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Study of computer digital signal processing network based on the genetic algorithm

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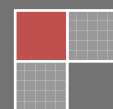
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ABSTRACT

With the extensive application of computer technology in all areas of society, the computer has become indispensable to people's lives, an important part. Computer voice digital signal is more due to its simple, direct, and easy to be accepted into many areas of the characteristics of human society. In the popularization of computer technology, the popularity of the trend, subject to a number of computer-aided voice processing software for real-time signal processing is based on an important development direction of general-purpose computer signal processing simulation system. This article focuses on the genetic algorithm to improve computer assisted voice digital signal processing technology, focusing on the effect of genetic algorithms in terms of speaker recognition, proposed a set of related technologies using genetic algorithm to improve computer-aided optimization of voice processing solutions. One can easily LBG algorithm for speech processing plays an important role in vector quantization techniques used in the design process codebook into local optimum problem, will produce genetic algorithm (GA) and its combination of GA-LBG algorithm; Second, for poorly performing computer-aided speech processing problems play a very important role in neural network RBF network obtained in the clustering process, combined with improved adaptive genetic algorithm to optimize the design of the network training algorithms. Examples of the computer-aided speaker recognition by voice processing applications through improved genetic algorithm LBG algorithm and RBF neural networks were trained and identified. Experimental results show a good effect on genetic algorithm optimized generated.

KEYWORDS

Computer; Signal processing; Genetic algorithm.



INTRODUCTION

One of the development trend of modern digital signal processing is the use of hardware, software in general to implement complex functionality, with increased dependence on software, software development costs have been increased, catch up with the trend even hardware investment. In order to reduce software development costs, in algorithm design on "object-oriented programming techniques, developed in the general computer environment." Through computer simulations on a common signal processing system mathematical model that can efficiently complete the demonstration of various algorithms and performance evaluation, and object-oriented programming technology enables software components reuse, thus reduce design workload and improve the reliability of the system design and shorten the design cycle and reduce development costs. General-purpose computer uses a von Neumann structure, single-processor parallel processing of data difficult conditions, so that the signal processing simulation system in real-time digital signal processing subject to certain obstacles. Since Win32 operating system support for multithreading, so that a general purpose computer to achieve the parallel processing of multiple tasks, and the ability to solve common signal processor has been growing for some low-speed signal, as long as a reasonable allocation of threaded tasks, the use of general-purpose computer can achieve real-time processing of signals. Software for real-time signal processing is based on an important development direction of general-purpose computer signal processing simulation system. In this paper, a general purpose computer system for real-time signal processing by the application of the block processing technology, the use of double buffering to meet the real-time transmission of data, the use of multi-threaded multi-task parallel processing, is given based on a common computer simulation of real-time signal processing design system, and block processing, double buffering and multithreading in the implementation process of the key points in-depth analysis.

DESCRIPTIONS AND RESEARCH STATUS GENETIC ALGORITHM

Genetic Algorithm (Genetic Algorithm, GA) is Evolutionary Computation (Evolution Algorithm, EA) is to be an integral part. Genetic algorithm is a reference biological natural selection and the "selection, crossover and mutation" random search algorithm that genetic machine generated. Its object is to search the individual chromosomes and, in the form of a group of binary string (population). Body color corresponds to a solution ask questions. Exchange of information search strategy groups and groups of individuals between the two main features of the genetic algorithm. More representative of the traditional search methods are analytical method, brute-force method, and random method. Compared to these methods, the transmission method has no knowledge of the search space, parallel to climb peaks adaptability encoding method, the search does not depend on the gradient information, the continuity of the derivative function is defined and there is no other advantages.

