Use of Multiparameter Adaptation in Communication Systems

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Contribution to the state of the art
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Abstract: The article discusses the use of multiparameter adaptation in communication VHF waves communication, provides specific schema that implements the proposed algorithm.

Keywords: adaptation, multiparameter system VHF waves communications, the transmission of information.

Introduction

Short wave and VHF wave data transfer systems are widely used in connection with the ability to transmit large amounts of information over relatively long distances at relatively low power transmitters. VHF radio stations are required to be installed on vessels of any tonnage. VHF radio communication is widely used in rail transport, in other industries.

However, the reliability of wireless radio depends largely on the level of interference, deliberate and natural, i.e. generated by other sources of radio emission, interference current radio propagation conditions. These features have the greatest apparent for a range of HF and VHF frequencies.

The most significant type of interference in radio signals close in frequency spectrum radios which are commensurate with the wide spectrum of useful signal. These disturbances are called “lumped”. Statistics show that 85% of radio sessions exposed to concentrated disturbances. The data about the properties of these disturbances (except fixed isolated radio systems) are missing.

Adaptive Radio Communication System

To ensure reliable transfer of large amounts of information at high speed and the required accuracy of multiparameter methods adaptation to specified dynamically changing signal-jamming conditions.

The main characteristic is to reduce the level of the ratio signal/noise. On this ratio except for the above-mentioned reasons affect mismatched transmission line of the signal, thermal noise and shot noise in components of the system, resonance phenomena, parasitic coupling, the self-excitation of system, the nonlinearity of the transfer characteristics, etc.

Adaptive radio communication system is a system that has the property to adapt to changes in the external environment operation and properties of incoming radio in it and set the value of qualitative indicators by the radio settings and modifying its structure. Under the adaptability of the system should understand such a level of organization that is characterized by the presence not only of backward linkages, but also devices of observation, measurement and analysis, identification and control, providing the ability to make decisions based on analytical builds.

Feature build adaptive radio communication systems is the lack of a priori information about the characteristics of interference and signal, the signal level is continuously changing and there are powerful Nonstationary interference. Should therefore be provided with observability and identification.

A parametric task adaptation in general case boils down to optimize a function Q (U) in an atmosphere of random noise, i.e. on its observations, noisy polyaddition hindrance [2]:

$$Q^{`}(U) = Q(U) + \varepsilon(\sigma)$$

where U is the vector of optimized parameters, and ε (σ) is an independent random noise (in most cases it is assumed - with zero mathematical expectation) and variance σ, which can be unknown.

To solve function optimization problem

$$Q(U) \to \min_{U \in S}$$

given only their observations, developed many adaptive methods.

Distinctive features of the build adaptive systems for VHF radio is that they, in conjunction with dynamically changing external environment must run in real time.

In addition, these circumstances make it necessary to undertake, to improve reliability, adaptation by several parameters, i.e. use multiparameter adaptation.

Thus, there is a certain contradiction: on the one hand the algorithms should be implemented to operate in real time, i.e. are fairly simple, on the other hand, to improve reliability, and requires their constant complication.

In this regard, in many practical ways to build the algorithms adaptation, despite widespread use of microprocessor technology in these systems, heuristic methods are used.

Among the existing approaches it is possible to identify some solutions used in practice.

In particular, usually taken when building automatic control systems and communication HF (VHF) allocate deterministic number of fixed frequencies to test HF (VHF) range. In so doing, to meet this challenge creates a standalone hardware from the channel communications system using microprocessor technology designed to manage HF (VHF) range. This allows to tailor the operation channel equipment to changing dynamics of the ionosphere and radio interference. Using the inertia of the ionosphere and controlling the dynamics of the transmitter on best radio frequency signals, predicted the time of permanent bounce and in advance, even before the emergence of refusal is done rebuilding communications both correspondents of the new optimum frequency.

The aviation data transfer systems consisting of on-board and ground parts to ensure greater reliability of information exchange in the aviation communications system established radio communications are complemented by control systems assessment units the quality of the communication channel, as well as control units and blocks that implement the adaptation task rate measurements in real time and select parameters and operation modes of the radio links under specific conditions of propagation of this range using multiparametric adaptation.

Also known transfer method of discrete messages with multiparameter adaptation based on the procedure of entering the link, initial messaging using codes from most corrective ability in each of the areas rate on the current underlying messages, sharing the main messages in each direction, radio links, with dedicated time intervals or away from the transfer are the main messages and passed special sequence parameters sensitive maximum channel of communication and its changes, analyze these sequences for admission, according to the results of their analysis and other data about the status of the message transmission channel choose the code and alternation options signals and transmit its correspondent along with software settings alternation signals.

The main disadvantages of the described techniques multiparameter adaptation use tend to channel sounding the same receiving and transmitting funds, and for reference. Accordingly, while sensing the channel an interruption in communication. In addition, no multi-channel radio receivers to reduce the time of the occurrence.

