Deep learning based Object detection by using traditional motion models: Benchmark and state of the art

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Abstract

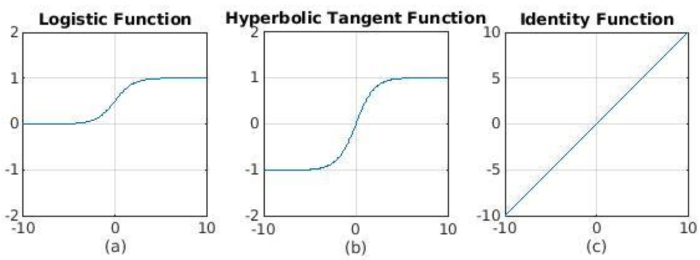
Okay we want to detect an object. But how can we do it?This is a wide area of interest known as computer vision , And we are going to use the traditional techniques of object detection in synchronization with the ardent topics of soft computing, image synthesis or processing and computer vision as whole.

Keywords: Soft computing, Motion models. Optical flow, image processing and computer vision.

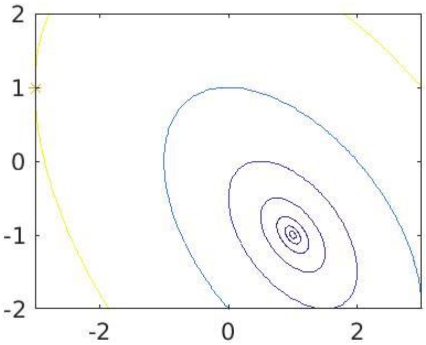
1. Introduction

Soft computing is discrete mathematics of computer science. When we talk of soft computing it revolves around fuzzy logic and all those concepts we are already well equipped with but are not knowing the significance of their usage which we are writing this very paraphrases for our usage.

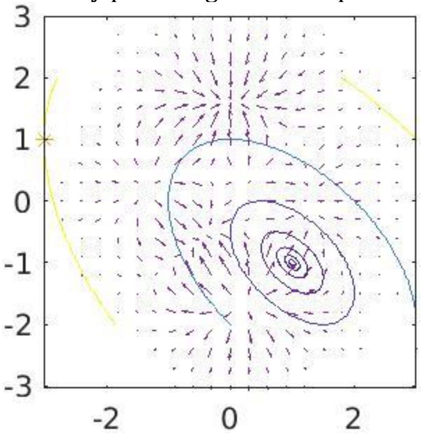
What do you mean by activation function, well it is a function which has very large significance. Exponential activation function is a widely discussed topic of interest.



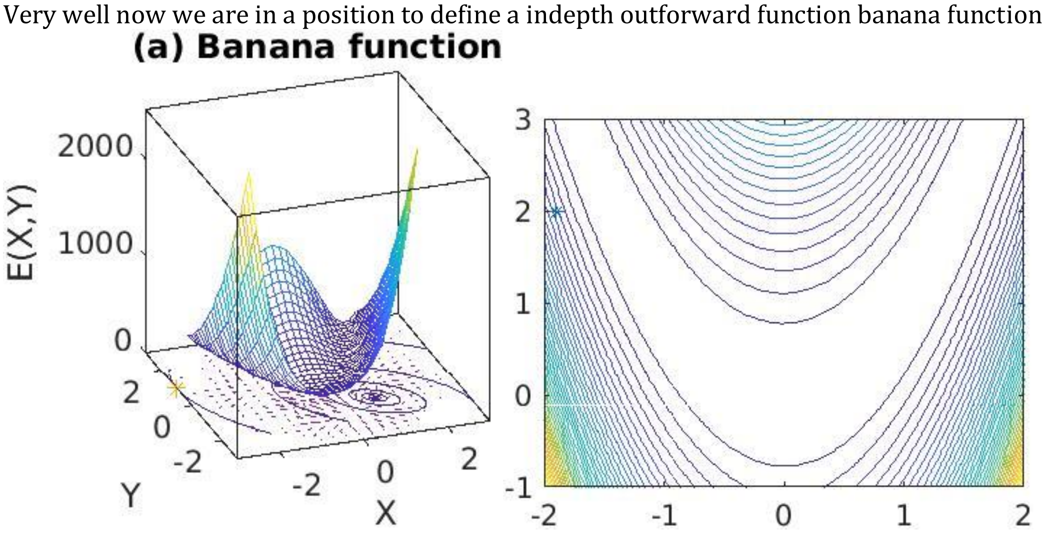
The first derivative gives us the gradient descent which is the slope of the curve. When we find the infinitesimal distances for a movement from a point in space we get the distance moved for infinitesimal distance from space, and this helps us in finding for movement from z, y and z coordinate in space leading to the famous Berthold horn derivative of equation of a line optical flow equation.



