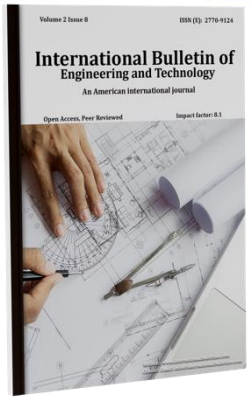

DIGITAL PROCESSING OF SIGNALS USING WAVELET METHODS

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Abstract.
Capabilities and the importance of building a wavelet model, in this paper through digital signal processing, digital signal processing and its. Wavelet models provide high accuracy in digital processing of signals, providing useful information about signal processing and reception. In today's research, the results of comparative analysis of some types of wavelets, which are a daily necessity and are widely used, are discussed. As it relates to digital processing of signals from human body temperature sensors, special attention is paid to signal types in the research work.

Keywords: Types of digital processing to signals, Fure replacement, Weyvlet-substitutions, weyvlet types.

INTRODUCTION

Digital signal processing (DSP) is the processing of data in the digital form of a signal through analytical and operational processes. These processes are used in many industries, such as telecommunications, audio and video processing, biometric technology, and many other applications.Most signals in nature have their analog form, which varies continuously with time and is described by physical quantities, for example, in the form of a sound wave. Analog signals, which are usually used in digital signal processing, are digitized at the same time interval.

Often, processing of digital signals by taking spectrum values or bringing them to a useful form helps to eliminate interferences or noises, to smooth, compress, and identify signals.Today, digital signal processing is used in many areas that cannot be performed with new analog devices, except for those previously used by analog methods. The attractiveness of digital signal processing is due to the following main advantages. Accuracy guaranteed. Accuracy is determined by the number of bits used. Absolute reflection. Digital signal processing to digital recording can be copied or mirrored multiple times without compromising signal quality using transmission methods.

- Flexibility. The possibility of reprogramming the execution of various functions without changing the device through a digital signal processing system.

- High performance. Digital signal processing

signals can be used to perform tasks that cannot be reproduced by analog.

For example, it is used in the implementation of complex adaptive filtering, taking linear spatial characteristics.

Speed and costs. Digital signal processing projects for broadband signals can be expensive. The fast ATSPs (analog-to-digital/digital-to-analog converters) currently used in broadband signal processing are either expensive or lack the processing capability required for broadband signals.

Processing time. If you are not familiar with the digital signal processing methodology or the use of digital processing software tools, it may take a lot of time or not be possible to perform the tasks with quality. The purpose of digital signal processing is to transmit them efficiently through various modifications , consists of storing and extracting information. Digital signal processing methods, which have been widely developed in recent times, have a number of advantages:

- in general, it is possible to implement any complex algorithms of signal processing and there is a base of elements that allows the implementation of these signal processing algorithms in real time;

- digital devices that enable high-resolution operation

creation and availability of algorithms;

- theoretically, digital signals are characterized by the possibility of error-free reproduction as a result of transmission and storage of transmitted messages using destructive codes.

Realizing the above advantages depends on having a basic knowledge of discrete signals and elementary circuits.Qo‘llanilish sohalar:

Digital signal processing (SRIB) is a rapidly developing field in modern electronics and is used in all areas that consist of information in digital form controlled by a digital processor.

At a glance, the field of application of SRIB can be mentioned in other fields besides the ones mentioned above.

Digital signal processing, signal digitization

Digital signal processing performs operations with discrete signal transformation and signal processing systems. The mathematics of discrete transformations appeared in the depths of analog mathematics as early as the 18th century in the framework of series theory and their application to interpolation and approximation of functions, but it had an accelerated development in the 20th century, after the appearance of the first computing machines. It's done.

In general, in its main content, the mathematical apparatus of discrete processing is similar to analog signal and systems in terms of processing.

