Design and Analysis of FIR Filter Performance Based Multi Stop Band Technique for Mobile Receivers
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Abstract
This paper introduce a novel Finite Impulse Response (FIR) filter design based Equiripple multi stop band technique to overcome the adjacent band interference in the mobile communication receivers. The performance improvements of FIR in the band of interest play vital rolls in the receiver path due to critical pass band in new communication receivers. Hence, the filter order and stop band stages could be used to optimize the filter response with minimum error in the desired band. To reduce the pass band ripple in the filter response, multi stop band could use by insert different weights in different band in the filter response. Furthermore, in the pass band region, the weights has been set to thirty time more than stop band weights in order to compensate the adjacent band rejection as well as blocker region. The simulation results shows important development in the pass band ripple by 20% and blocker requirements by 15% compared with traditional FIR filter design. The suggested techniques promising to enhance and support the current and future communication receiver’s requirements.

Keywords- FIR, Multi stop band, adjacent band rejection, Mobile Receivers

Introduction
The early used of FIR filter in the digital communication systems force the researcher to focus their objective to develop the filter response due to widely filed could use this type of filter in the specific field. The useful performance of minimax techniques in the FIR filter design keep the researcher interest in developing and improve the filter response due to openly specify band edge and error size optimization in each band of interest[1]. The linear phase of all FIR filter could use to provide the optimization response in the critical band region. The complete minimization error in the pass band response is approached the exact function [2]. The different between any function and its polynomial is define as error in term of unwanted ripple. If \( P_n(X) \) is the minimum polynomial in a given interval \([a, b]\), then there must be at least \((n+2)\) points reach absolute maximum value as illustrated in Figure 1. The first iteration by set of \((n+2)\) is use in the given duration and each iteration collected as two steps in the first step. Then, the coefficients that make error function equal magnitude at \((n+2)\) points reach absolute maximum value as in [3]. Nevertheless, the magnitude of the error does not consider maximum in the wanted duration. Thus, the proposed minimax form does not meet as in [4]. The better solution is by set new points in the required interval. Some of researcher is contribute by set new \((n + 2)\) points to attain the minimax approach which so called exchange technique as in [5]. In the first step, one can change a single point in the present \((n+2)\) and the second step is by exchange all points in the present \((n+2)\) set points as shown in Figure 2.

![Figure 1: third order polynomial of minimax criteria](image1)

![Figure 2: second step of points exchange](image2)

At the final set of points exchange, the error magnitude represent a maximum value and the error function could expressed as follow as in [6].

Table 1: standard FIR filters parameters from [7]

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<td>0</td>
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2. \( E(m) = W(m)[A_d(m) - A(m)] \)
where \( A_d(m) \) and \( A(m) \) is the desired and designed response function And the weight function is: (1)
\[ w(a) = (\omega'.1.m) E \text{ (passband)} \]
\[ , m \text{ E (stopband)} \]
Hence, the actual FIR filter response could formulate as product of two filters as: \( G(m) = 1^{\text{new}} g[k](\cos m k) \times M = \wedge . \)
\[ K = 0.1.2 \] (3)

1. Suggested Filter Structure
The suggested FIR filter structure is designed and implemented using M-file in MATLAB version 7.4
programs. The idea of inserting multi weight in the FIR filter response is formulated using fvtool environments introduce by mathworks. Hence, to control the pass and stop band weight, the weights is set to 30 time in pass band more than stop band interval. The filter order is set to be 64 and sampling frequency has been chosen as 541 MHz as in GSM system for example. The technique of Equiripple window in FIR filter widow has been chosen to get the linearity in phase and magnitude response. The magnitude response of proposed filter with two different stop band is illustrated in Figure 3 and Figure 4. Clearly, the two stop band in filter response is highlight in the band of interest and ripple in the pass band region look minimized as planned and the filter provide 0.02dB as shown in Figure 5.

![Figure 3: magnitude response of proposed filter](image1)

![Figure 4: stop band and pass band response of suggested filter](image2)

Concept
This paper introduce a novel linear phase FIR filter design with minimum pass band ripple and two stop band region. The insertion of different weight in the different band and different values results in important adjacent band rejection improvements to block the nearest channel and prevent the interference in the modern communication receiver side.

References


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