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Design of an Anti-Aliasing Low Pass Filter

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Abstract:- In this paper an anti-aliasing low pass filter is designed for removal of aliasing. The proposed method extends an existing fundamentally novel approach to the design of anti-aliasing filter, termed filtering by aliasing, incorporates the frequency domain aliasing operation itself into the filtering task .The spectral content is spread with a periodic mixer and weighted with a sample analog filter before it aliases at the sampler. By designing the system according to the formulation presented in the proposed method, the sampled output will have been subjected to sharp anti-aliasing filtering. This describes the proposed filtering by aliasing idea, the design, and its range of frequency response. It also provides a performance comparison against existing techniques in the context of reconfigurable anti-alias filtering.

Keywords: filtering, anti-aliasing, software defined radio, cognitive radio.

1. INTRODUCTION

In communications receivers in particular, anti-aliasing is traditionally jointly achieved using strong fixed off-chip filters as well as one or more filtering stages in the on-chip analog receiver path, prior to the analog-to-digital converter (ADC). In this project we are using decimation process to design of anti-aliasing low pass filter. Aliasing occurred due to overlapping or combining or interfere to the two or more signals to each other. To reduce this problem we design the anti-aliasing low pass filter, in here decimation factor increases to increase the aliasing similarly to reduce it reduce the aliasing. Aliasing is an effect that causes different signals to become in distinguishable when sampled. Aliasing also refers to the distortion or artifact those results when the signal reconstructed from samples is different from the original continuous signal. The following techniques are previously implemented to avoid the aliasing.

Cognitive radio, software defined radio and multi standard radio methods are used to designing of anti-aliasing low pass filter .In these standard technique, Cognitive radio is used to reduce the interference between signals in wide band spectrum and spread spectrum .software defined radio means replacing software instead of hard ware requirement and multi standard radio enables the radio access technology to enables a range of signals to be transmitted from a single base station. This increases spectrum efficiency and also reduces the expansion cost. Software-defined radio (SDR) is a radio communication system where components that have been typically implemented in hardware (eg. mixers, detectors etc.) by means of software on a personal computer or embedded system. While the concept of SDR is not new, the rapidly evolving capabilities of digital electronics render practical many processes which used to be only theoretically possible.

With the advent of Long term evaluation (LTE), the communications industry is facing spectrum management challenges like never before. New generation mobile phones and other portable devices capable of transmitting and receiving GSM, WCDMA and LTE simultaneously, as well as base station infrastructure, are creating growing demand for advanced interference analysis.

2. PROPOSED METHOD

The proposed method extends an existing fundamentally novel approach to the design of anti-aliasing filter, termed filtering by aliasing, and incorporates the frequency domain aliasing operation itself into the filtering task. The spectral content is spread with a periodic mixer and weighted with a sample analog filter before it aliases at the sampler. By designing the system according to the formulation presented in this proposed method, the sampled output will have been subjected to sharp anti-aliasing filtering. This describes the proposed filtering by aliasing idea, the design, and its range of frequency response. It also provides a performance comparison against existing techniques in the context of reconfigurable anti-alias filtering. This filter is an anti-alias filter because by attenuating the higher frequencies. It prevents the aliasing components from being sampled.

2.1 Anti-Aliasing Filter

In our proposed method we mainly focused on aliasing causes due to the decimation operation. The input spectrum is decimated by a decimation factor D=1, 2, 3….. If we observe that spectrum at D=3 the decimated signal is effected due to aliasing. In our proposed method the main task is that effected spectrum signal is get back or reconstructed after performs by anti-aliasing low pass filter. An anti-aliasing low pass filter is a filter mainly

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used before a signal sampler to reconstruct the signals to completely satisfy the sampling theorem over the band of interest. Sampling theorem states that the unambiguous interpretation of the signal from its samples is possible when the power of frequencies above the Nyquist frequency is zero, a real anti-aliasing filter can generally not completely satisfy the theorem

2.2 Decimation

Decimation by an integer factor, M, can be explained as a 2-step process, with an equivalent implementation that is more efficient:

1. Reduce high-frequency signal components with a digital low Pass filter.
2. Down sample the filtered signal by M; that is, keep only every M^{th} sample.

Down sampling alone causes high-frequency signal components to be misinterpreted by subsequent users of the data, which is a form of distortion called aliasing. The first step, if necessary, is to suppress aliasing to an acceptable level. In this application, the filter is called an anti-aliasing filter, and its design is discussed below. Also see under sampling for information about down sampling band pass functions and signals.

