# СЕКЦІЯ КОМП'ЮТЕРНИХ ТА ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ І СИСТЕМ

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## THE NEURAL NETWORK TECHNOLOGY FOR DIAGNOSING OF THE CORONAVIRUS INFECTION IN THE SPACE OF ACOUSTIC FEATURES

The paper considers technology of application of neural network models of various architectures and complexity in the space of acoustic features for automatic recognition of a viral infection by analyzing the spectrum of sound vibrations arising at sick patient cough. It will improve the quality of disease recognition and significantly reduce time of decision-making at therapy choice.

Study of the symptoms of coronavirus infection shows significant changes in the structure and internal processes in the lung tissue of a patient with coronavirus. Obviously, this fact should affect the amplitude and phase of the harmonic components of the signal spectrum (patient's cough) at application of the technology and tools of the discrete Fourier transform (DFT).

It is necessary to create a large library of examples of such "sound portraits" of patients' cough, both sick and healthy people, with the obligatory fixation of their real health status. It will be a class library for the developed pattern recognition system. The feature dictionary for each class during the examination of patients will be formed at the output of the transducer (DFT). In this case, it is sufficient to apply the well-known technology of the Fourier transform, for example, as shown in.

Input of sound is carried out in real time via the sound card. In order to put the sound to the input of the neural network, it is necessary to carry out an analog-to-digital conversion (ADC), and then a discrete conversion (DFT) of it.

It is desirable to make logarithmic change of the obtained spectrum scale in the amplitude space and in the frequency space to facilitate the formation of a representative training sample and increase the information content of the precedent set. The parameters of the patient's cough obtained in this way are his primary features and represent a multidimensional signal adapted to the input of the neural network. Next, we implement the classic pattern recognition algorithm.

Array of input features of neural network $X^n = \{x_1, x_2, ..., x_n\} \subset X$ along with the alphabet of classes allows implementing the well-known rule of pattern recognition:

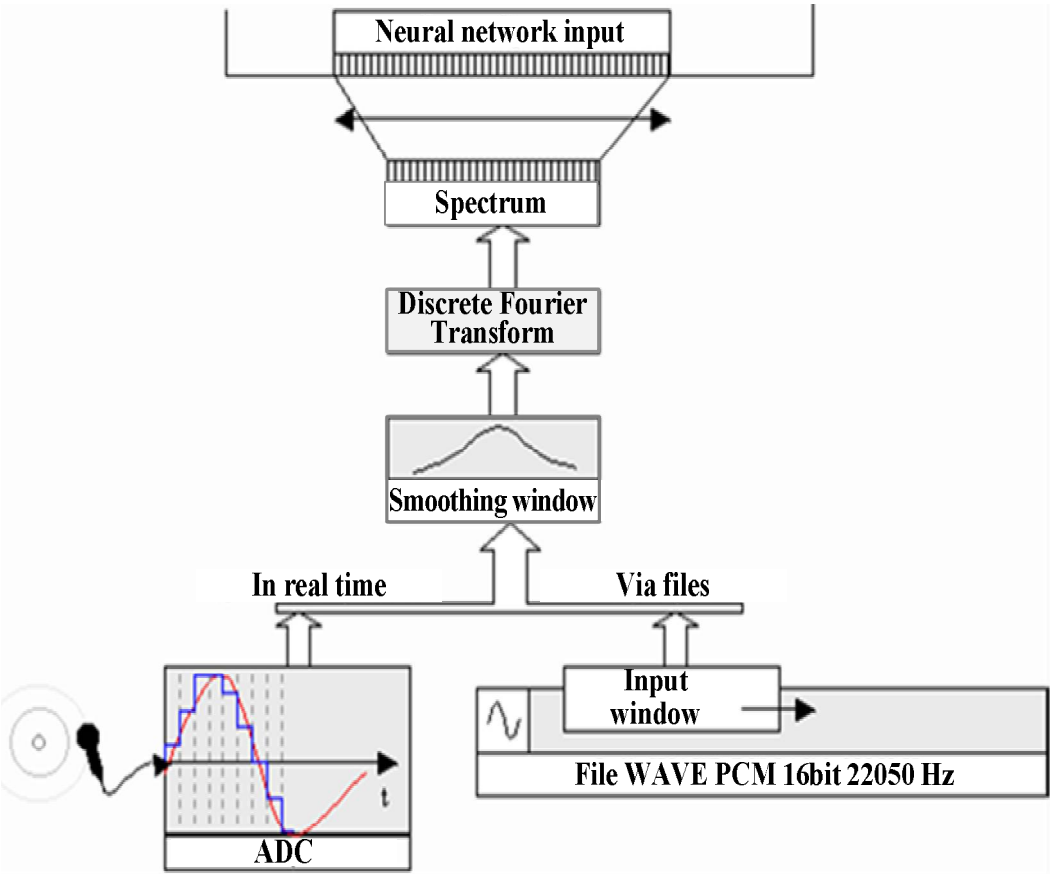


**Fig. 1. Processing of acoustic features of a patient's cough**

$$\omega_g \in \Omega_k, \text{ if } \quad L(\omega,\{\omega_g\}) = \sup_i L(\omega,\{\omega_i\}), \qquad (1)$$
$$L(\omega,\{\omega_g\}) \to \omega_g \in \Omega_k ,$$

where $X^n = \{x_1, x_2, ..., x_n\} \subset X$ are features at the output of DFT device; $L(\omega,\{\omega_g\})$ is a rule for assigning the network state $\omega_g$ to the appropriate class; $\{\omega\}$ is states of the network (sick / healthy) in the feature space (*k*, *l)* for all their possible combinations $(\omega_{pk}, \omega_{gl})$.

Instrumentally, the problem is solved on the basis of the existing gradient methods of teaching ANN by the backpropagation algorithm. The adequacy of neural network models is established by the productivity and errors on the training and test sets, which allows us to assert the consistency of the decisions based on the simulation results.

Thus, it is proposed a technology of use of the neural network models in the space of acoustic signs for automatic recognition of a viral infection. The efficiency of the technology and its effectiveness are evaluated on arbitrary examples. Further research should be aimed at collecting a consistent training set of precedents from the practice of patient care and obtaining the results of training models on this database, which will ensure the consistency and reliability of the result in practice.