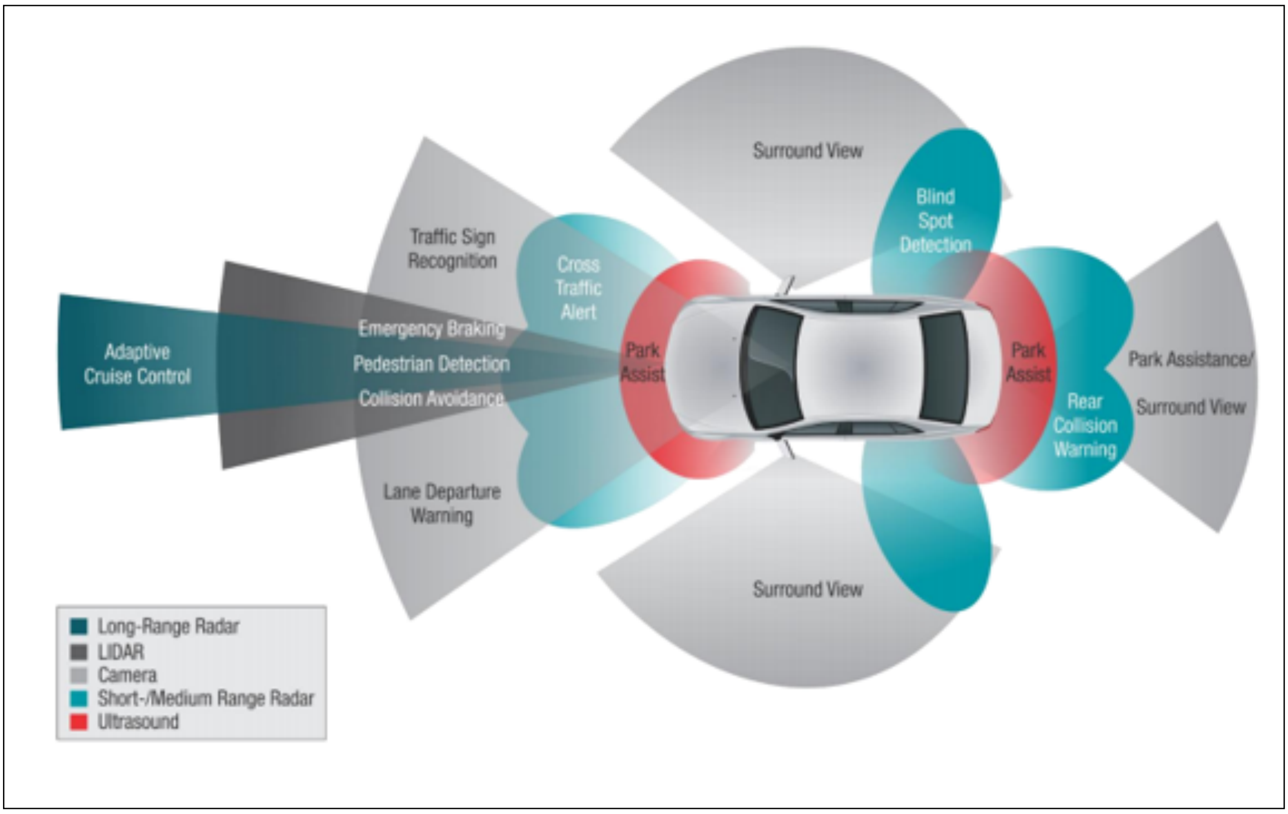
FMCW RADAR

Self driving cars

11 December 2021



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FMCW Waveform Design

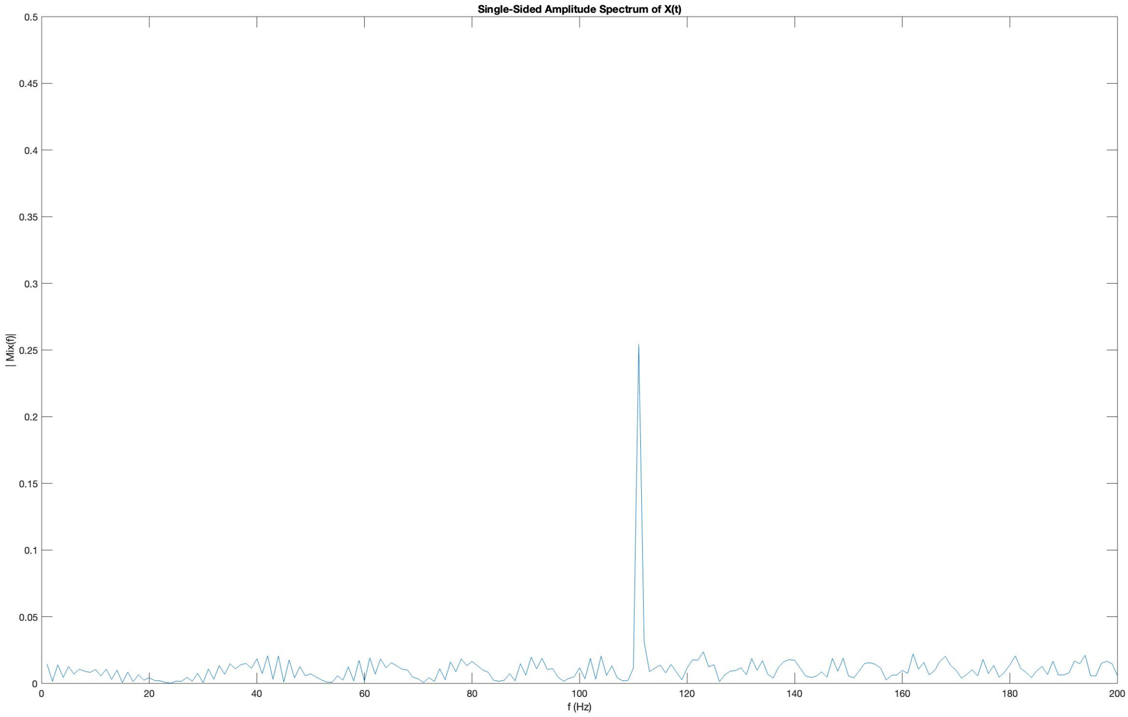
