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DEVELOPMENT PROSPECTS OF THE DIGITAL SIGNAL PROCESSING

Abstract: This article provides a brief description of digital signal processing, discusses its relevance, traced its evolution and development prospects, and describes the advantages and disadvantages of DSP in various fields of application.

Key words: digital signal processing, usage of DSP, advantages of DSP, problems of DSP.

What is digital signal processing? Many people have heard about it, but never thought about where it is used and why it is needed.

Just two decades ago, digital signal processing (DSP) was something out of science fiction. Only massive mainframes and supercomputers were able to process the signal and even then, much of the processing was done not in real time, but off-line. For example, seismic data was collected in the field, stored on magnetic tapes and then taken to a computing center, where a mainframe might take days to digest the information. And 20-30 years ago the main deterrent to the introduction of digital processing methods was the lack of the required element base; 10-15 years ago there was the lack of effective algorithms providing the solution of a number of applied problems [4]. And now there are no such global problems, and nowadays DSP is used almost everywhere, namely in [3]:

- Medicine (diagnostic imaging, electrocardiogram analysis, medical image storage);
- Space (space photograph enhancement, data compression, intelligent sensory analysis by remote space probes);
- Commerce (image and sound compression for multimedia presentation, movie special effects, video conference calling);
- Telephoning (voice and data compression, echo reduction, signal multiplexing, filtering);

- Military (radar, sonar, ordnance guidance, secure communication);
- Industrialization (oil and mineral prospecting, process monitoring and control, nondestructive testing, design tools)
- Science (earthquake recording, data acquisition, spectral analysis, simulation and modeling).

All of us take the advantage of DSP a lot of times a day, but most people do not know that this technology is used in their everyday activities, using cell or smart phones, computers, cable or satellite television, charge cards, digital cameras, Global Positioning System (GPS) and video games [2]. And it is evident that Digital Signal Processing is one of the most perspective technologies that will shape science and engineering in the twenty-first century.

Digital signal processing is the study of signals in a digital representation and the processing methods of these signals. DSP manipulates different types of signals with the intention of filtering, measuring, or compressing and producing analog signals. Analog signals differ by taking information and translating it into electric pulses of varying amplitude, whereas digital signal information is translated into binary format where each bit of data is represented by two distinguishable amplitudes. Another noticeable difference is that analog signals can be represented as sine waves and digital signals are represented as square waves [1].

On the one hand, all the invented algorithms work fine and there is no need to invent something new, but on the other hand digital signal processing is highly numerical and very repetitive. As each new piece of signal data arrives, it must be multiplied, summed, and otherwise transformed according to complex formulas.

DSP systems must work in real time, capturing and processing information as it happens. Analog-to-Digital converters and DSPs must keep up with the work flow. If they fall behind, information is lost and the signal gets distorted. Some equipment requires a DSP to perform hundred billions of cycles per second range. Moreover, there are problems of narrowband signal filtering and designing multidimensional filters. And for each of these problems there are dozens of developers who offer solutions. For example, every year (in 2018, the twentieth conference will be held), a conference is held in Moscow, it is called "DIGITAL SIGNAL PROCESSING AND ITS APPLICATION." Not only Russian but also

foreign scientists take part in this conference. They present reports on 10 main topics:

- Theory of Signals and Systems;
- Processing and transmission of measurement information;
- Theory and methods of DSP; Design and technical implementation of DSP systems;
- Signal processing in telecommunication systems;
- Systems of technical vision, artificial intelligence and robotics;
- Signal Processing in Radio Engineering Systems;
- Digital processing of multidimensional signals;
- Image processing and transmission;
- Neurocomputer signal and image processing

Moreover, research on DSP algorithms for optical communications is currently flourishing, with the aim of further increasing bandwidth-efficiency and performance, while at the same time reducing power consumption of the digital receiver.

On the basis of just one conference you can solve a huge number of tasks. But why this does not happen? Here comes the main problem. This is the conservatism of developers who prefer to use traditional approaches. Investors are in no hurry to spend money on developments, which, perhaps, will not be used anywhere. Even if the development will be executed, then a large amount of money and time will be required for their implementation. In addition, by the time the global implementation may appear more promising developments since the DSP is developing at a high speed [5]. Besides, not all developments can be tracked at all, because much is done at home, without the participation of any educational institutions or enterprises and many of these people do not have the opportunity to convey their message to the world because of the lack of opportunities.

Thus, on the one hand, we have an excellent, rapidly developing industry, but on the other hand, external factors hinder the development of this industry. And in my opinion, only engineers and programmers can solve this problem at the moment.

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ПЕРСПЕКТИВЫ РАЗВИТИЯ ЦИФРОВОЙ ОБРАБОТКИ СИГНАЛОВ

Аннотация: в данной статье приводится краткое описание цифровой обработки сигналов. Рассматриваются ее актуальность, прослеживается ее эволюция и перспективы развития. Описаны достоинства и недостатки ЦОС в различных отраслях применения.

Ключевые слова: цифровая обработка сигналов (ЦОС), применение ЦОС, преимущества ЦОС, проблемы в сфере ЦОС.

СПИСОК ЛИТЕРАТУРЫ:

1. David Skolnick. DSP 101 Part 1: An Introductory Course in DSP System Design. Analog Dialogue, 1997.
2. Donald Krambeck. An Introduction to Digital Signal Processing. All about circuits, 2015.
3. Fred Harris. Digital Signal Processing in Radio Receivers and Transmitters. International Journal of Wireless Information Networks, pp 133–145, 1998.
4. Richard G. Lyons, D. Lee Fugal. The Essential Guide to Digital Signal Processing. Published May 15, 2014 by Prentice Hall. Part of the Essential Guide Series.
5. Steven W. Smith, Ph.D. The Scientist and Engineer's Guide to Digital signal processing, 2002.