Compensate Deficiencies

To compensate for these deficiencies can be offered parallel structure with the main line radio uses a separate radio link that enables you to carry out adaptation signal in accordance with changing conditions [1].

The adaptation is carried out both in frequency and the signal code design. Thus implements a multiparametric adaptation.

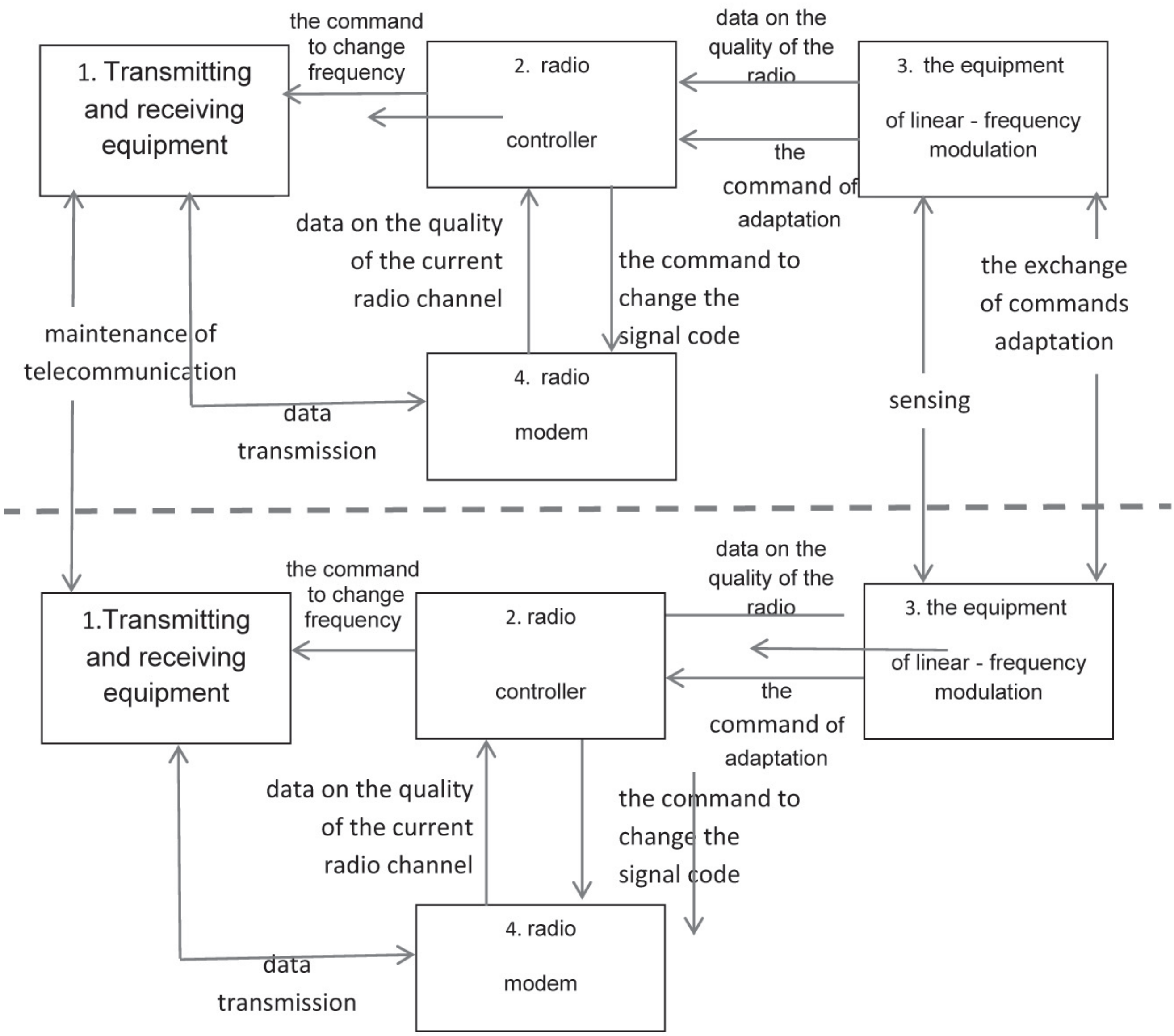

Fig. 1. *The structure of the proposed radio system with multiparametric adaptation.*

This will significantly reduce the duration of the session, which will be achieved by reducing the amount of time entering the relationship, and by reducing the time of message transmission. The general structure of the proposed radio system is shown in Fig. 1.

To build the proposed structure of the radio, you must decide the following tasks.

In General, the build system is based on ensuring the process of transfer of discrete messages with multiparameter adaptation, based on:

- the procedure of entering the link,
- initial messaging in each of the areas of radio links,
- assessment of the status of message transmission in each direction radio links,
- selecting signal code constructs,
- the message about the selected signal code constructs to your correspondent,
- exchange main messages in each direction radio links.

