CCET JOURNAL OF SCIENCE AND ENGINEERING EDUCATION
(ISSN 2455-5061) *Vol. - 3, Page-58-59, Year-2018*

Innovative Trends in Digital Signal Processing

Dolly Reney

Assistant Professor, E&TC Dept., Christian College of Engineering & Technology, Bhilai, ,CG, India, d_reney@rediffmail.com

Abstract

The field of digital signal processing (DSP) has been a very vigorous area of research and application for more than 5 decades. This comprehensive development has paralleled in time the rapid development of high-speed electronic digital computers, microelectronics, and integrated circuit fabrication technologies. An ever-increasing range of integrated circuits specifically custom-made to perform common DSP functions is available to the design engineer as system building blocks or parts-in-trade. DSP methodologies have been applied to consumer electronics, communications, automotive electronics, instrumentation, medical electronics, tomography and acoustic imaging, cartography, seismology, speech recognition, robotics etc. In this paper a brief overview of the initial developments in DSP, followed by a review of some of the important advances made during almost sixty-year period of its growth, and describe a number of key applications. Paper concludes with a conjecture on the future trends and directions.

Index Terms: *Digital Signal Processing, Microelectronics, Integrated circuit fabrication, Medical Electronics*

1. Introduction

Digital signal processing (1-D and 2-D) is pretentious a new role in research and applications due to several circumstances: — the present impact of 1-D techniques in consumer electronics (mainly in digital audio) and in telecommunications, where, due to the high volumes of production, complex algorithms can be efficiently implemented in VLSI, and the estimated extension of 2-D techniques into the video area (digital video disks, interactive video, etc.); — the increasing prominence of images in many applications with the corresponding emphasis on the development of efficient algorithms). This is made possible by the parallel development of related technology (circuitry and computer aided design facilities), with costs and performances suitable for many application fields. The following examples can be considered: — the impact of DSP chips, which, due to their decreasing costs and increasing performances, contribute to the application of digital techniques also where volumes of production are not accustomed with custom implementations (e.g. in measurement instrumentation, biomedicine and industrial non-destructive tests); — the development of new technologies (standard cells, gate arrays) for the production of semi-custom circuitry, in applications where full custom VLSI are not economically viable; — the increase of performances of available technologies (e.g. CMOS), the development of new high speed technologies (e.g. GaAs) and the development of parallel processing approaches. Obviously it is not possible to review in the short space at our disposal all the possible activities in signal processing, this paper tries only to point out some topics, which can be interesting as a starting point for future in depth analyses and discussions, with main emphasis on implementation problems.

2. Assessment Of Signal Processing Techniques

Many techniques are now accessible to process signals and images. Several forms of transforms have been defined (Fourier transform, Hadamard transform, Walsh transform, Haar transform, slant transform, Karhunen-Loeve transform, SVD — singular value decomposition), which are used in measurement applications, in data compression and as building blocks of complex processing operations. Fast algorithms have been defined, excluding only the Karhunen-Loeve transform. Of particular interest in this field (mainly in the 2-D case) is the exploration of implementation architectures, which allow an efficient use in real-time applications. Digital filtering is a second dispensation technique, of fundamental importance in 1-D and 2-D applications. The basic theory of design and implementation of corresponding algorithms is now available [1, 2] and some applications are now reaching the level of consumer electronics.

Of increasing interest are also 2-D local space operators performing nonlinear filtering operations. This is a common trend in many applications where nonlinear filtering (e.g. median filtering) is becoming very important.

Digital filtering (mainly decimation and interpolation) is the basis of algorithms for geometrical transformations, which are very important in 2-D processing for presentation problems and in applications where images from different sources have to be correlated (e.g. in remote sensing, where often images with different resolution have to be compared).

In the case of locally connected systems it is necessary to incorporate the problem of communication in the study of the building blocks, to be used in the setting up of the entire structure. In the case of networks of processors, it is necessary again to take into account these considerations in the segmentation of the algorithms so as to minimize the communication between the processing nodes and it is necessary to optimize the transfer of information to minimize the time when processors are idle, waiting for data to be processed.

3. Implementation Architectures and Components

Several options are now available for the implementation of signal and image processing operations, which cover important application fields with different levels of prices and complexity [1, 5].

Most of the work in the design of signal processing algorithms was based on the following assumptions:

— that the implementation had to be done on computers or computer like architectures;

— that the most demanding part of the effort in the implementation was in the arithmetic computations and therefore their number had to be minimized.

The situation started to change with the diffusion of image processing, because, in conventional systems the time to access the disk was in many cases predominant with respect to the arithmetic processing time. This is now the rule, both with DSPs (digital signal processors) and special purpose architectures, where the number of arithmetic operations is no more a correct figure of merit for the evaluation of relative efficiency of algorithms.

a) Unconstrained architectures: - In this class, at least in value, no constraints (in terms of control or arithmetic) are imposed by the available components, obviously excluding speed limitations. This means that any architecture can be designed to be adapted to the chosen algorithm.

b)Constrained architectures: - This class consists of the implementations based on: — general purpose computers, minicomputers and microcomputers; — digital signal processors. So far, theloops, averaging, arbitrary waveform generation, transient analysis are particularly important measurement in many measurement applications and digital instrumentation is widely becoming available.

4. Conclusions

As appears from the above synthetic considerations, the area of digital signal processing is very important at the present time and yet more in the near future. Practically, with the fast improvement of digital signal processors (increased processing speed, size reduction and lower cost), near all possible applications can be covered extending from low to high frequency signals and from static to dynamic images. Indeed, a continuous trend is represented by the multidimensional signal processing: i.e. more and more 3-D processing algorithms are currently used (as in communications, remote sensing and robotics). Looking forward to the long term future, optical, signal processing will become very important in particular for increasing the processing speed, being performed not only in analog form (as available also atthe present time), but also in digital form (with the implementation of an optical digital computer).

References

[1] V. Cappellini, A. G. Constantinides and P. L. Emiliani: Digital Filters and Their Applications. Academic Press, London 1980.

[2j V. Cappellini and P. L. Emiliani: Two-dimensional digital systems and applications: The state of Art. In: Multidimensional Systems (S. Tzafestas, ed.), Marcel Dekker Inc., New York1985, Chap. 1.

[3] W. K. Pratt: Digital Image Processing. Wiley, New York 1978.

[4] G. Benelli, V. Cappellini and E. Del Re: Data compression techniques. In: Data Compression and Error Control Techniques with Applications (V. Cappellini, ed.), Academic Press, New York 1985, Chap. 3.

[5] V. Cappellini and E. Del Re: Hardware implementation of data coiv.pression and error control techniques. In: Data Compression and Error Control Techniques with Applications (V. Cappellini, ed.), Academic Press, New York 1985, Chap. 3.

[6] V. Cappellini and A. N. Venetsanopoulos: Some high-efficiency two-dimensional digital filters with applications to biomedical image processing. In: CAR'85, 1985 (H. V. Lemke, M. L. Rhodes, C CJaffee and R. Felix, eds.), Springer-Verlag, Berlin —Heidelberg—New York 1985, p. 485.

[7] V. Cappellini: Internat. J. Remote Sensing *1* (1980), 175.

[8] V. Cappellini and A. Del Bimbo: Digital processing of time varying images. In: Issues in Acoustic Signal/Image Processing and Recognition, S. Miniato, Italy, 1983 (C H. Chen,ed.), Springer-Verlag, Berlin—Heidelberg—New York 1983, p. 283.