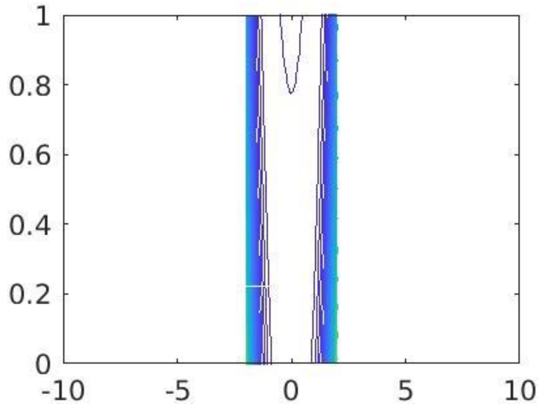
And then the magnetic points known as crisp descent concept is introduced in space. We find derivative for every point in geometric space.



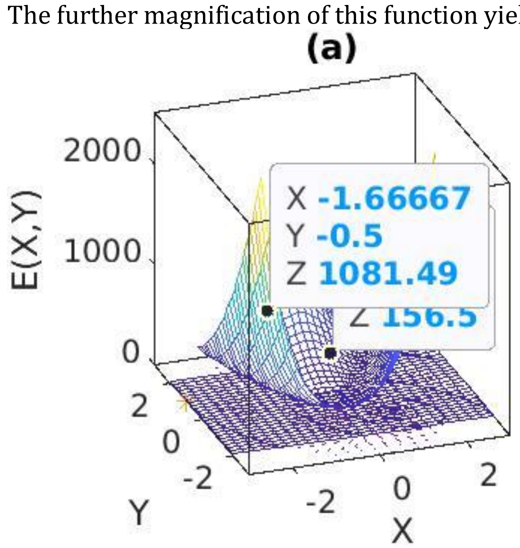
Very well now we are in a position to define a indepth outforward function banana function defined as:



The infinitesimal points being in space as above. Showing optical equation as a hyperbolic function.



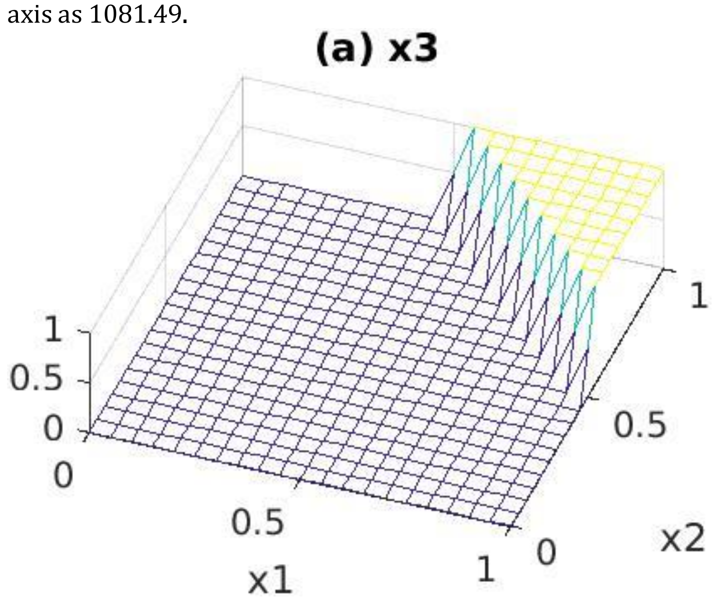
The further magnification of this function yields the above functional graph:



The well defined coordinated in x,y and z coordinates is as follows.

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

The major equation being the above equation. The optical flow equation is elaborated in this paper, we find the differences in infinitesimal distances which leads to determining the coordinates of the new position of the object. The position coordinates is achieved to be x coordinates as -1.66667, y as -0.5 and z axis as 1081.49.



This is a famous descretization of gradient descent of fuzzy logic optimization.
We find changes in 0.5 points in space for infinitesimal changes in location.

Image processing and analysis is what we are looking to withdraw from our research in this discussion is very clear.