After designing the system the slope of the chirp was found to be as following

slope =

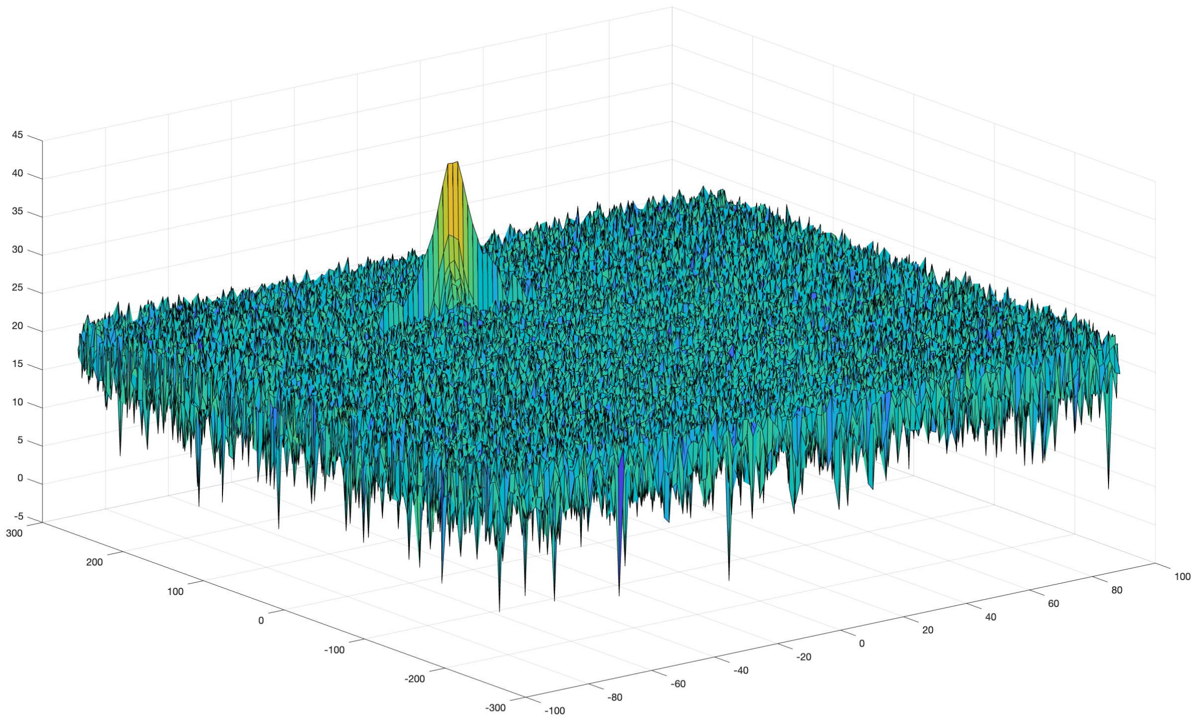
2.0455e+13

Range FFT (1st FFT)

The peak was found to be around 110 which was the value of the initial velocity.