But data discreteness requires taking into account this situation, and its failure to take into account can lead to serious errors. In addition, a number of methods of discrete mathematics have no analogs in analytical mathematics. In recent decades, computing techniques are a rapidly growing process. The transition to practical methods of digital data processing was a big leap, mainly in the fields of economy and all scientific studies.These are used in various computing, i.e. digital signal processing (SRIB) systems techniques, later in remote sensing during data processing, in med-biological research, aerospace and marine navigation: communication, radiophysics, It is used to solve problems of digital optics and a number of digital fields. Digital Signal Processing (SRIB) is a dynamic recording of transitions as a technician in computer hardware (HT) and in software tools. For digital signal processing and related fields use message theory. These include the theory of optimal signal reception and the theories of visual perception. In this process, its main task is to first identify the background noise and various sound signals in nature, and secondly to classify, equalize and automatically identify the signals.We can observe the effect of signal processing in the following technologies: telecommunications, digital TV and sound recording, biometrics, mobile communication and video systems. These are mainly used in computing devices.

1- table

Field of application	Some processes used in digital processing
scientific activity	Modeling of processes in nature; analysis of underground processes; Analysis of waves is spectral; Creation of databases;
Space research	Clarify images of space objects; Data compression; Analysis of signals received from space probes;
Health care	filtering records and biomedical signals; Diagnosis of various diseases; Analysis and storage of images, visualization of signals; Epidemiological modeling of processes; Analysis of the impact of the external environment on the human body;
Industry	Determining the locations of minerals and estimating their reserves; Automation of design processes; Automation of production and management processes;
Mobile communication	Reducing the size while preserving the informational (data compression); Multiplexing of communication channels; Signal filtering;
Defense	Secure communication; Radiolocation; Targeting; Navigation(location);

- D - analog signal indicator;
- Filter - low frequency filter;
- ARO' - analog digital converter;
- SRIB - digital processing of signals;
- RAO' - digital analog conversion;
- OF - end user;
- Special functions of devices:

The main elements of digital signal processing:

- D - analog signal indicator;
- Filter - low frequency filter;
- ARO' - analog digital converter;
- SRIB - digital processing of signals;
- RAO' - digital analog conversion;
- OF - end user;
- Special functions of devices:

- Indicator - a device for changing physical parameters in proportion to an electrical signal;

- Analog filter - an electrical circuit in reactive elements (L, C, R) that smoothes the analog signal pulse;

SRIB (DSP- Digital Signal Processing) is a signal processor that implements digital signal processing algorithms. Mainly powerful processors are needed.

SIGNAL DIGITALIZATION IS IMPLEMENTED IN THREE STEPS:

1. Time discretization (function argument).
2. Amplitude quantization (function value).

3. Coding.

Discretization is the continuous transformation of discrete functions. It is used in pulse-code modulation of signals in digital devices in hybrid computing systems and data transmission systems. It is used for converting a non-stop analog signal to a discrete one during image transmission or for a discrete non-stop signal. The reverse process is called regeneration. In the process of time discretization, a non-stop analog signal is continuously counted and replaced, and at the same time the magnitude is determined.

Kotelnikov's theorem: The sampling frequency must be twice the frequency of the main signal.

$$F = 2 * f$$

In general, an analog signal can show amplitude functions

(eg: trigonometric and easy enough), the argument shows the region of accuracy with time t.

When we're processing a digital signal, it's obviously an analog signal

it is rendered suitable for processing with limited memory and fast computing devices. Undoubtedly, we have to choose an orderly chisel.

In digital signal processing, the magnitude of the analog signal is selected and played through the correct time interval. This process is called time discretization.

MAIN PROCESSES:

Sampling: Measuring an analog signal at discrete time intervals.

Quantization: Converting measured values to digital format.

Filtering: Separating the desired components of a signal or reducing noise. Transform: For example, converting a signal to the frequency domain using the Fourier transform.

Reconstruction: Converting a digital signal back to an analog form.

Fields of application:

-Audio processing: Music and voice recording.

-Photo and video: Video compression and editing.

-Telecommunications: In the process of signal transmission and reception.

