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FEATURES OF THE SPEECH SIGNAL AT PATIENTS WITH THE TUMOUR OF THE THROAT

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The given work is directed on revealing of parameters of the speech signal changing depending on presence of a tumour of a throat and its size. In experiments speech signals of eighteen announcers with the diagnosis a cancer of a throat were used. During the done work characteristics of a speech signal, such as frequency of the basic tone and harmonics of the basic tone, the attitude intensity of the harmonics to intensity of the basic tone, dynamics of change of frequency of the basic tone and others have been investigated. Those characteristics which allow to distinguish a voice of the announcer with a tumour of a throat from a voice of the healthy person are allocated. The estimation of influence of the size of a tumour on these characteristics is lead. Results of the lead experiments can be used for early diagnostics of the given disease on a voice, and also for research of influence of parameters of throat on characteristics of a speech signal.

1. Introduction

The structure of a speech signal even now is poorly investigated. Insufficiency of knowledge of it does not allow carrying out qualitative synthesis in a place and resinthesis in spite of the fact that the certain successes in this area are already achieved [1]. The basic problems in studying structure take place at research of formation vocal sounds, i.e. with participation of a voice.

For a deepening of knowledge of a speech signal and about influence on its structure of various speech formation bodies it is necessary to investigate not only speech of the healthy person, but also people with various deviations in speech formation system. For example, research esophageal voices [2,3]. In this case the structure of speech signals of announcers with the diagnosis a cancer of a throat is analyzed.

The cancer of a throat means presence of a tumour in a throat or in voice folds. Depending on size of a tumour and a degree of its prevalence four stages of disease differ. At the first stage treatment with application of methods of chemotherapy is possible. On the second partial removal of a throat is necessary. At the third and fourth stages - full removal of a throat.

2. Researched speech signals

Research of a speech material is directed on allocation of the parameters, allowing determining a stage of disease. At present the stage is defined on the value judgment made on the basis of roentgenograms.

Researched speech material the cat includes phrases and the isolated vowels duration 1,5 - 2 seconds said by announcers with the put diagnosis - a cancer of a throat. All announcers have been divided into three groups depending on a stage of disease.

Total of announcers - 18.

Group 1: the first stage - 2;

Group 2: the second stage - 13;

Group 3: the third and fourth stage - 3.

The parameters of a speech signal used in research:

1. Vocalization of sounds;

2. Frequency of the basic tone;
3. Intensity of the basic tone;
4. Dynamics of change of frequency of the basic tone;
5. Dynamics of change of intensity of the basic tone;
6. The attitude of intensity of harmonics to intensity of the basic tone.

3. Results of experimental researches

At both announcers carried to the first stage on vocal segments, unlike announcers without pathological changes, instability of frequency and intensity of the basic tone is observed. This distinction noticeably on the isolated vowels (fig.1, 2) is the most distinct.

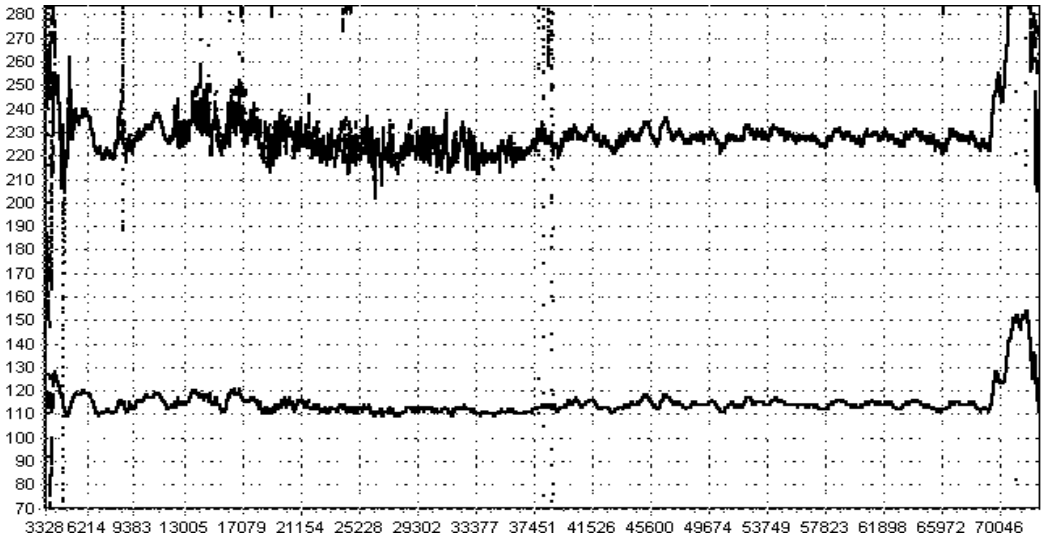

Fig. 1. Dynamics of change of frequency of the first and second harmonics of the basic tone of a speech signal of the announcer concerning the first group (a sound "O").