So motion models starting from optical flow are distinct functions of object detection.
We will discuss optical flow Directed by Berthold Horn in seventies.

$$f(x,y,t) = f(x+dx, y+dy, t+dt)$$

This is equation derived for infinitesimal changes in x, y and z axis.

$$f(x,y,t) = f(x,y,t) + \frac{\partial f}{\partial x}dx + \frac{\partial f}{\partial y}dy + \frac{\partial f}{\partial t}dt$$

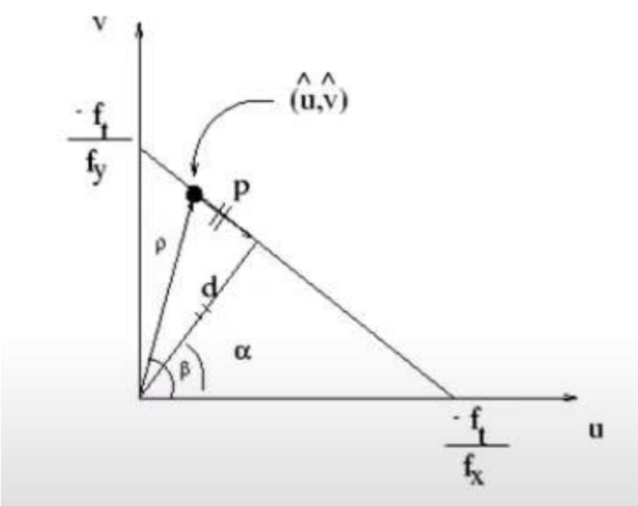
The partial derivatives is corrected for the small distances in x, y and z axis.

$$f_x dx + f_y dy + f_t dt = 0$$

Thus we obtain the optical flow equation which is very famous in its own way to be used in most fundamental object detection optical flow equation.

$$f_x u + f_y v + f_t = 0$$

Mathematical interpretation of optical flow.



This is nothing but a straight line stretching across x and y axis. The optical flow equation is nothing but an equation of a line in coordinate axis in the mathematical flow.

$$d = \frac{f_t}{\sqrt{f_x^2 + f_y^2}}$$

The distance given by the above equation.

$$\iint \{(f_x u + f_y v + f_t)^2 + \lambda(u_x^2 + u_y^2 + v_x^2 + v_y^2)\} dxdy$$

The above equation show for two discrete form and stretches of equation of optical flow.

$$u(x,y) = a_1 x + a_2 y + b_1$$
$$v(x,y) = a_3 x + a_4 y + b_2$$

$$\begin{bmatrix} u(x,y) \\ v(x,y) \end{bmatrix} = \begin{bmatrix} x & y & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & x & y & 1 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ b_1 \\ a_3 \\ a_4 \\ b_2 \end{bmatrix}$$

The optical flow equation is taken to be in the two form coordinates, there are two equation taken up, which define the optical flow equation,

For two different coordinates of equation of a line. The optical flow equation is inserted into the global motion flow equation to obtain the below equation.

$$f_x u + f_y v = -f_t$$

$$E(\mathbf{u}) = \sum_{\forall x \in f(x,y)} (f_t + f_{\mathbf{x}}^T \mathbf{u})^2$$

$$E(\mathbf{a}) = \sum_{\forall x \in f(x,y)} (f_t + f_{\mathbf{x}}^T \mathbf{X}(\mathbf{x})\mathbf{a})^2$$

In the above equation of Global motion of Bergen model we obtain equation as above.

$$E(\delta a) = \sum_{\forall x \in f(x,y)} (f_t + f_{\mathbf{x}}^T \mathbf{X} \delta a \ )^2$$

We have to find a from the above equation and not x.

$$u\, f_x + v\, f_y + f_t = 0$$

The optical equation is again used above.

$$\mathbf{u}^T \mathbf{f}_{\mathbf{x}} + f_t = 0$$

Bergen equation as above.

