Proceedings of the Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV 2021).
IEEE Xplore Part Number: CFP21ONG-ART; 978-0-7381-1183-4

2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV) | 978-1-6654-1960-4/20/$31.00 ©2021 IEEE | DOI: 10.1109/ICICV50876.2021.9388422

Object detection by using Chebyschev filter

Reducing error in object detection using traditional way

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Abstract:In the preceding papers we have very distinguishably described object detection methods right from its roots. The mathematical models such as optical flow by LucasHorn form the backbone of modern object detecion. The next models such as the motion models also play a important part in object detection, these were Picard and Bergen et.al. In this paper we are on the very distance of object detection by using a prominent filter which is the Chebyschevfilter.Previous study done by us play a major role in establishing this work.

Introduction: Chebyschev is a very basic low pass filter, by which we mean that it allows for the passage of low bandwidth frequencies through it. This basic concept is multiplicatively used in our research which will allow us sophisticatively in identifying objects of certain frequencies from the light spectrum. We know that light ranges from maximum to minimum wavelenghts from red to violet.

In our very first simple design we have designed a 9th order low pass chebyschev type 1 filter with 6 decibel of passband ripple and passband edge of low frequency 300Hz and data is sampled by using the Nyquist criterion close to 1000Hz, and this correspond to .9π radians per sample. Plotting its magnitude and phase responses as below before we proceed any further.

We filter a signal which is 1000 times randomly sampled.

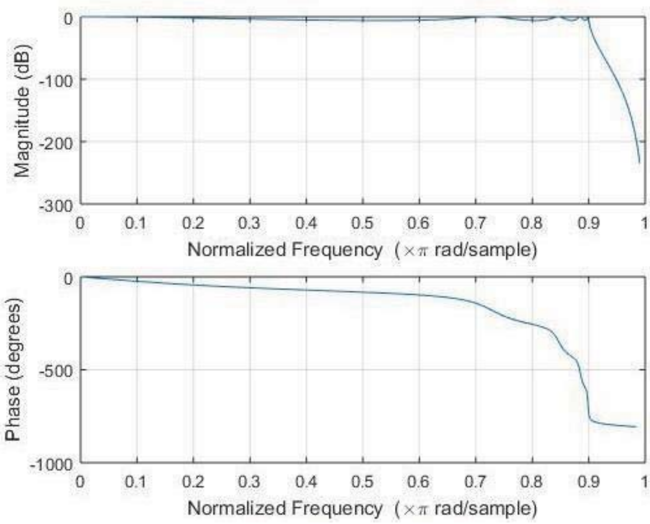


Figure I as follows.

The first part of the figure is very interesting as it decreases after .9 before being very very constant, I mean totally constant for a big part of it. This plays a major part in our research and speaks a lot about chebyschevfilter.In the second part of the above figure it is very very interesting phenomenon observed. First it decreases at another rate, then decreases at another rate and finally remains constant. i.e it decreases from 0 to .7, then decreases rapidly while finally remaining constant after .9.

Very well lets go to the next part of our very interesting finding on this method. In this paper we have kept one thing in strong commitment is finding a better method then previous methods and also carrying our previous work forward. In our previous methods which can be retrieved by my previous research publications it is very clear about traditional methods of object detection using optical flow, lucaskanade, bergen model mann and piccard methods and of course 3d rigid motion which clear all the air about our research.

Okay only speaking about respected Horn paper we see that the paper was very simple, it was a very simple mathematical derivation, keeping in mind the fundamentals of derivatives in mind. In this Horn found out infinitesimal changes in a object movement which formed the concept behind his derivation of equation. In his derivation he found out small changes in x and y 2D and found out the derivative.

Figure II.

$$f_x u + f_y v + f_t = 0 \qquad \text{Eq. 1}$$

This was nothing but an equation of a line and a first order linear equation.The mathematical derivation given by figure 3 as below.

Figure III

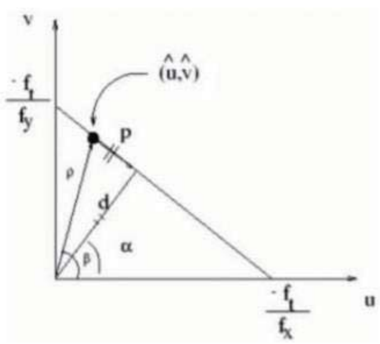
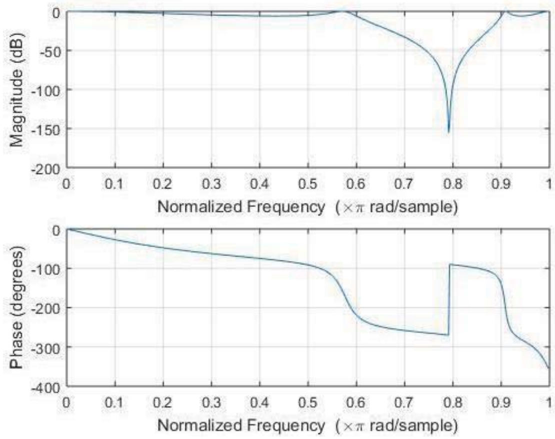


