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Design And Analysis Of Semi-Adaptive 2-6 Ghz Digital Band Pass Filters For SAR Applications

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Abstract-Technologies have advanced rapidly in the design of filters to enhance effectiveness of Signal to Noise Ratio for mobile communications including SAR applications[1]. In this research work Butter worth active band pass filter for 2 to 6 GHz was designed using XILINX and MATLAB softwares. This was optimized, analysed and evaluated keeping the sampling frequency at 48 GHz and Kiser window for 0.5 Beta. As part of this research work 7 -9 KHz Butter worth active band pass filter was designed using active components which was put into circuit, tested by passing a sinusoidal test signal along with noise and the filtered output signals are presented. Based on this practical results conclusions were drawn for 2 to 6 GHz filter for SAR applications[2].

Keywords – Active filter, XILINX and MATLAB softwares.

I. INTRODUCTION

A filter is a device that passes electronic signals at certain frequency ranges while preventing the passage of others. An active filter is a type of analog filter distinguished by the use of one or more active components such as voltage amplifiers, buffer amplifiers. They are generally a solid state transistor or operational amplifier[3].

Active filters are preferred over passive filters especially at high frequency ranges where the response of the passive filters is very poor and they add their own noise due to LRC components. The inductors are avoided in active filters which otherwise add weight and hence they are resistible for airborne SAR applications. Active filters basically have the following advantages over passive filters[4] :-

(a) In active filters inductors which are large and expensive are avoided thus removing significant internal resistance.

(b) Active filters can reject significant amount of surrounding unwanted electromagnetic signals.

(c) In this filters variable inductances can be used which are not practicable in passive low frequency filters, thus control over the following.

(i) Shape of the response
(ii) The quality factor
(iii) Frequency is tunable

(d) In this the amplifier powering the filter can be used to buffer the filter thus preventing the variations which affect the shape of the frequency response significantly[5].

II. PROPOSED DESIGN METHODOLOGY

The proposed designed methodology is as shown in fig.1. The design process involved the following steps[6]:
(a) MATLAB software tool is used to generate the coefficients required for the operation of the filter.
(b) Xilinx software tool was used to design the filter.
(c) In this design methodology Finite Interval Response (FIR) and Kaiser window with 32 order TAP was used.
(d) Filter response was derived for the sampling frequency of 48 GHz.

The (FDA) Filter Design and Analysis tool in MATLAB provides the option to design the digital filter to offer the respective response and coefficients to be implemented within the design using VHDL. Filter design can be carried out often selecting various options available in FDA tool for generation of required [6]coefficients for the respective filter from the target menu using the C header option of the FDA tool.

The generated coefficients in the C header files are then used in the VHDL file for the digital filter designing which is to be convoluted with the sampled data of SAR[7].

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In this research work the following designs were carried out.

(a) Butter worth digital active band pass filter for frequencies 2 to 6 GHz of 32 order Kaiser window with 0.5 Beta a sampled frequency of 48 GHz is carried ou[8]t.
(b) 7 to 9 KHz butter worth active band pass filter was designed using active components with suitable programming of XC 3S 400 PQ 208 & DSC IC 0808.
(c) This filter was integrated into the circuit testing system as shown in fig.2.

Simulated SAR signal accompanied with random noise is sampled at a frequency of 48 GHz[9].

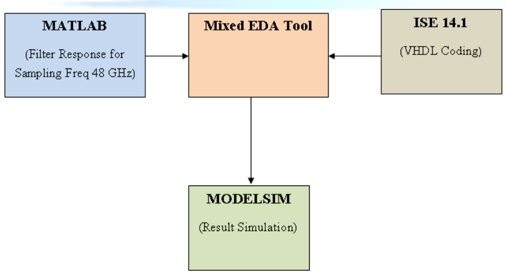

Figure 1. Block diagram of the proposed methodology.

