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**NON-STATIONARY MODELS IN PROCESSING SPEECH SIGNALS**

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*In work a models of speech formation system is considered on the basis of various approaches to speech signal formation. The analysis of speech signal formation models a is carried out, the feedback formed at normal speech formation and at deviation (esophagus voice, stutter, etc.) are considered. The incorporated model is a basis for allocation informative a component of a speech signal. Thus, requirements to algorithms of speech signal processing a and allocation of its informative parameters are formulated.*

### **Introduction**

In works [1,2,3,4] it has been shown, that speech formation models should take into account hierarchy of feedback. It results in necessity of the analysis of areas of occurrence of steady fluctuations, and as vicinities of points of an attraction [5,6]. At the same time it is shown, that the analysis of arising structures of generated signals is possible only on the basis of the algorithms modelling features of system of acoustical perception of the person.

In the report models speech formation and speech perception are resulted, allowing to explain a number of the moments connected to mechanisms of formation pathology of changed speech (esophagus), and as with possible mechanisms of occurrence of stutter.

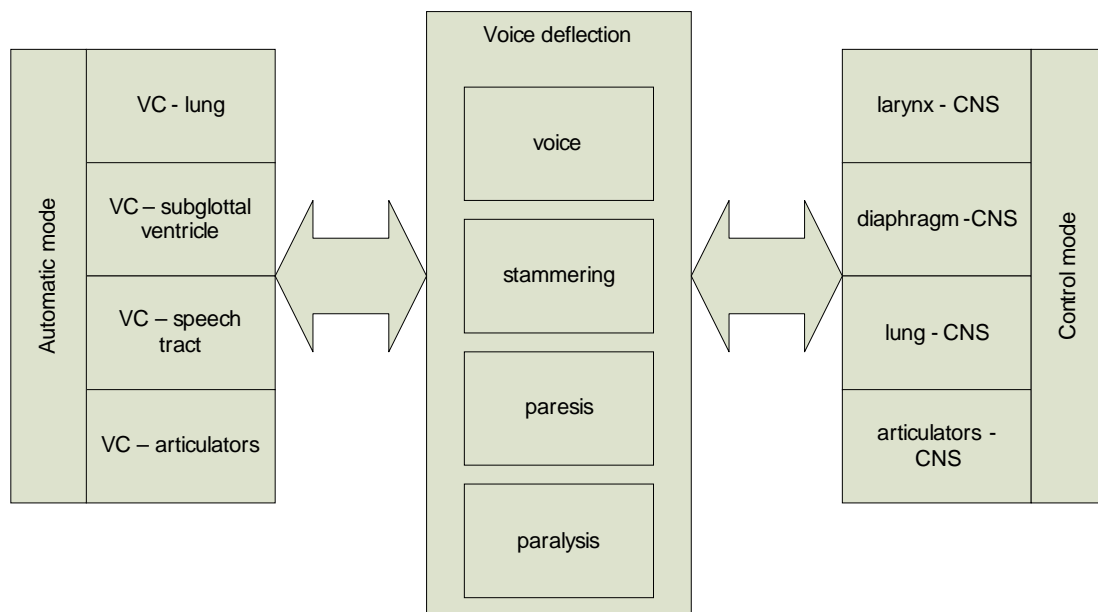
### **Hierarchy of feedback**

Person speech formation will involve a plenty of feedback [6] in process, the part from which becomes isolated at a level of sensor controls, and a part through acoustical, that is through the central nervous system (CNS). Feedback allow to compensate deviations in speech formation bodies and even, in some cases, to generate a speech signal on the basis of other mechanisms, for example gullet voice. Infringements in structure and functioning of feedback results in various pathologies at speech formation, for example to stutter.