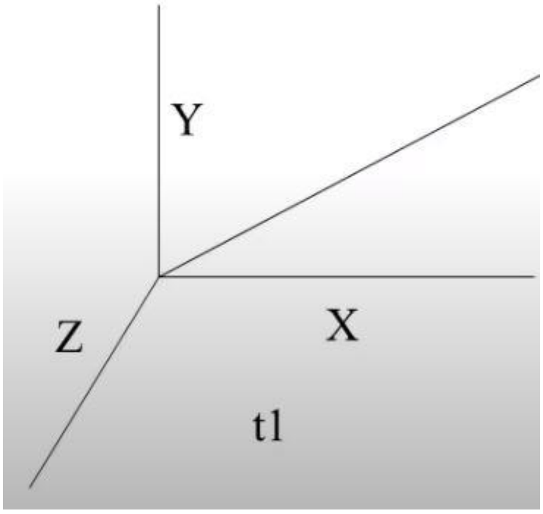
$$\mathbf{x}' = \frac{A\,\mathbf{x} + \mathbf{b}}{\mathbf{C}^{\mathbf{T}}\,\mathrm{x} + 1}$$

We obtain x’ as above.

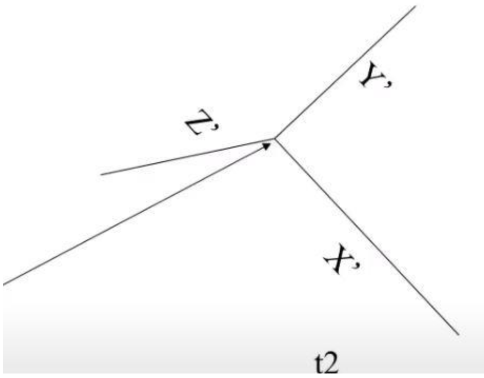
$$(\sum \phi\phi^T)\mathbf{a} = \sum (\mathbf{x}^{\mathbf{T}}\mathbf{f}_x - f_t)\phi$$

The global motion equation with unknowns as above.

3D rigid motion is a model in which we find motion of 2D objects for movement from x, y , z tp x’, y’ and z’ axis .

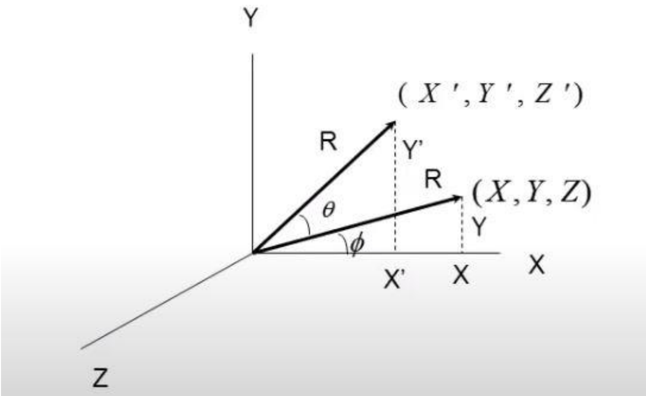


For movement of body from x,y ,z to x’, y’ ,z’ axis



$$\begin{bmatrix} X' \\ Y' \\ Z' \end{bmatrix} = R\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} + T = \begin{bmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{bmatrix}\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} + \begin{bmatrix} T_X \\ T_Y \\ T_Z \end{bmatrix}$$

The 3D rigid motion is analysed with the above matrix.



$$X = R\cos\phi$$

$$Y = R\sin\phi$$

$$X' = R\cos(\Theta + \phi) = R\cos\Theta\cos\phi - R\sin\Theta\sin\phi$$

$$Y' = R\sin(\Theta + \phi) = R\sin\Theta\cos\phi + R\cos\Theta\sin\phi$$

The above equation can be mathematically solved to obtain for 3D rigid motion.

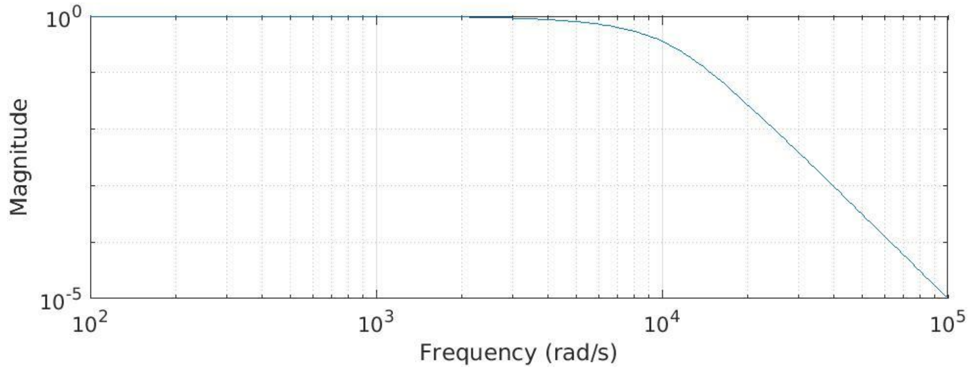
2. What do we have in these motion models