When the anti-aliasing filter is an IIR design, it relies on feedback from output to input, prior to the down sampling step. With FIR filtering, it is an easy matter to compute only every M^{th} output. The calculation performed by a decimating FIR filter for the n^{th} output sample is a dot product**:**

$y[n] = \sum_{k=0}^{k-1} x[nM-k].h[k]$...(1)

Where the h sequence is the impulse response and K is its length. x represents the input sequence being down sampled. In a general purpose processor, after computing y[n], the easiest way to compute y[n+1] is to advance the starting index in the x array by M, and recomputed the dot product. In the case M=2, h can be designed as a half-band filter, where almost half of the coefficients are zero and need not be included in the dot products.

Impulse response coefficients taken at intervals of M form a subsequence, and there are M such subsequences (phases) multiplexed together. The dot product is the sum of the dot products of each subsequence with the corresponding samples of the x sequence. Furthermore, because of down sampling by M, the stream of x samples involved in any one of the M dot products is never involved in the other dot products. Thus M low-order FIR filters are each filtering one of M multiplexed phases of the input stream, and the M outputs are being summed. This viewpoint offers a different implementation that might be advantageous in a multi-processor architecture. In other words, the input stream is multiplexed and sent through a bank of M filters whose outputs are summed. When implemented that way, it is called a polyphone filter.

For completeness, we now mention that a possible, but unlikely, implementation of each phase is to replace the coefficients of the other phases with zeros in a copy of the h array, process the original x sequence at the input rate, and decimate the output by a factor of M. The equivalence of this inefficient method and the implementation described above is known as the first Noble identity.

2.3 Filtering

To implement a simple yet effective low pass filter to prevent aliasing in a down sampler and interpolation in an up sampler, we can use the function fir1 () which designs linear phase FIR filters using a windowed sinc function.

FIR1 FIR filters design using the window method.

B = FIR1(n,ω_n) designs an Nth order low pass FIR digital filter and returns the filter coefficients in length N+1 vector B.

3. Simulation Results and Discussions

The overall process has to be performed on matlab software. By using that software the decimation process has to be done. In decimation process, we have four spectrums. We show the spectrums of spectrums of four signals are represented by $|x(e^{j\omega})|,|y(e^{j\omega})|,|X(e^{j\omega})|,|Y(e^{j\omega})|$.First one is the input spectrum and it is decimated by factor 3 and aliasing occurs,it is represented by a circleand then by using a filter to get filtered output and is to decimated by factor 3 here by using filter to get resultant signal ideally it is possible to zero but prctically it is not possible.

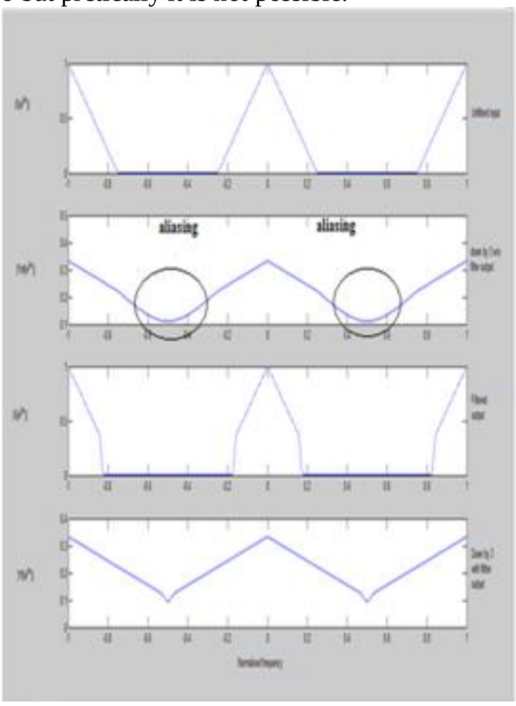

Figure 1 shows the removal of aliasing using low pass filter.

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In the above results, finally aliasing has to be removed and the spectrum should become as input spectrum.

4. CONCLUSION AND FUTURE WORK

In this paper, we provided a fundamentally novel look at the design of anti-aliasing low pass filter. We showed that the proposed approach of involving aliasing in the filtering task provides a wide range of anti-aliasing responses that are well suited for the needs of future software defined communication systems. Filtering by aliasing, it describes the overall operation are to be performed on the low pass filter and to reduce aliasing by using decimation process.

So far we discussed about filtering by aliasing on low pass filter and we implemented on them. Anti-aliasing is also performed by using high pass filter, band pass filter, band reject filters and improves the aliasing results.

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