When the assessment ratio signal/noise ratio (usually expressed in logarithmic units using the decibel $SNR_{dB}=10\log_{10}\left[\frac{P_{signal}}{P_{noise}}\right]$), on the current operating frequency during a data transfer form in radio modem, exercising demodulation and decoding the signal, and transmits the radio controller, managing hardware mode linear frequency modulation, getting from her information on assessments of the current signal-to-noise ratio on all selected to conduct the session, except for frequencies used by radio.

Further commands to the adaptation of the ability to send and receive using transmission and reception equipment tools linear frequency modulation probing to each of the correspondents.

Also in the proposed structure of discrete information transmission with multiparameter adaptation via the availability of operational data on the state of the ionosphere, derived from the linear frequency modulation equipment sensing, rank assigned in order of decreasing frequency ringing their ease and begin to call with the most favourable reception by using frequency call multi-channel radio receiver, listening all the ringing frequency.

Evaluation of signal/noise ratio and frequency fading correlation on the current operating frequency of exercise and transmit radio radio controller. The controller evaluates the current signal code constructs and data packet size of the actual condition of the communication channel. In case of inconsistency calculated the optimal values for the above parameters and simulate the situation of application of these settings. When this commands to adapt the send and receive using transmission and reception equipment tools linear frequency modulation probing each of the correspondents.

Availability of radio receivers with the number of channels is not less than N, where N is the number of of frequency of calling allows you to opt out on the receiving side of radio frequency scanning, implementing efforts to detect a call signal simultaneously on all N frequencies.

The availability of operational data on the state of the ionosphere, derived from equipment linear frequency modulation sensing allows for high confidence rank assigned frequency ringing in descending order of their joining. Call transfer must start with the most favorable rate. Availability on the receiving side of radio links multi-channel radio receivers allows you to receive calls at any order of calling frequencies.

As a result of the proposed solutions, in most cases, the connection will be provided at the first used a ringing frequency of N of allowed frequencies.

Reduction of time expenses in the data transfer phase is achieved by excluding time spent on multiparametric adaptation. Evaluation of propagation conditions and jamming on dedicated to holding the session frequencies in the process of the session is carried out equipment linear frequency modulation. Receiving funds from the whole apparatus of linear frequency modulation sensing are also used to transmit/receive service commands that control the operating mode of the complex communications, carrying out thereby multiparametric adaptation.

Provided in Figure 1. 1 diagram of the proposed radio system, which proposed a way to transfer discrete messages with multiparameter adaptation, showing the main components of the proposed system: transceiver apparatus 1, Radio 2 controller, Unit 3, linear frequency modulation 4.

The proposed method works as follows. For the transfer of discrete messages with multiparameter adaptation rate controller 2 through Repeater equipment 1 produces guaranteed entry into the relationship. Call transfer starts with the most favorable frequency from ranking dates of sensing equipment according to 4 of the list of frequencies. Receiving a call is carried out from the device to foster multi-channel repeater equipment 1 reception parties for any order of calling frequencies. Entering the link exchange messages through exchange of radio modems 3 assesses the state of channels of communication in each direction, radio links and the assessment rate controller on each side 2 shall decide on the need to conduct a multiparametric adaptation.

Adaptation takes place in frequency thus:

Signal/noise ratio on the current operating frequency in the transmission of data is generated on radio modem exercising demodulation and decoding the signal and transmitted to the radio controller. Radio controller controls the equipment of linear frequency modulation, receiving from her information on assessments of the current signal-to-noise ratio on all selected to conduct the session, except for frequencies used by radio modem. If the current operating frequency does not provide a maximum data transfer rate supported by radio modem, and according to the linear frequency modulation sensing a frequency capable of high speed data transmission, simulate the situation of transition to this frequency.

Conclusion

If by the results of modeling time communicating the message is reduced when you navigate from the current operating frequency for the better according to the linear frequency modulation equipment sensing, is an appropriate transition. Commands to adaptation transmitted and accepted by using transmission and reception equipment tools linear frequency modulation probing each of the correspondents.

Adaptation to signal code design is as follows:

Signal/noise ratio and frequency fading correlation on the current operating frequency is carried out by radio and transmitted to the radio controller. Radio controller assess the appropriateness of the current signal code constructs and data packet size of the actual condition of the communication channel, in case of inconsistency calculates the optimal values for the above parameters and performs simulation of the situation of these parameters.

If by the results of modeling time communicating the message is reduced when moving to the optimal batch size values calculated data and signal code design, is an appropriate transition.

Commands to adaptation transmitted and accepted by using transmission and reception equipment tools linear frequency modulation probing each of the correspondents.

References

[1] Klyachko L.M., Nikolaev A.B., Svirsky V.M., Balyuk D.A., Kostylev S.B. Transfer method of discrete messages with multiparameter adaptation. Patent of Russion Federation, RU № 2598993.

[2] L.A. Rastrigin Adaptation of complex systems. Riga. Zinantne. 1981.

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