Figure 1: Equation of a line with intercepts u and v

Keeping our terms as simple as possible and looking no further than the model by Lucas K Horn. This paper was very famous for almost a decade getting more than tens of thousand citations and thousands of papers written folowing it.

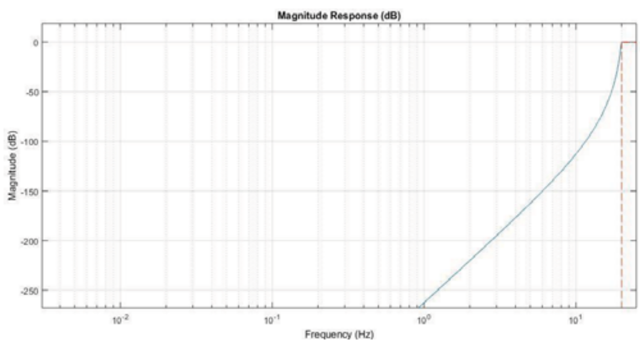
In our second analysis we deesign a 5th order chebyschevbandstop type I filter , the normalized band frequencies obtained by us were .6 π and .9 π radians per sample and 6 decibel ofpassband ripple.

Figure IV



In this section we have used the properties of logarithms in designing a ChebyschevHighpass filter, this filter will only allow objects of high frequency colours to pass through it, which means the objects will appear violet to indigo blue coloured. Check the below figure to check about highpass filter design plot. To be sarcastic the plot shows violet frequencies only but has nothing to do with out research in this paper.

Figure V

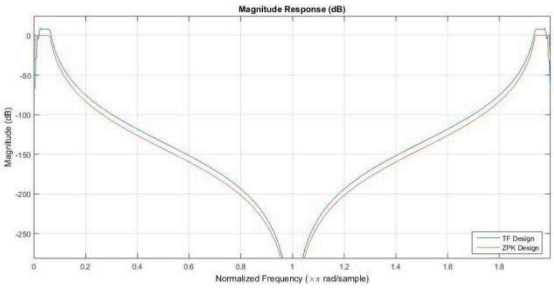


The figure below shows some of the limitations we have found on analysis with a bandpass filter. We had used for information a [z,p,k] syntax to design IIR filter. To analyse our filter further we have used [z,p,k] output with zp2sos. We have designed the filter with [b,a] syntax, though we encountered various problems in this process for n as low as 4.

For points from 0 to 600 and pi going from [0,2pi]

We have

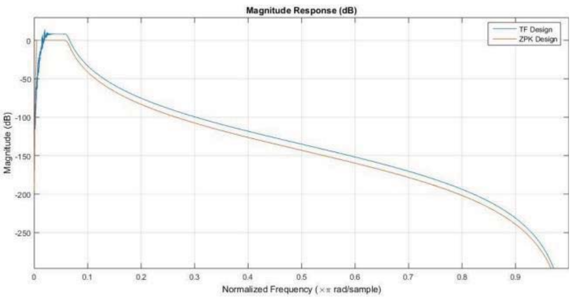
Figure VI as follow and it is



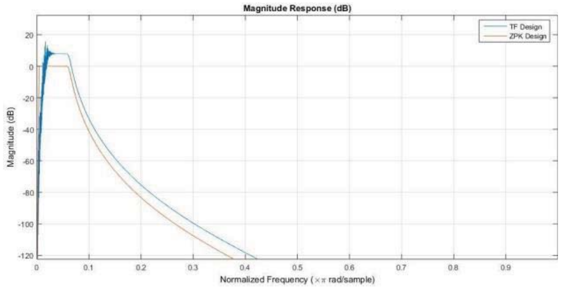
The figure is similar like a hyperbola going to infinity in the negative and positive x axis.

The next figure VII we have plotted

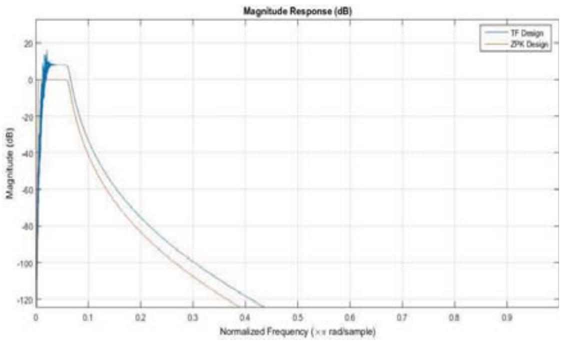
for 6000 points from [0,pi]



The next figure VIII we have plotted for 16000 points for same range as before.