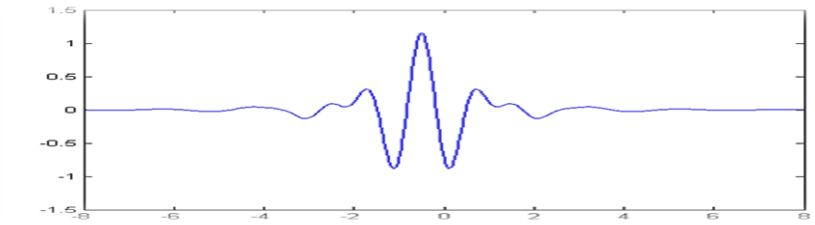
-Medical: Medical image processing.

If you have additional questions or need more information on a specific topic, feel free to ask!

Digital processing is the process of converting signals such as sound, images or other data into numbers. This process consists of the following main steps:

Signal Acquisition: Converting an analog signal to a digital format. This is done using an ADC (Analog-to-Digital Converter).

Signal Filtering: Various filtering techniques are used to remove unwanted noise from the signal. This includes, for example, low-pass or high-pass filtering.Signal Analysis: Digital signal analysis using various algorithms. For example, identifying frequency components by Fourier transform. Signal processing: Converting a signal to a desired format, such as compression, modulation, or encoding. Signal extraction: Converting a digital signal back into analog form. This is done using a DAC (Digital-to-Analog Converter). Digital processing plays an important role in the fields of science and technology today. refers to the representation of signal information in the form of a sequence of numbers or characters. Digital signal processing. The purpose of digital processing of signals is to store and extract useful information, and to transmit them with quality through various changes. Algorithms for digital processing of signals are used in programs, new technologies in various fields. Digital work, which combines many methods and technologies in its fields, gives impetus to the wide development of science and technology. Its attractiveness is tied to the following basic amenities.



2-picture Infinite wavelet reduction wavelet

Infinite Wavelet Reduction Wavelet A wavelet is like the Fourier transform (simple in many ways), but consists of functions with a compact appearance, which can be used not only for periodic functions, but also for non-periodic functions.Wavelets are used in engineering problems of digital information processing theory, numerical solutions of differential equations, approximation theory and some theoretical problems of function theory. Wavelet transforms are based on the definition of two functions that are continuous and integrable along the entire time axis:

$$\int_{-\infty}^{\infty} \psi(t)dt = 0 \qquad (1)$$

"parent" wavelet function ps(t) satisfying the condition; $\psi(t)$ wavelet function;

$$\int_{-\infty}^{\infty} \varphi(t)dt = 1 \qquad (2)$$

conditional "father"$\varphi(t)$ scale-function.

Using the functions (1) and (2), the signal function s(t)

$$s(t) = \sum_{k} a_k \varphi_k(t) + \sum_{k} d_k \psi_k(t) \qquad (3)$$

(3) can be expressed in the formula. Wavelet-transforms mainly $\psi(t)$ differs depending on the appearance of the function.

Nowadays, wavelet methods are widely used. There are more than 500 types of wavelets in the world. Today, wavelet types such as Haar, Dobeshi, Mexican Hat, Mayer, Coiflet, and Simplet are widely used. In the study, some of them are described in order to select wavelet types suitable for the following visible signals.

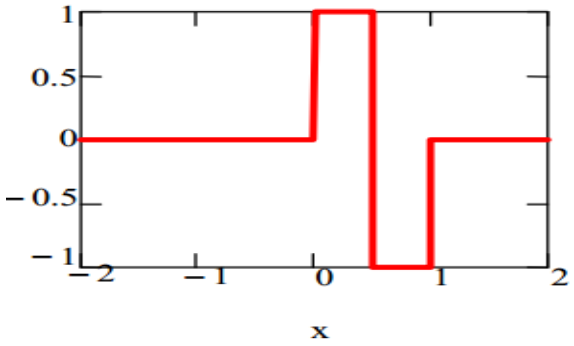
Haar wavelet is one of the first and simplest wavelets. It is based on an orthogonal function system. The process of wavelet transformation of signals, proposed by the mathematician Alfred Haar in 1909, relies on the use of two types of functions: a wavelet function and a scaling function, that is, they are a single wavelet function.$\psi(t)$ - is constructed by time-shifting along the signal and changing the time scale a.

