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Adaptive Weight Computation Processor for Medical Ultrasound Beam former: VLSI Architecture and FPGA implementation.

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Abstract:- *We find difficult to detect and diagnosis the disease in olden times ,our human body is sensitive and there are lot of obstacles in which we fail to understand the disease as well as the activities that are going inside our body, so recently scientists have found out how ultrasound can be useful in medical field .In this paper we discuss about the beam former technology using VLSI architecture and FPGA implementation.*

Index terms:- *FPGA(field programmable gate array),ultrasound, disease, obstacles, VLSI(very large scale integration)*

I. Introduction.

As we are living in 21st century ultrasound plays an important role, it may be considered as a boon to the human civilization .As years passes human witness new more technologies but invention of ultrasound remains a benchmark .Medical science have huddled a lot before the invention of ultrasound as you see now the functioning of many devices are smooth and easily .We may say that medical field have widened the horizon and we are fishes which dwelling in the sea. In olden times there were no devices to detect the defect in our body such as tumor, kidney stone, thyroid enlargement ,fetus position etc. The ultrasound scanner mainly depend on pulse echo principle . So there a question arises what is the difference between ultrasound, sonar and radar ?.Ultrasound scanner is a medical RADAR/SONAR. The SONAR/RADAR works based on pulse echo principle , and SONAR operates in khz ultrasound scanner in Mhz and RADAR in GHZ range . The ultrasound system that is now available in the market is compact and easy to handle so that we may find in ambulance ,in the corner of doctors office and in future we may find it in suitcase . The specialty of the ultrasound system is that in some model we may be able to visualize the ECG with in seconds. The main idea behind the ultrasound system is that it uses medical imaging technology. In which ultrasound penetrate though the body tissue reaches the target and it bounce back so that an image of the particular target is produced .The Beauty in the imaging technology is that we will be able to view the image that is produced former by 2D,3D,4D vision. But we can point out that the first preference /reference is give to the 2D imaging , 3D and 4D we will be able to view in real time .The interesting fact is that even animal can produce ultrasound in order to find a sex mate ,food, location which by means of echo location. Reducing the size of the components we may visualize the blood vessel ,heart ,esophagus .This paper mainly discuss about the scope ,architecture and The implementation .Here the figure shows the ultrasound machine.

Explanation of the block diagram. Echoes arrive at transducer elements at elements at different times depending on the location of a target point and the elements position on the transducer. Here the center elements receives the eco from the target point sooner than off center elements receiver the echo last. By applying a proper time delay to each channel the received echoes are aligned properly before they are summed up coherently .As a result higher SNR and better. Spatial resolution are obtained leading to improved image quality.