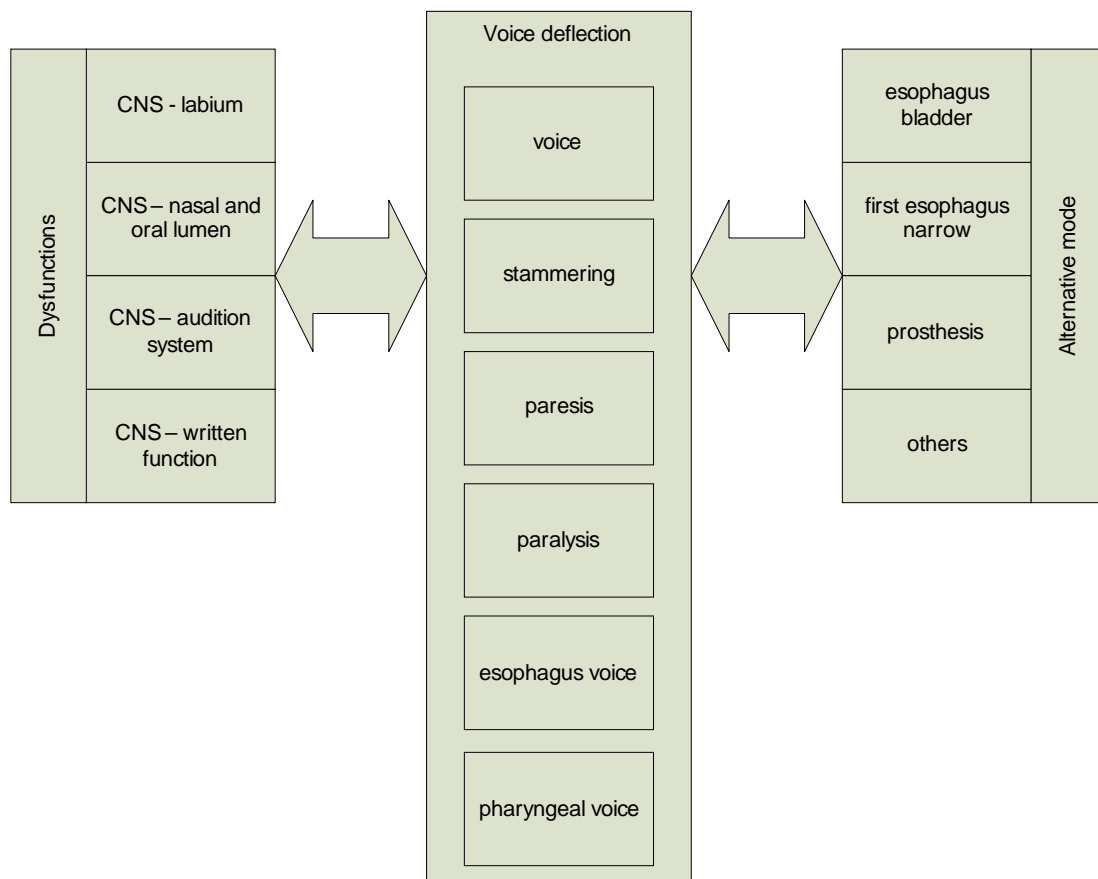
The most difficult process is voice formation. Sounds of speech the voices formed with participation concern to a class vocal and make about 70 % from the general number on duration. They provide intonation, melodic and rhythmic of the statement. In the majority cases of infringement in speech are connected to pathologies voice formation.

On fig. 1 and 2 circuits of influence of feedback of a various level of hierarchy on process voice formation and its possible infringements, and as formation of alternative feedback are schematically submitted due to creation of new conditioned reflexes. In figures reductions are used: CNS – the central nervous system; VC – voice crimp.

Voice deviations can have both insignificant character, and essential value, for example, even cold demands various fine tunings in voice formation system. Correction of deviations can be carried out by change of parameters of feedback in an automatic mode or control mode (see fig. 1). Such deviation as stutter has the difficult nature that is essential at construction of models [3], but demands the detailed analysis of influence of feedback on voice formation process.



**Fig. 1.** Feedback on automatic control and management and possible deviations voice formation at their infringements



**Fig. 2.** Alternative feedback due to formation of new conditioned reflexes at a pathology in speech formation system

Opportunity of formation of alternative feedback for speech formation at formation esophagus speeches it is the most effective with use of a biological feedback [7]. It confirms necessity of detailed studying of functioning of feedback of a various level at speech formation. Complexity of a problem is connected to essential nonlinearity of processes by which the speech formation system [3,5,6] is described.

Besides at absence of alternative feedback restoration of speech at patients with serious complications on speech formation tract (for example, a resection of a throat, a tumour, etc.) [7] practically is not obviously possible.

### **Approaches to the analysis of feedback in speech formation system**

Various approaches to the analysis of feedback in speech formation system are possible. One of approaches is based on the analysis of an output of speech formation system [6,7], that is structures of a speech signal and speech. The given approach allows to reveal features of these processes, that is areas bifurcation, to explain possible mechanisms of occurrence of stutter, etc. It is necessary to note, that the given approach allows to track influence of management by speech formation process at enough high levels of hierarchy, down to the central nervous system. However, it does not allow to investigate feature of management and regulation at a touch level, that is at a level, for example, voice crimp – a diaphragm.

At a level voice crimp – a diaphragm in speech formation system it is necessary to provide steady oscillatory process. As it has been shown in enough simple model [3], for this purpose it is necessary to provide the coordination between speed of change of volume easy and own frequency voice crimp. Complexity of the decision of similar problems it is connected to the high order of system of the differential equations describing these processes. In some cases it is possible to lead analyzed processes to independent system [8], but it results in some restriction of area of received decisions [3]. The analysis of full speech formation system assumes, that it should be not independent. Really, higher levels of management constantly change character of management depending on the formed statement, that is it melodic, rhythmic, prosody. Therefore even at the very first levels of management it appears, that research of such systems is necessary be conducting from positions of on-line systems. And it assumes the analysis of such phenomena, as stability, on an input to an output of system [9].

### **The conclusion**

The offered approach to the analysis of speech formation system demands research not only in a mode normal voice formation, but also at deviations. The important component of research is the analysis of feedback. The lead modelling allows to ascertain about introduction of nonlinear elements at all levels of hierarchy of speech formation system model.

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