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Review paper on digital signal processing

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1 Introduction

Digital signal processing (DSP) is the mathematical manipulation of an information signal to modify or improve it in some way. It is characterized by the representation of discrete time, discrete frequency, or other discrete domain signals by a sequence of numbers or symbols and the processing of these signals.

The goal of DSP is usually to measure, filter and/or compress continuous real-world analog signals. Usually, the first step is conversion of the signal from an analog to a digital form, by sampling and then digitizing it using an analog-to-digital converter (ADC), which turns the analog signal into a stream of discrete digital values. Often, however, the required output signal is also analog, which requires a digital-to-analog converter (DAC). Even if this process is more complex than analog processing and has a discrete value range, the application of computational power to signal processing allows for many advantages over analog processing in many applications, such as error detection and correction in transmission as well as data compression Digital signal processing and analog signal processing are subfields of signal processing. DSP applications include audio and speech signal processing, sonar and radar signal processing, sensor array processing, spectral estimation, statistical signal processing, digital image processing, signal processing for communications, control of systems, biomedical signal processing, seismic data processing, among others. DSP algorithms have long been run on standard computers, as well as on specialized processors calleddigital signal processors, and on purpose-built hardware such as application-specific integrated circuit (ASICs). Currently, there are additional technologies used for digital signal processing including more powerful general purpose microprocessors, field-programmable gate arrays (FPGAs), digital signal controllers (mostly for industrial applications such as motor control), and stream processors, among others.[2]

Digital signal processing can involve linear or nonlinear operations. Nonlinear signal processing is closely related to nonlinear system identification[3] and can be implemented in the time, frequency, and spatio-temporal domains.

2 Advantage of Digital OverAnalog Signal Processing

1. The main advantage of digital signals over analog signals is that the precise signal level of the digital signal is not vital. This means that digital signals are fairly immune to the imperfections of real electronic systems which tend to spoil analog signals. As a result, digital CD's are much more robust than analog LP's.

2. Codes are often used in the transmission of information. These codes can be used either as a means of keeping the information secret or as a means of breaking the information into pieces that are manageable by the technology used to transmit the code, e.g. The letters and numbers to be sent by a Morse code are coded into dots and dashes.

3. Digital signals can convey information with greater noise immunity, because each information

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component (byte etc) is determined by the presence or absence of a data bit (0 or one). Analog signals vary continuously and their value is affected by all levels of noise.
4. Digital signals can be processed by digital circuit components, which are cheap and easily produced in many components on a single chip. Again, noise propagation through the demodulation system is minimized with digital techniques.

5. Digital signals do not get corrupted by noise etc. You are sending a series of numbers that represent the signal of interest (i.e. audio, video etc.)
6. Digital signals typically use less bandwidth. This is just another way to say you can cram more information (audio, video) into the same space.
7. Digital can be encrypted so that only the intended receiver can decode it (like pay per view video, secure telephone etc.)

8. Enables transmission of signals over a long distance.
9. Transmission is at a higher rate and with a wider broadband width.

10. It is more secure.
11. It is also easier to translate human audio and video signals and other messages into machine language.
12. There is minimal electromagnetic interference in digital technology.
13. It enables multi-directional transmission simultaneously.

3 Applications

The main applications of DSP are audio signal processing, audio compression, digital image processing, video compression,speech processing, speech recognition, digital communications, radar, sonar, financial signal processing, seismology andbiomedicine. Specific examples are speech compression and transmission in digital mobile phones, room correction of sound in hi-fi and sound reinforcement applications, weather forecasting, economic forecasting, seismic data processing, analysis and control of industrial processes, medical imaging such as CAT scans and MRI, MP3 compression, computer graphics,image manipulation, hi-fi loudspeaker crossovers equalization, and audio effects for use with electric guitar amplifiers.

4 Implementation

Depending on the requirements of the application, digital signal processing tasks can be implemented on general purpose computers.

Often when the processing requirement is not real-time, processing is economically done with an existing general-purpose computer and the signal data (either input or output) exists in data files. This is essentially no different from any other data processing, except DSP mathematical techniques (such as the FFT) are used, and the sampled data is usually assumed to be uniformly sampled in time or space. For example: processing digital photographs with software such as *Photoshop*.