Genetic algorithms originated in the 20th century the sixties and seventies, Holland professor at the University of Michigan student summed up the law from the United States and its evolution in the nature of biological survival of the fittest, and creatively used in computer simulation models. Previously, the use of nature "survival of the fittest" rule, some scientists have begun to address some of the engineering optimization problems, and in which the proposed and other populations, selection and mutation related concepts. Genetic algorithms by Professor John Holland at its mid-1960s book "Adaptation in Natural and Artificial Systems" formally proposed. Because of its encoding technology and genetic manipulation method is simple and effective, easy to use, will soon be extended to practical use. Subsequently, Professor Grefenstette GENESIS software successfully developed and promoted more widely used genetic algorithms and popularity. In 1989, American University of Illinois, Dr. Goldberg, in his book "Genetic Algorithms in Search, Optimization and Machine Learning", a thorough description and analysis of the basic theory and application of genetic algorithms^[8]. In 1992, "Genetic Algorithms Data Structures Evolution Programs" published by Professor Michalewicz this book has greatly promoted the use of genetic algorithms in optimization problems. The case since the 1980s, the rapid increase and parallel computing has been popularized in computer processing speed; genetic algorithm has been out of the calculation speed of the bottleneck. Since the last decade of the last century, theoretical studies of the genetic algorithm has been in a rising period, a large number of books have been published. Especially in recent years, related applications in many fields have been outstanding results, and produce good results in many ways. With the continuous develop related technologies; genetic algorithms will achieve more significant developments.

MATHEMATICAL MODELS OF THE SPEECH SIGNAL

After the generation process to understand speech, we need to use the computer through a reasonable mathematical model quantitatively analyzed and processing the analog voice signal. Complete mathematical model of the speech signal can be used incentive model, serial channel model and radiation model of the three sub-models to represent.

Shown in Figure 1, and its transfer function $H(z)$ can be expressed as:

$$H(z) = A \cdot U(z) V(z) R(z) \quad (1)$$

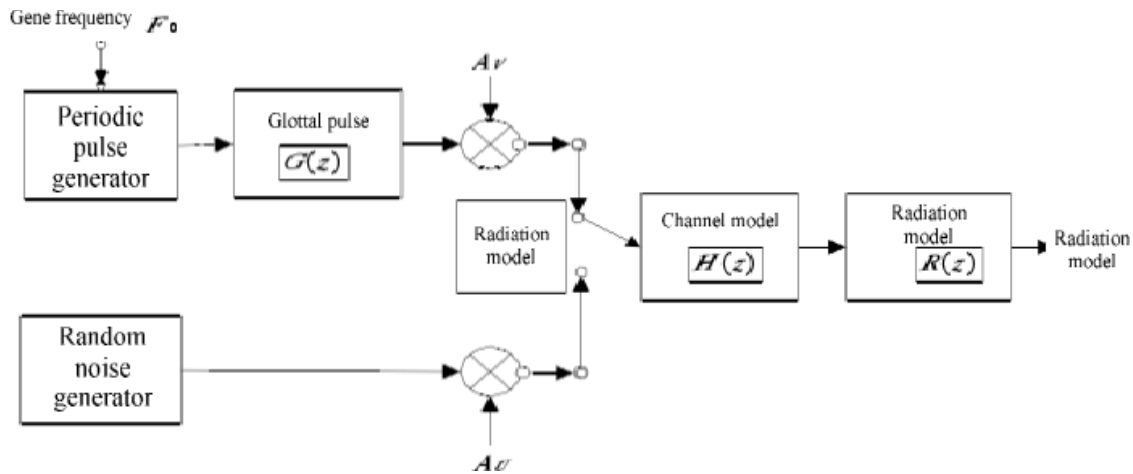


Figure 1 : Speech production model

$U(z)$:excitation signal, $V(z)$: channel transfer function, $R(z)$:radiation impedance obtained by the channel. Voiceless and voiced excitation source has two, as determined by the position of the switch. Random noise generator mean of 0 and variance of an unvoiced excitation signal; voiced excitation signal is an impulse sequence, represented by $E(z)$, model:

$$U(z) = E(z)G(z) \tag{2}$$

Figure 1, V_A denotes amplitude of the voiced signal, U_A and represents the amplitude of unvoiced signals. Channel transfer function is based on the assumption that short-term steady analysis derived. Usually think of the speech signal in a short time (10 ~ 30ms) within the shape of a stable pipeline, which is a quasi-commentary voice steady. $V(z)$ is an all-pole function expressed by the formula:

$$V(z) = \frac{1}{1 - \sum_{k=1}^P a_k z^{-k}} a_0 - 1, a_k \in R \tag{3}$$

The formula, P represents the order, in theory, P values are all-pole filter made larger degree of fit with the channel transfer function model of the actual transfer function is higher, in general, $P = 8$ to 12 on very appropriate; change the channel model parameters a_k is caused by channel mixer. The ratio of the speech signal channel output sound pressure wave and the velocity of the wave is the radiation resistance of the lips end. Lips radiation effect is small in the low frequency end of the impact, the high band is more obvious, the radiation effect of the model is typically a high-pass filter is represented by:

$$R(z) = R_0(1 - z^{-1}) \tag{4}$$

Voice file handling

In this paper, the waveform stored in the .wav format sound files that WAV files. By reading the data analysis file, the voice data represented in digital form. WAV files are RIFF (Resource Interchange File Format) as a standard. A WAV file includes three basic blocks: RIFF block, fmt blocks and data blocks. Four bytes before a WAV file is a RIFF block, fmt blocks and data blocks are included in the RIFF two sub-blocks. WAV file storage structure. Fumet block contains information WAVE FORMATEX structure, such as the waveform data sampling rate, number of channels, sample files, memory length and the like. Data blocks are stored voice data itself, and its end is the end of the RIFF block, namely the end of the WAV file. In reading any WAV file, must be read out fmt, data two blocks.

WAV file data storage structures are in accordance with all Intel's sort of little endian format

Type. This format provides the low byte first store multi-byte data, shown in Figure 3.

Sampling rate WAV files sound signal that the analog voice signal unit time - digital conversion and frequency of sampling value refers to the analog signal integration values within a sampling period. Save the data block format WAV file samples for PCM, namely pulse code modulation. Sample WAV files stored in a length of the integer i . i specify the length of the sample stored for a minimum length. First, the sample is stored in an effective low byte, followed by a representative sample of the stored value in the high-amplitude significant byte; the other remaining position is set to 0.

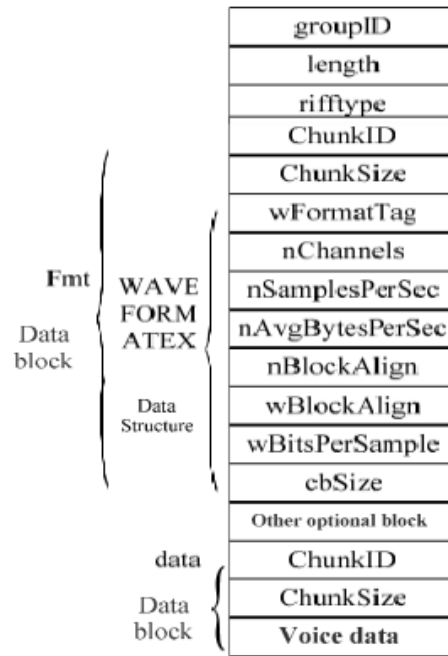


Figure 2 : WAV file structure

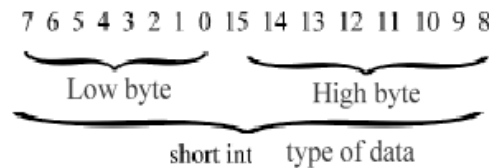


Figure 3 : Storage format

Speaker recognition experimental methods

In this experiment, using relate sound card and a mono microphone for 50 young men were sound acquisition. Everyone is a "school" pronunciation of the word, 20 times per person, 15 times for the training, and the remaining five times for identification. Experiments using MFCC audio library functions within the collected sound with WAV format files for storage, signal sampling frequency is 44100HZ, a median of 16 samples, SNR is 20dB. Voice input feature extraction, according to the order,including pre-emphasis, windowing, sub-frame, endpoint detection. In this experiment, the use of pre-emphasis filter 0.95HZ, using the frame length is 256 points. Since MFCC coefficient ratio LPCC Costrel better results at runtime, more robust, choose a better voice MFCC this performance characteristic parameter represents the way in the experiment, in order to better speaker on behalf of the respective personality traits. MFCC extraction parameters shown in Figure 4.

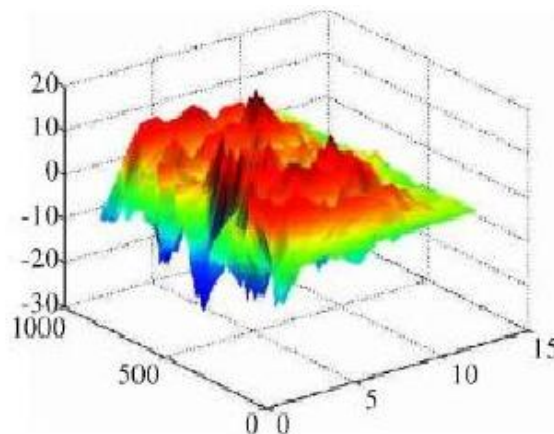


Figure 4 : MFCC Parameters

Conclusions from the above analysis, we can know: the traditional LBG algorithm due to the state space of the objective function extremism points with the code of the length change, easily regarded local optima. Traditional RBF neural network clustering algorithm in this case under the same code also has limitations, ineffective. Improved GA-LBG algorithm and adaptive GA-RBF neural network in the experiment succeeded in raising the codebook and network optimization effect the ability to identify, with great advantage.