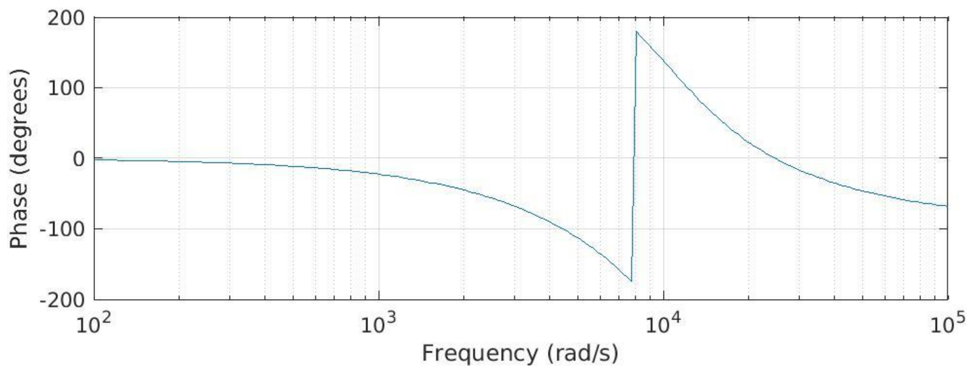
So in these optical flow equation and motion models we have some phenomenal fundamental understanding of object detection taking to the grassroots.

These are some fundamental equations of object detection which has evolved into the modern object detection deep learning models.

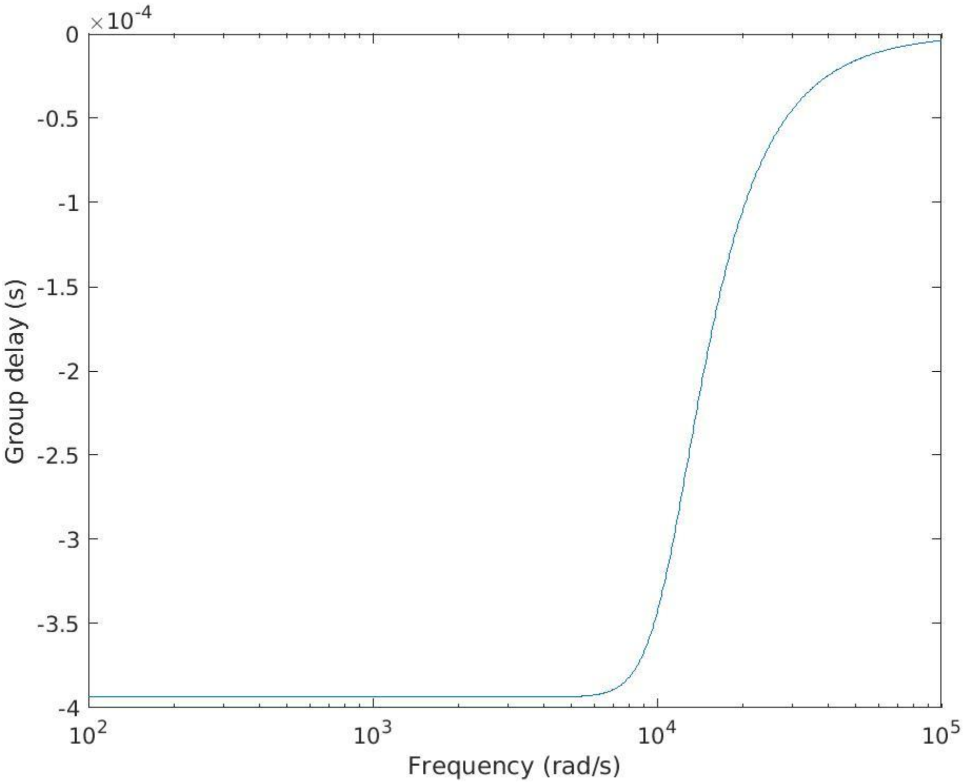
3.Object detection using some discrete techniques.