However, when the application requirement is real-time, DSP is often implemented using specialized microprocessors such as the DSP56000, the TMS320, or the SHARC. These often process data using fixed-point arithmetic, though some more powerful versions use floating point. For faster applications FPGAs[5] might be used. Beginning in 2007, multicore implementations of DSPs have started to emerge from companies including Freescale and Stream Processors, Inc. For faster applications with vast usage, ASICs might be designed specifically. For slow applications, a traditional slower processor such as a microcontroller may be adequate. Also a growing number of DSP applications are now being implemented on embedded systems using powerful PCs with multi-core processors.

5 Techniques

- Bilinear transform
- Discrete Fourier transform
- Discrete-time Fourier transform
- Filter design
- LTI system theory
- Minimum phase
- Transfer function
- Z-transform
- s-plane

6 Related Fields

- Analog signal processing
- Automatic control
- Computer Engineering
- Computer science
- Data compression
- Dataflow programming
- Electrical engineering
- Fourier analysis
- Information theory
- Machine learning
- Real-time computing
- Stream processing
- Telecommunication
- Time series
- Wavelet

7 References

[1.] James D. Broesch, Dag Stranneby and William Walker. *Digital Signal Processing: Instant access*. Butterworth-Heinemann. p. 3.

[2.] Dag Stranneby and William Walker (2004). *Digital Signal Processing and Applications* (2nd ed. ed.). Elsevier. ISBN 0-7506-6344-8.

[3.] Billings S.A. "Nonlinear System Identification: NARMAX Methods in the Time, Frequency, and Spatio-Temporal Domains". Wiley, 2013

[4.] Oppenheim, Alan V.; Schafer, Ronald W.; Buck, John R., *Discrete-Time Signal Processing* (3rd ed.), p. 15

[5.] JpFix. "FPGA-Based Image Processing Accelerator". Retrieved 2008-05-10.

[6.] Richard G. Lyons: *Understanding Digital Signal Processing*, Prentice Hall, ISBN 0-13-108989-7

[7.] Jonathan Yaakov Stein, *Digital Signal Processing, a Computer Science Perspective*, Wiley, ISBN 0-471-29546-9

[8.] Sen M. Kuo, Woon-SengGan: *Digital Signal Processors: Architectures, Implementations, and Applications*, Prentice Hall, ISBN 0-13-035214-4

[9.] Bernard Mulgrew, Peter Grant, John Thompson: *Digital Signal Processing - Concepts and Applications*, Palgrave Macmillan, ISBN 0-333-96356-3

[10.] Steven W. Smith (2002). *Digital Signal Processing: A Practical Guide for Engineers and Scientists*. Newnes. ISBN 0-7506-7444-X.

[11.] Paul A. Lynn, Wolfgang Fuerst: *Introductory Digital Signal Processing with Computer Applications*, John Wiley & Sons, ISBN 0-471-97984-8

[12.] James D. Broesch: *Digital Signal Processing Demystified*, Newnes, ISBN 1-878707-16-7

[13.] John G. Proakis, DimitrisManolakis: *Digital Signal Processing: Principles, Algorithms and Applications*, 4th ed, Pearson, April 2006, ISBN 978-0131873742

[14.] Hari Krishna Garg: *Digital Signal Processing Algorithms*, CRC Press, ISBN 0-8493-7178-3

[15.] P. Gaydecki: *Foundations Of Digital Signal Processing: Theory, Algorithms And Hardware Design*, Institution of Electrical Engineers, ISBN 0-85296-431-5

[16.] Paul M. Embree, Damon Danieli: *C++ Algorithms for Digital Signal Processing*, Prentice Hall, ISBN 0-13-179144-3

[17.] Vijay Madisetti, Douglas B. Williams: *The Digital Signal Processing Handbook*, CRC Press, ISBN 0-8493-8572-5

[18.] StergiosStergiopoulos: *Advanced Signal Processing Handbook: Theory and Implementation for Radar, Sonar, and Medical Imaging Real-Time Systems*, CRC Press, ISBN 0-8493-3691-0

[19.] Joyce Van De Vegte: *Fundamentals of Digital Signal Processing*, Prentice Hall, ISBN 0-13-016077-6

[20.] Ashfaq Khan: *Digital Signal Processing Fundamentals*, Charles River Media, ISBN 1-58450-281-9

[21.] Jonathan M. Blackledge, Martin Turner: *Digital Signal Processing: Mathematical and Computational Methods, Software Development and Applications*, Horwood Publishing, ISBN 1-898563-48-9

[22.] Doug Smith: *Digital Signal Processing Technology: Essentials of the Communications Revolution*, American Radio Relay League, ISBN 0-87259-819-5