RBF NEURAL NETWORK GENETIC ALGORITHM OPTIMIZATION

Feed forward neural network, RBF network usually used, often use a technique called radial basis function (Radial Basis Function, RBF)neural network classifier not only have better classification results, but also has shorter training and recognition time. Radial Basis Function RBF multivariate interpolation method was first proposed by Powell in 1985, 1988 Broom head and Lowe first used in radial basis function neural network designs, constitute RBF neural network. RBF neural networks because of its simple structure, fast convergence, powerful mapping capabilities,the best approximation and the global optimum, are widely used in pattern recognition, function approximation and classification problems in many fields. Radial basisfunction refers to a kind of center of radial functions. Commonly used Gaussian function, reflecting sigmoid functions and quadratic functions and so on. RBF neural network is the use of radial basis function network characteristics as a function of the feed forward constituted. RBF neural network has its own unique features, it only contains a hidden layer and output characteristics is its hidden layer unit with radial basis function, seen RBF neural network is a network of three-fed before, shown in Figure 5.

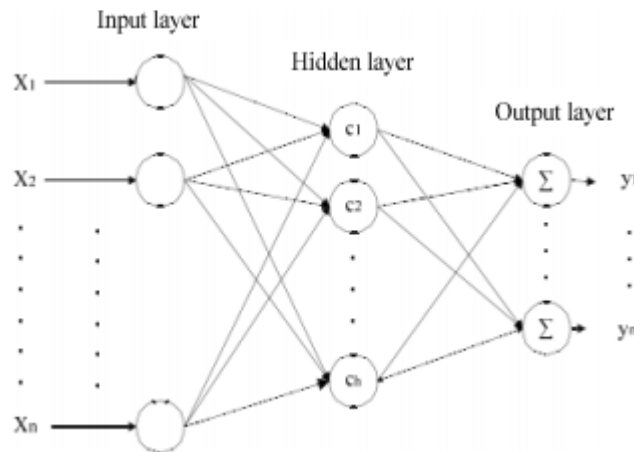


Figure 5 : RBF Network structure

In this paper, the process of genetic algorithm into the training network, RBF network for improvement, to improve its global optimization capability. By using genetic clustering algorithm to train the network hidden layer, using the principle of least squares gradient descent to train the output layer to improve network performance pattern recognition. After genetic clustering algorithm is introduced training process, training algorithm for RBF network:

- 1) According to k-means clustering algorithm, the fitness function is taken as the reciprocal of the total distortion:

$$f = \frac{1}{J_k} \left(\sum_{i=1}^k \sum_{x_i \in \Omega_i} \|X_i - Z_i\|^2 \right)^{-1} \tag{5}$$

Wherein Z, Y chromosome corresponding to the cluster center.

- 2)Through genetic manipulation to make convergence, including the selection operation, crossover and mutation operations in three ways.
- 3) The resulting clusters for each category are as a hidden layer node
- 4) Determine the weights of the network output layer.
- 5) Because the value of the initial population structure of chromosomes and is the cluster category number.

CONCLUSION

In this paper the basic ways in today's computer-aided speech processing were summarized and reviewed and improved genetic algorithm applied to computer-aided speech processing. In speaker recognition technology, for example,

discusses the effects of genetic algorithms to improve recognition accuracy rates. In order to test the accuracy and simplicity, it should be readily available to choose a mode of measurement and analysis. Dispersion curves calculated for the experimental design provides an important basis. A dispersion curve, but also to determine the relative speed mode, to determine the sampling time delay of the received signal, and so on. Combined with improved adaptive genetic algorithm designed to optimize the network training algorithms. Examples of the computer-aided speaker recognition by voice processing applications through improved genetic algorithm LBG algorithm and RBF neural networks were trained and identified.

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