Object detection using Bessel function

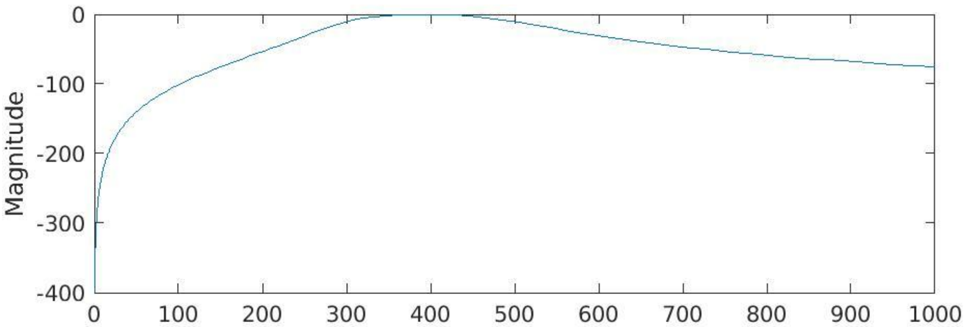




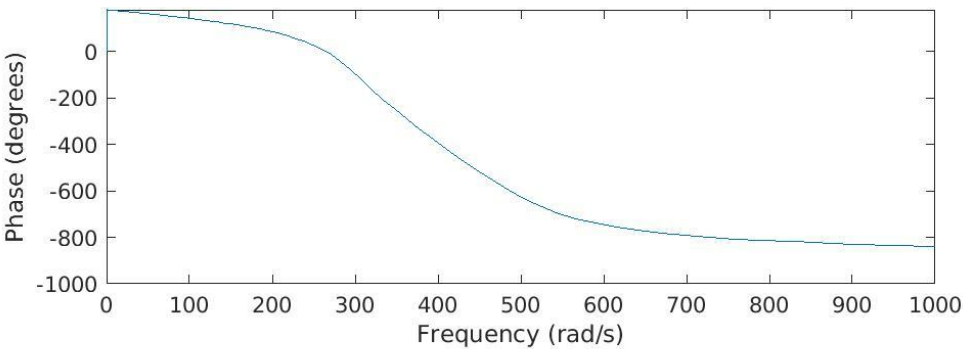
The above Bessel function plot gives a linear decrease with sudden increase of function with non uniform decrease.



This is a very organized plot of Bessel object detection function in which there is uniform increase in group delay with increase in frequency.

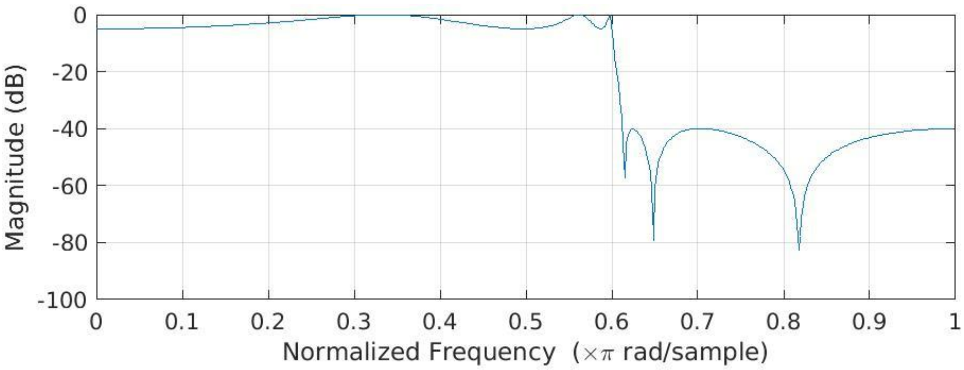


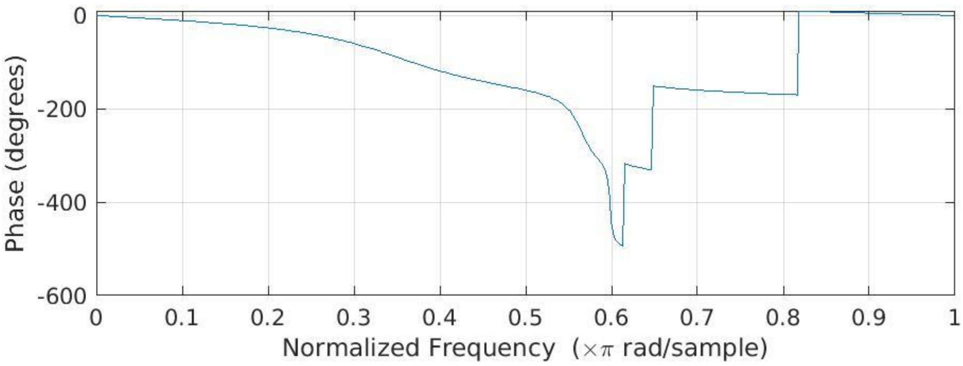
This is magnitude increase and then uni form decrease at 400 frequency.



