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## Electrophysiological method and interval model for identification the distance to reverse laryngeal nerve during surgery operation on the thyroid

**Abstract.** The electrophysiological method and interval model for identification the distance to reverse laryngeal nerve during surgery operation on the thyroid was considered.

**Keywords:** Laryngeal Nerve, Electrophysiological Method, Interval Model, Model Identification.

### Introduction.

Electrophysical methods are widely used in medicine for an identification the nerve endings from the muscle tissues. Especially the indicated methods are actual in Ukraine through a significant growth of thyroid diseases which treatment are carried out by surgical methods and there is a risk of damage the reverse laryngeal nerve. Today there are several manners to identify the reverse laryngeal nerve. The main point of most manners is a stimulation the surgery area by direct current and an estimation the results of stimulation on vocal cords [1]. Lately the methods and tools for visualization the reverse laryngeal nerve in surgical wound are developing [1]. For this case it is developed a manner and methods which by using prior probing the surgery wound make it possible to get images of reverse laryngeal nerve between the muscle tissue in surgical wound and while the patient is in the second stage of anesthesia [1]. The main disadvantage of these manner and methods is necessity to install the sterile grid in a surgical wound for affixment the coordinates of points the muscle tissue stimulation to an image where the reverse laryngeal nerve is displayed. At the same time reducing the risk of reverse laryngeal nerve damaging concerned not so much with its visualization as with continuous control by the surgeon of distance from the surgery area to reverse laryngeal nerve.

So the task of developing a model that will represent the distance from the stimulation of muscle tissue to reverse laryngeal nerve on the basis of analysis the amplitude of the noisy signal as response on stimulation is actual.

### Features of electrophysical manner the reverse laryngeal nerve identification by alternating current.

The scheme of electrophysical method in structure is not differ from the scheme described in the patent of Ukraine [3]

Stimulation the tissues in the surgical wound by probe with alternating current of fixed frequency from alternator, for which provided the small electrical signal conductivity in muscle tissues in surgical wound and high electrical signal conductivity in laryngeal nerves and muscles that control the vocal cords tension. Then the vocal cords contraction on the given frequency is registered by sound sensor installed in the respiratory tube which placed in patients larynx. After that this signal is transformed to the electrical signal by special block and through a standard audio input is going for further processing to personal computer.

Output information signal characterize the proximity of the probe position to reverse laryngeal nerve. It is determined by change of amplitude the selected sinusoidal electrical signal with given frequency. While the distance to the nerve is reducing the signal amplitude is increasing.

Special attention is paid in this manner to the information signal extraction. In fact, the vocal cords

vibration modulate the sound noise-type signal that is generated by air flow during patient breathing and has a quasiperiodic character with instantaneous roll-on and roll-off. Exactly this modulated noise-type signal contains the desired information signal. These nonlinear transformations of the information signal complicate its extraction. In addition, the frequency of alternating current for muscle (laryngeal nerve) stimulation is also important. On the one hand it should be chosen as the higher (up to 1000 Hz) for ensuring the stimulation reaction of laryngeal nerve exceptionally, and on the other hand high-frequency alternating current causes great attenuation the stimulation signal on the synapses and in addition the vocal cords are enough inertial system. Clinical investigations made it possible to select the optimal frequency of alternating current for stimulation. During these investigations also found that when choosing some frequency of current generator and in case of reverse laryngeal nerve stimulation in the spectrum of modulated by vocal cords vibrations the noise-type signal – response on stimulation it is essentially increases the amplitude of component, which coincides in frequency with the frequency of AC used for stimulation. Such investigations made it possible to simplify the scheme of information signal and its parameters extraction, namely maximal amplitude the component of noise-like signal, which coincides in frequency with the frequency of AC generator.

Thus, for information signal processing a software module in MATLAB was created.

For visualization of reverse laryngeal nerve the interval model of dependency the distance of stimulation point in the surgical wound from the interval maximal amplitude of information signal was created.

### REFERENCES

- [1] Dyvak M., Kozak O., Pukas A. *Interval model for identification of laryngeal nerves // PRZEGLĄD ELEKTROTECHNICZNY (Electrical Review), ISSN 0033-2097, R 86 NR 1/2010, pp.139-140.*
- [2] Dyvak M.P., Kozak O.L., Shidlovskiy B.O. *Manner of identification the laryngeal nerve from other tissues in surgical wound during realization of surgical operations on a thyroid / Patent of Ukraine on an Useful Model №51174 Reg. 12.07.2010. Publ. 12.07.2010.- Bul.№13. (in Ukrainian)*

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