Fig. 2. Dynamics of change of intensity of the basic tone of the speech signal concerning the first group (a sound "O").

It is possible to explain sharp increase of instability of frequency of the second harmonic instability of time of opening and closing of voice folds on the period of fundamental frequency.

Speech signals of group of announcers with the second stage of disease are characterized as instability of frequency and intensity of the basic tone (characteristic for the first stage), and practically full disappearance of periodic structure on sounds which should be formed with participation of a voice source. At two announcers from this group on the segments corresponding vowel sounds, periodicity or is observed on separate sites, or is absent at all (fig.3). Thus formant structure of vowels is kept on all extent of a segment.

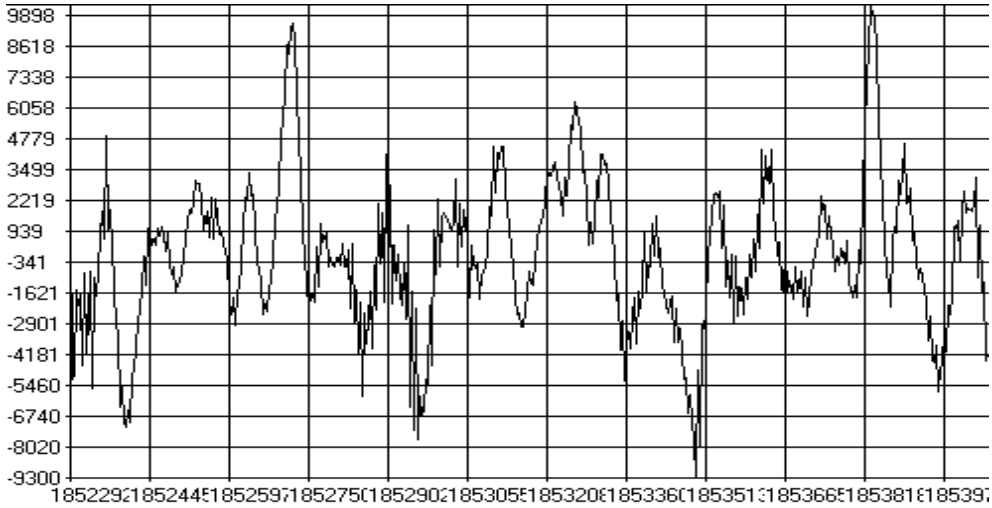

Fig. 3. The oscillogram of a speech signal of the announcer with the disturbed periodic structure vocal sounds (a sound "O")

Announcers have been carried to the third group with the greatest sizes of a tumour. Announcers from this group are men. At all frequency of the basic tone has appeared in an interval from 200 up to 250 Hz, i.e., in comparison with frequency of the basic tone at men without pathologies, has increased in 1,5 - 2 times. At the same time, unlike the first and second groups, instability of frequency and intensity it is not observed (fig.4, 5).