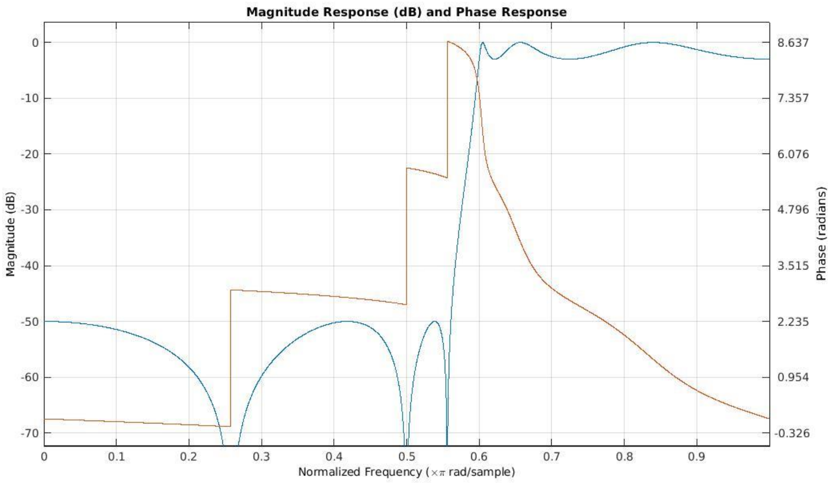
The phase is decreasing at two different rates.

Low pass elliptic transfer function is given in below figure as two different functions as below



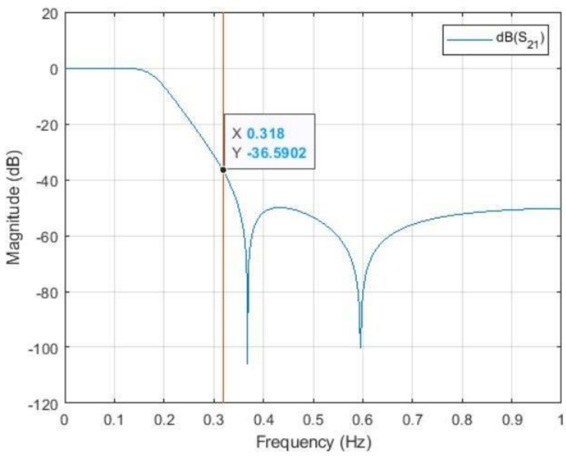


The discrete object detection can be heard as below functions:



So what do we have in these above figures. We have used low pass Bessel functions in congruence with the above functions of elliptic functions.

We want to detect object in accordance with their coordinates and to the utmost accuracy.



The object is accurately detected in the above coordinates as above. The object has been detected at X being at 0.318 and Y being at -36.5902. The Berthold Horn optical flow is the cornerstone of all major derivations in object detection. It is derived for infinitesimal variations or distance movement in object. Then there is 3D rigid motion model which is time consuming but also accurate for 2D objects. For 3D object detection we have motion models of Bergen Model and Mann and Piccard used to detect object. They are also accurate but complicated in its very detection.

Deep learning has played a vital role in Vision sensors if you look up the other chapters in object detection.

Conclusion: Object detection my machines is a very complex task involving vast complex algorithms and mathematical equations. In this paper we have simplified the object detection method. We have shown some of the mathematical equations which are helpful in detecting objects particularly humans. We have simulated for the equations to obtain some fine plots showing motion models in object detection. Today we are trying to simulate and create smart driving cars. Object detection is a very complex problem, the approach, the distinction between different objects, all this involves multiple approaches and algorithms. The most common algorithms used in object detection are shown in our paper. Today the computer has achieved progress compared to infinitesimal compared to what perfection is required in total. There has been design of robots which perform multiple and few tasks based on the data feed into it. But all this involves vast amount of research.

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Declaration: Funding:No funding received.
Conflict of interest:No conflict of interest.
Availability of data:No data procured.
Code availability:No code available.

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