameters is highly susceptible to individual and group variability expressed polymorphism, and at the same time, can be traced the high level of inheritance. The complex of these properties determine the scope of the analysis of dermatoglyphic analysis in practical purposes: in genetics [5,6,7], in anthropology [8,9,10], in criminalistic, criminology and forensic medicine [8,11,12,13].

In the practice of forensic medicine and criminalistics the dermatoglyphics and fingerprinting are used to identify the person at a mass incoming unrecognized bodies, in the commission of experts the disputed paternity, analysis of relationships between populations and people [14]. The most profound forensic developments on this issue aimed at classic program whether slightly modified program that focuses on the study of dermatoglyphics parameters of the distal phalanges of the fingers (Cammins H., Midlo Ch. 1943; 1961) [15] and the study of dermatoglyphics features of palms and feet [3,13,14].

Enough little at this time studied dermatoglyphic parameters of medium and proximal phalanges of the fingers, which also can be incorporated into the system and identifying parameters and used during the identification of an unknown person at the level of dermatoglyphics parameters of distal phalanges. The study of dermatoglyphics patterns of medium and proximal phalanges of hands was engaged Shpak LY [16] She was one of the first researchers in anthropology, which