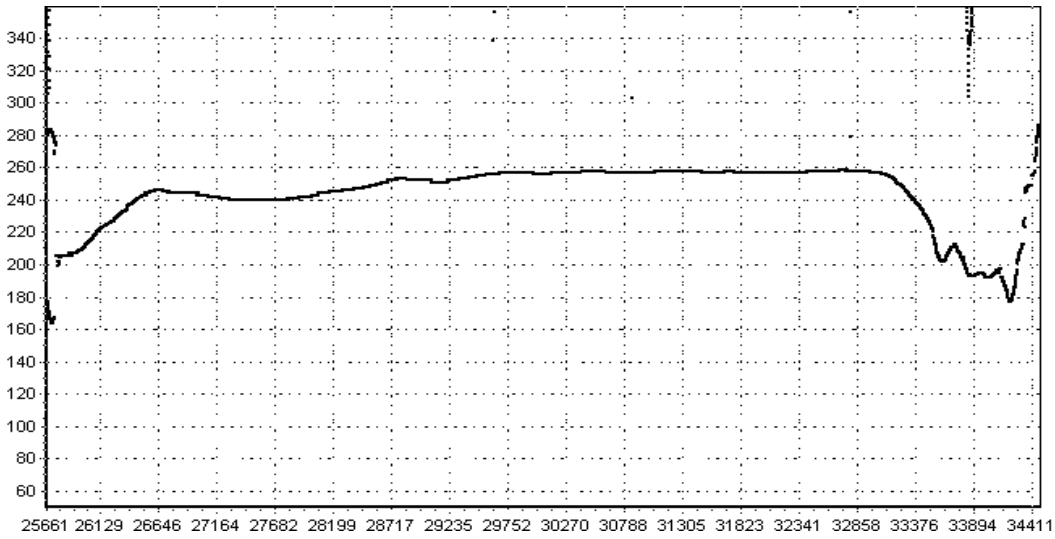

Fig 4. Dynamics of change of fundamental frequency of a speech signal of the announcer concerning the third group (a sound "O").

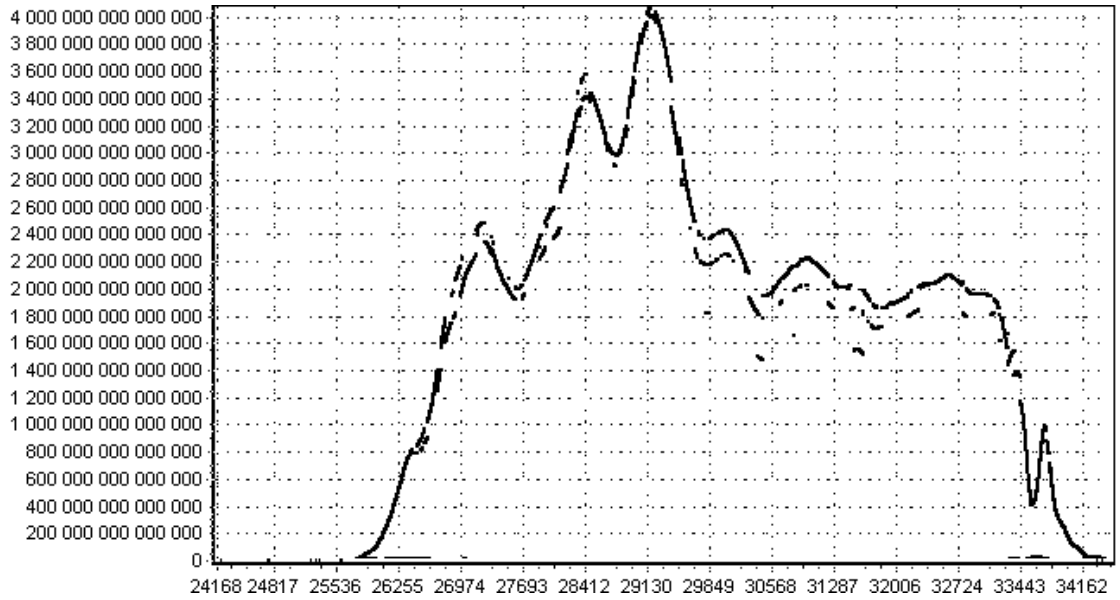

Fig. 5. Dynamics of change of intensity of the basic tone of a speech signal of the announcer concerning the third group (a sound "O").

Carried out researches allow to reveal following laws which are offered in table 1.

Table 1.

	Fundamental frequency	Deviation	Intensity of 2nd harmonic
1 stage	astable	increased	astable
2 stage	astable or destroyed	increased	astable
3, 4 stages	stable, increased	small	stable
normal speech	stable	small	stable

At the given investigation phase there are no full data about changes in structure of the throat, caused by a tumour. Therefore it is impossible to find interrelation between infringements in anatomy and neurophysiology and structure of a speech signal. It demands carrying out of additional anatomic researches. In the further obtained data can be used for construction of model which would enable to determine size of a tumour both its localization, and systems of diagnostics of diseases of a throat.

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