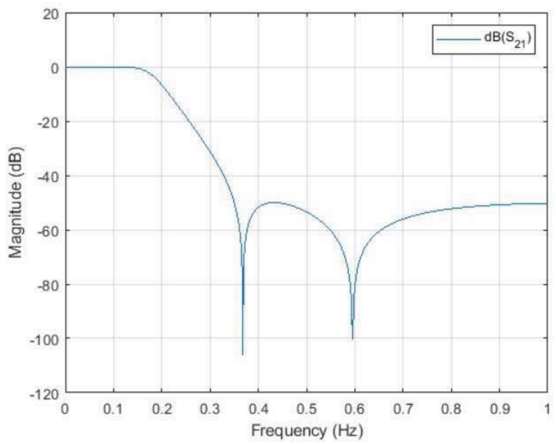


And for the final figure IX in this filter design we have plotted 24000 points for same range. The major point to be noted in these figures is very important and noteworthy and play a major part in our object detection model. We have also elaborated this in our object detection paper using the kalman filter.

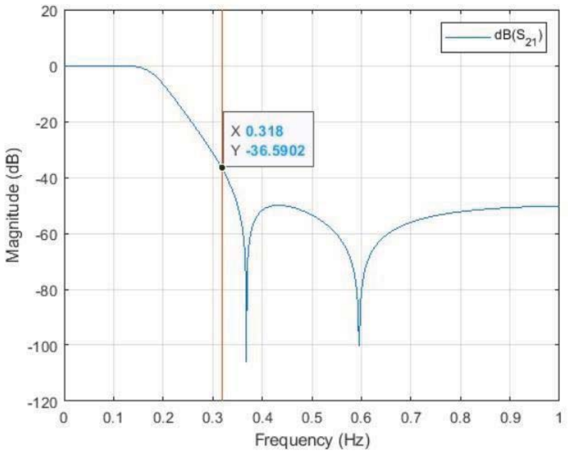


Pausing a little to discuss a few concepts. A depth and detailed explanation can be given about the motion models which showed high accuracy in detecting object such as the Bergen and Mann and Piccard models. Not to speak anything of the term we must not use in our traditional approach as this which is the deep learning, python language, etc and all those terms which we have restricted ourselves from. Though they show high accuracy today. Nothing that they are very expensive methods. We have modelled a simple object detection method using the traditional Chebyshev filters in our present research.

We have plotted the Chebyschev filter as follows visualizing the amplitude response of the filter.The plot was as follows in figure X.

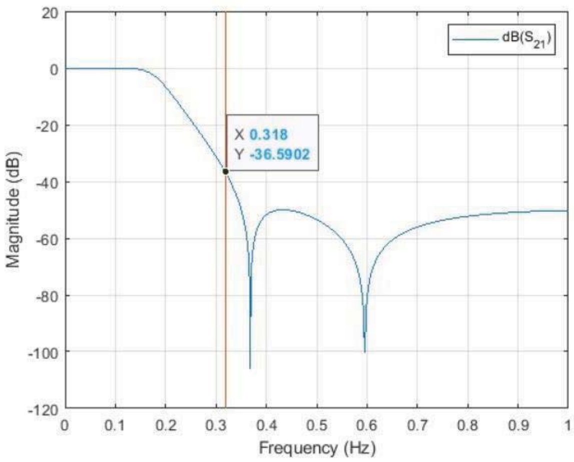


The object was detected by using the radians as follows in figure XI.



There is a slight precision in reading to be very precise in this object detection but it is very very accurate and close to perfect according to chebyschev filter and our traditional approach.

Figure XII



x and y as [.318, - 36.5902].

Optical flow method can be used to find the image using video file

Figure XIII

Result: We know that Chebyschev filter are between butterworth filter and the latter type 1 filter, The major point being that they reduce the error between the actual and ideal filter. This reduction in error is taken into consideration by us in devising a Chebyschev filter which will detect the object with utmost accuracy, without increasing the cost, time and efforts required in detecting the object by the modern methods. We can say that our discussion will be of value to the peers who are going to read our work and play a important role in future object detection methods. We have elaborately discussed from the famous Horn paper to Bergen.et.al and Mann and Piccard et.al methods. In the future scope of our research we will try to go in traditional object detection methods and side by side also use the modern object detection methods such as deep learning,etc.

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