$$\psi_{ab}(t) = \frac{1}{\sqrt{|a|}} \psi\left(\frac{t-b}{a}\right) \qquad (4)$$

There are fast Haar wavelet transformation algorithms, and its orthogonal wavelets are widely used in solving practical problems. (5) - the scaling function is presented in the

$$\text{formula.}\varphi^{H}(x) = \begin{cases} 1, & if \ \ 0 \le x < \frac{1}{2} \\ -1, & if \ \ \frac{1}{2} \le x < 1 \\ 0, if\ x < 0, x \ge 1 \end{cases} \qquad (5)$$

3- the figure shows the plot of the Haar wavelet.



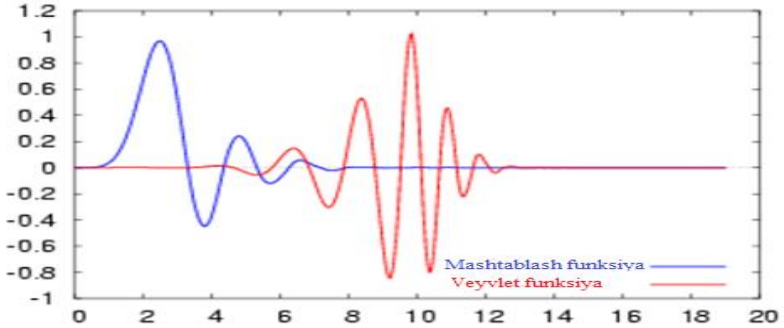
3- picture. Haar wavelet plot

Dobeshi waveletsda φ(t) va ψ(t) functions will look like this:

$$\varphi(t) = \sqrt{2} \sum_{k} h_k \varphi(2t - k) \qquad (6)$$

$$\psi(t) = \sqrt{2} \sum_{k} g_k \ \psi(2t - k) \qquad (7)$$

Graphs of Dobeshi wavelet scaling and wavelet functions are presented (see Figure 4).



4- picture

Plots of Dobeshi wavelet scaling function (in blue) and wavelet function (in red)

The results of the comparative analysis of some wavelet types that are widely used today are given in the research work. Some wavelet methods f(*x*)=e^{x} function [0,1] in between h=0.1 wavelet with step results of comparative analysis of interpolation methods 1.2- given in the table.

2- table

x(i)	f(x)=e^x	bior	coif	db	Xaar	Meyir	rbior	sym
0	1	1,09169209	1,14052611	1,05292556	1,05258546	0,99580578	1,06355893	1,04153967
0,1	1,10517092	1,11021013	1,14792416	1,07242214	1,05258546	1,06180813	1,1354536	1,04288143
0,2	1,22140276	1,12872817	1,12504621	1,22637938	1,28563078	1,18008241	1,23534906	1,24291528
0,3	1,34985881	1,31846335	1,32688901	1,344308	1,28563078	1,34105196	1,3511376	1,38970975
0,4	1,4918247	1,50819853	1,51383187	1,49790316	1,57027298	1,53191087	1,47526029	1,48326483
0,5	1,64872127	1,69793371	1,66530081	1,6419415	1,57027298	1,73769384	1,65006058	1,59108536
0,6	1,8221188	1,88766889	1,81136712	1,82954305	1,91793575	1,94235126	1,90426915	1,86643839
0,7	2,01375271	2,07740407	2,0103331	2,00547187	1,91793575	2,13003488	2,08061986	2,09690122
0,8	2,22554093	2,26713925	2,19725349	2,25247669	2,34257202	2,28622471	2,20706817	2,28247385
0,9	2,45960311	2,45687442	2,43293658	2,48043675	2,34257202	2,39891816	2,32905837	2,48007478
1	2,71828183	2,6466096	2,72011253	2,61923232	2,71828183	2,4594747	2,44135713	2,53249793

In this research work, the development of areas and areas of application of digital signal processing, digital processing methods were analyzed, and detailed information was given about the types of wavelet methods and their importance.

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