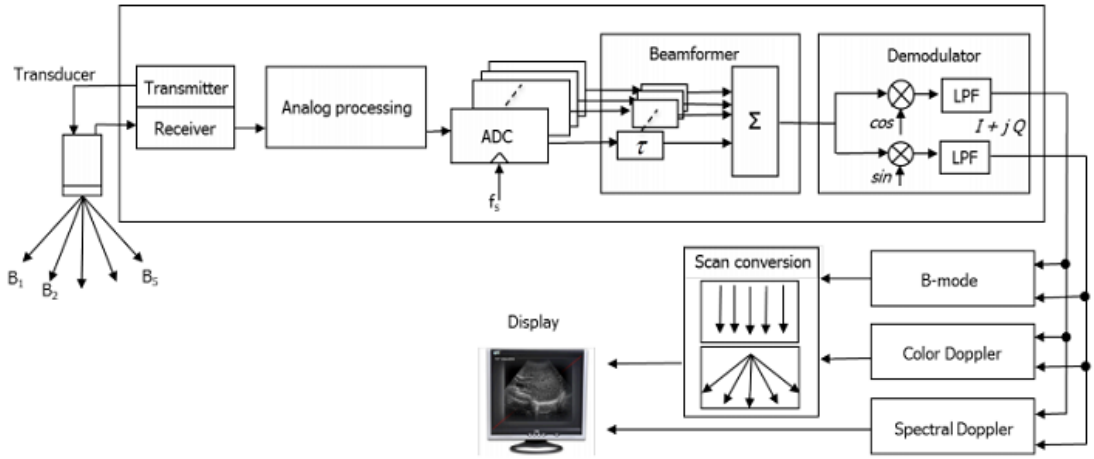

Figure 1: Ultrasound machine

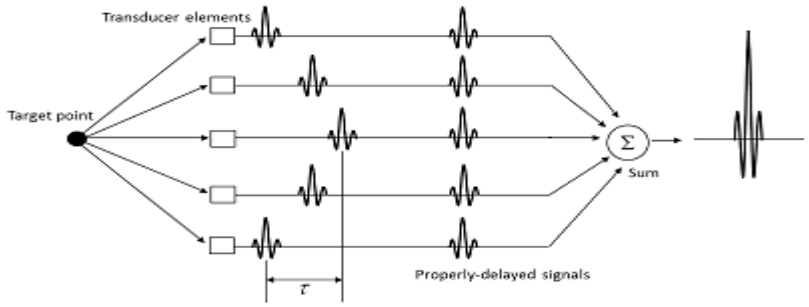

Figure 2: Schematic diagram with 5 channels illustrating the principle of beamforming

II. Ultrasound Beamformer

Ultrasound Imaging was born ages ago Still It Is taken as a reference for unaware disease that cannot be visualized by human eyes. We may understand that beam former Is the Important component and its architecture can be considered as the base of the device. As we all know that in olden times analog where considered as the mother of all earthly devices Because of drastic development in the industries and the requirements where more .we shifted our thought to digital because of so many means the main reason that we can point out is that.

If we consider all the devices in olden times and in present world there is a tremendous change in the design to model of a beam former .Main consideration for today imaging technique is that we will able to view the image in 4D.But we have to make sure that 2d and 4d images have to be taken as reference. We may be thinking why beam former is significant in ultrasound imaging its mainly because it's a signal processing technique used for transmission and reception of signal which is very important in the case of antenna here it is a transducer which act as a former [1] .

III. Adaptive Beamformer

Similar to beam former adaptive beam former is a technique of signal processing with an array of transmitter and receiver[2].when we consider adaptive beam former and ordinary may get high resolution when , side lobe is eliminated and compressing the main lobe. Adaptive Beam former incorporating ultrasound will result in a ultrasound scanner which is used mainly by doctors to detect malfunctioning of the body.

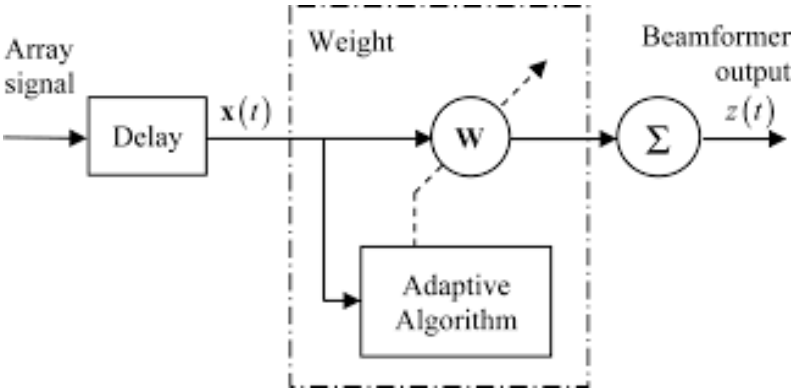

Figure 3: Adaptive weight computation

IV. Adaptive Weight Computation.

Adaptive weight computational (AWD) is mainly used for communication purpose mainly for adaptive beam former, equalization, predistortion, MIMO. The application deals with solving determined system of equations .In least squares approach eg least mean squares(LMS), wormalized LMS and recusive least squares (RLS) is used to find an approximate solution to these kinds of system of equations. Among them RLS is most commonly used done to its good numerical properties and first convergence rate. However it requires matrix inversion which is not efficient in terms of precision and hardware implementation [3] .

V. Vlsi Architecture For Adaptive Beamformer.

For decades the technology was facing a lot of problem mainly in the field of computers which was a pioneer for the human development discovered by Charles Babbage but it was overcome to an extent by the discovery of VLSI[4].We may say that VLSI chips where used to fill the gap between microprocessor and high cpu end[4].