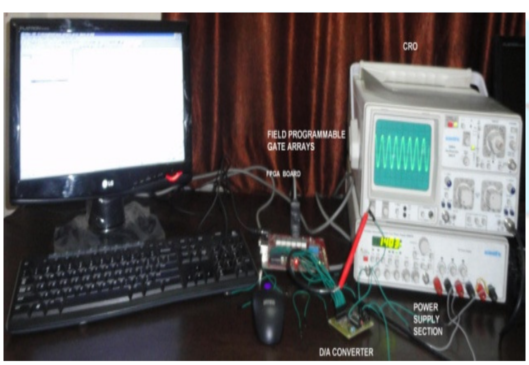

Figure 2. Experimental setup of the proposed methodology.

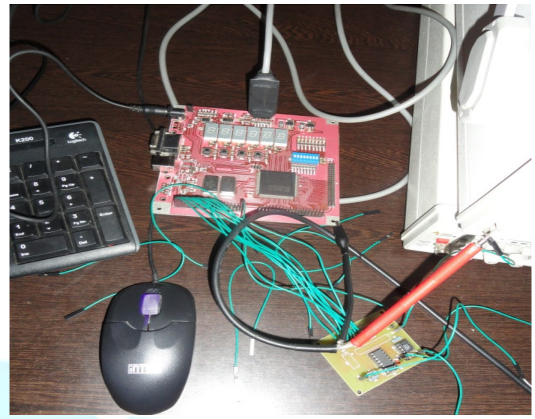

Figure 3. Designed circuit of the proposed methodology.

III. RESULTS AND DISCUSSION

The experimental setup and the designed circuit in this proposed research work are depicted in fig.2 and 3 respectively. The original sinusoidal test signal was passed through this 7 to 9 KHz signal for 32 order kaiser window with 0.5 Beta is shown in fig.4[10].

The response of the filter for original test signal mixed with noise is shown in fig. 6 and noise signal is shown in fig.5. The output filtered signal after passing through the filter is shown in fig. 7.

It is seen from the fig. 6 that the original signal is completely mixed with noise before it is passed through the filter. The output filtered signal is clearly seen in fig.7 which shows that the designed filter of 7 to 9 GHz is clearly achieving the desired results[11]

It is seen the fig. 6 and 7 that the band pass filter design is clearly achieved using the methodology proposed in this paper. It is seen from the fig. 7 that the simulated SAR signal clearly passing through the 7 to 9 KHz window, by suppressing the noise levels, presenting the reflected echo of the SAR signal[12].

It is observed from the fig. 8 that the filter response for the band pass frequency of 2 to 6 GHz the noise level has become predominant for the same SAR signal for 5 order Kaiser window with 0.5 Beta for a sampling frequency of 48 GHz. Further it is observed that from the figure that the filter output partially suppresses the signal[13].

It is observed from the fig[14]. 9 that the filter response for the band pass frequency of 2 to 6 GHz the test signal clearly passing through the filter for 32 order Kaiser window with 0.5 Beta for a sampling frequency of 48 GHz[15]. Further it is observed that from the fig. 9 that the filter output completely suppresses the noise and passes the SAR signal..

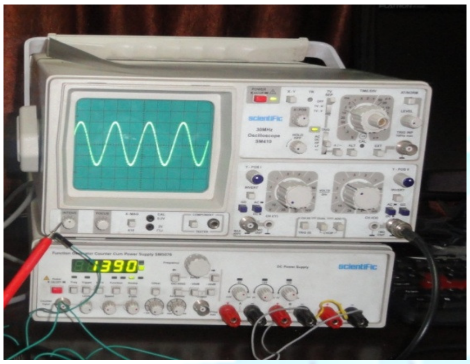

Figure 4. Original signal

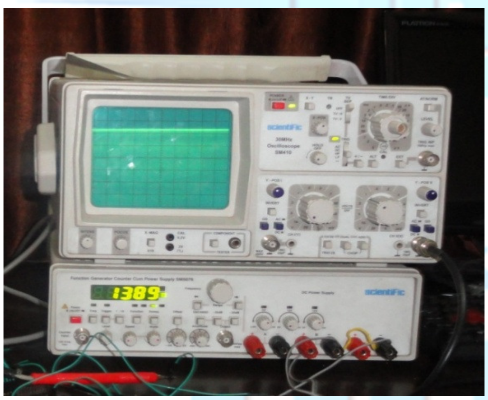

Figure 5. Noise

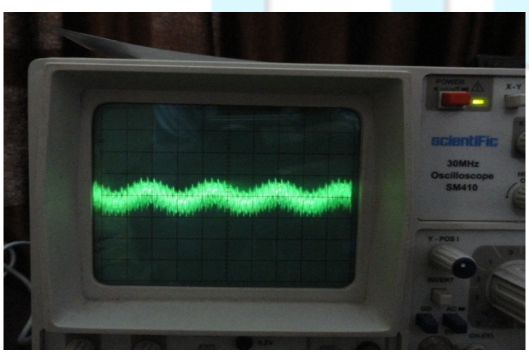

Figure 6. Noise and signal

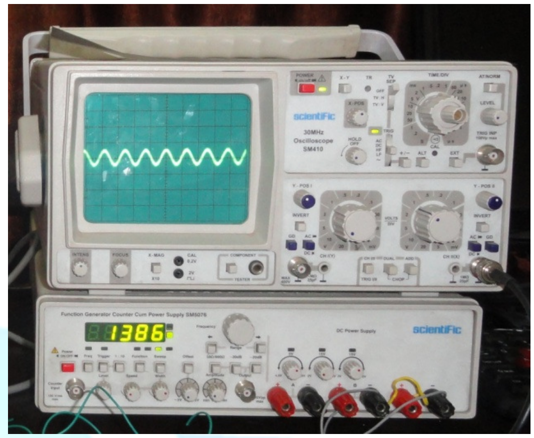

Figure 7. Filtered signal

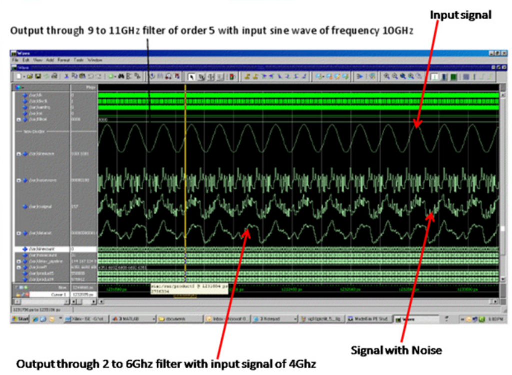

Figure 8. 2 to 6 Ghz Input, signal with noise and output signal

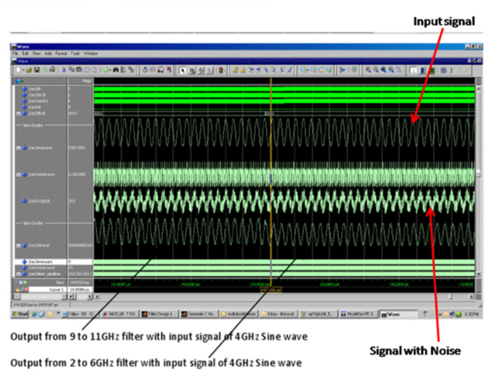

Figure 9. 2 to 6 Ghz Input, signal with noise and output signal

IV. CONCLUSION

The results obtained from this design clearly demonstrate that a 7 to 9 KHz band pass Butterworth digital active filter was designed successfully by using active components along with XC 3S 400 PQ 208 and DSC IC 0808 for 32 order Keiser window with 0.5 Beta. Another filter of 2 to 6 GHz for 32 order Keiser window with 0.5 Beta with the sampling frequency of 48 GHz was designed using MATLAB and XILINXK software tools. The response was successfully obtained for the designed frequency for 32 order Keiser window with 0.5 Beta for a sampling frequency of 48 GHz. These filters are suitable for SAR applications to mitigate random noise levels and give the desired target response so that resolution and identification of desired objects are achieved.

V. FUTURE SCOPE

This experiment on practical circuit design (7 to 9 KHz) and simulated design (2 to 6 KHz) of SAR filters show the way to formulate filters applications for Remote Sensing for Disaster management, Agriculture, rural development and military applications. These filters will play a crucial role in practical implementation in future SAR noise reduction.

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