Phase array technique have been used extensively now a days main idea behind transducer is that here we are using phase array transducer ie phase we refer to timing and array we refer to many elements[5].In non phased array (monolithic probes)we may have to move or turn the probe in order for diagnosis purpose but in the case of modern transducer ie most advanced transducers with multiple probe we just have to fix the transducer to the correct position without moving the probe here beam covers a large area[4].

VI. Fpga Implementation .

As we know that d sp (digital signal processing) has lot of application in high definition digital cameras ,tv, cell phones speech recognition most widely used hardware designing technology is FPGA(field programmable gate array it got flourished circuit design and along with that architecture. In recent years FPGA cope up with the needs of the users

The main postulates are -:

1. High definition.
2. Clarity.
3. Long life.
4. Precisely speaking of ease to use.
5. Reliability .
6. Less harm.

We may consider that "FPGA" implementation are benchmark for DSP (digital signal processing).

VII. Literature Review

Ultrasound is inevitable in the present era mainly in medical field here in this paper we discuss about the medical ultrasound scanning which is done in FPGA implementation using DCD algorithm. In this paper we are mainly depending upon the DCD (dichotomous coordinate descent) algorithm which is free from multiplication and addition technique so it is well suited for hard ware implementation [6]. FPGA (field programmable gate array) implementation of two variants of the DCD algorithm .known a cyclic and leading DCD algorithm for real valued and complex valued system. For which architecture and implementation with different degree of parallelism. Another approach we can point out is fixed point implementation ,but it is difficult to implement in real time approach, here fixed point implementation provide an accuracy performance which is very close to the performance of floating counterparts [6].

Application include (DCD).
1.complex division.
2. antenna array beam forming.
3. adaptive filtering.

DCD based complex divider is based on the idea that the complex division can be viewed as a problem of finding the solution of a 2*2 real valued system of linear equations which is solved using the DCD algorithm. Therefore the new divider uses no multiplication and division. Comparing with the classical complex divider ,the DCD based complex divider requires significantly smaller chip area. A DCD based minimum variance distortionless response(MVDR). Beam former employs the DCD algorithm for multiplication free finding the antenna array weights. An FPGA implementation of the proposed DCD-MVDR, beam former requires a chip area ,ie compact beam former.

Architecture & FPGA Implementation of DCD algorithm.
1. Ls approach is widely used in the area of signal processing & communication.
2. Solution is based on solving normal equations.
3. Normal equation is very complicated.
4. It is done using matrix inversion is generally regarded 0(N3).
The main component that we can discuss in this thesis is adaptive filter. Adaptive filter are applied in the field of

1. System identification.
2. Channel equalization.
3. Channel identification.
4. Interference suppression.
5. Acoustic echo cancellation.

The main speciality of adaptive filter can be either finite duration impulse response (FIR) or infinite duration impulse response(IIR).when comparing both FIR filter and IIR filter, FIR filter is simple stronger moreover it does not involve any feed back mechanism .So that lot of practical problems can be accurately modeled by an FIR filters. Such as cancellation using adaptive transversal filter and antenna beam forming . On the other hand IIR structure contains feed back mechanism which is sophisticated and unstable so obviously we go for FIR filter rather choosing IIR filters.

VIII. Conclusion & Future Scope

In this paper we discuss about medical ultrasound beam former using FPGA implementation VLSI architecture, to an extent we will be able solve the problem regarding the body .But the important aspect of this technology is limited .To an extent ultrasound is non harmful;ie it is ionizable in nature at the same time we need more water content in our body so that it travels more distance through our body.

If we discuss about the future scope most of the country fail to adopt a ultrasound scanner with high gajet equipment but in future we may find it in home that can be used by common people which is more reliable ,easy to use mainly because of cheap rate . Now a days doctors fail to visualize the target organ clearly to estimate the disease but in future we may find 3D/4D vision of a body organ especially a fetus with high definition with the development Of 3D/4D technology. Hopefully we may find the ultrasound scanner hand held in future. So let ultrasound imaging plays a prominent role in rescuing the life of the human being

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