2D FFT OUTPUT



2D CFAR

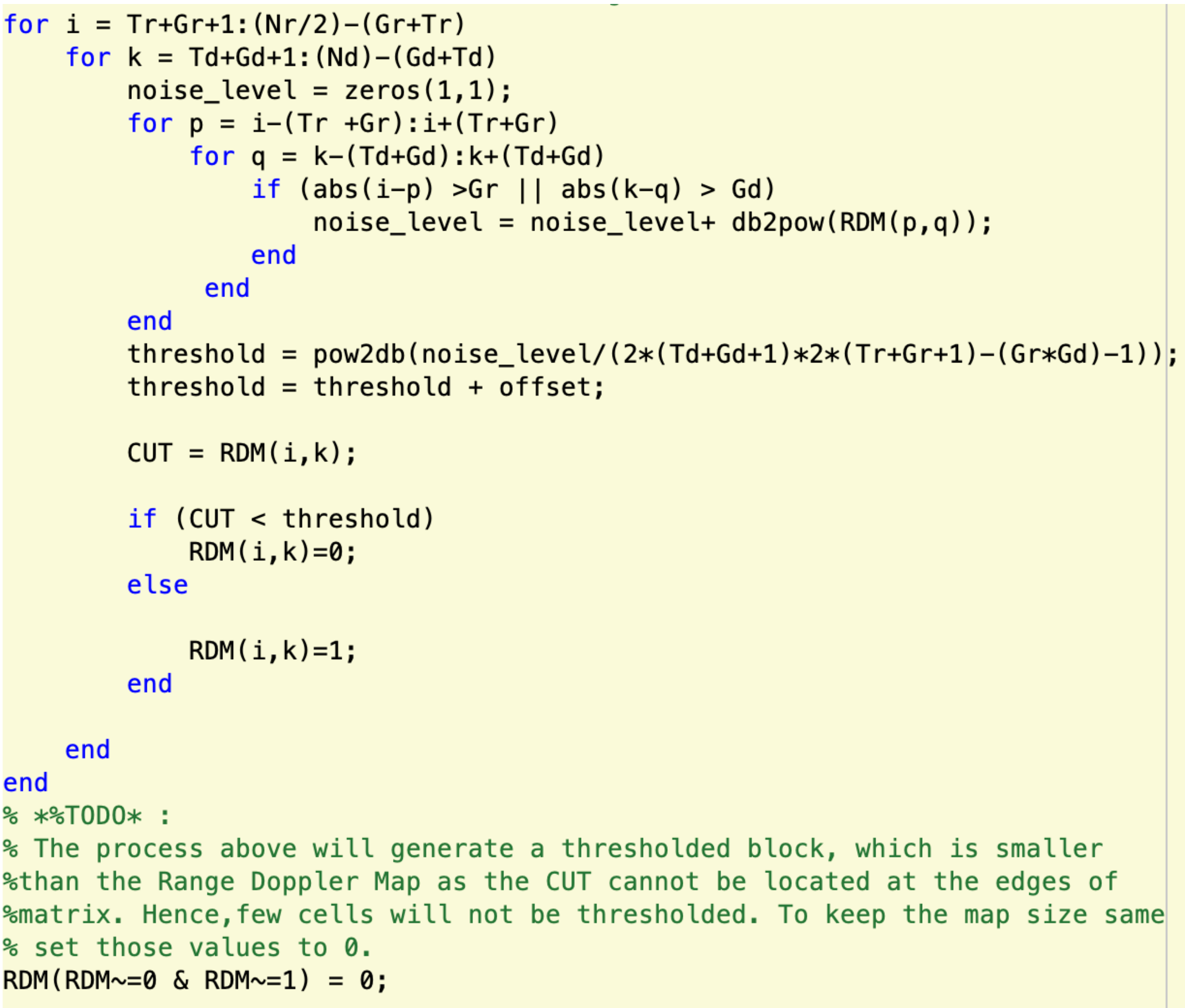
STEPS OF THE 2D CFAR:

- Slide the cell under test across the complete matrix. Make sure the CUT has margin for Training and Guard cells from the edges.
- For every iteration sum the signal level within all the training cells. To sum convert the value from logarithmic to linear using db2pow function.
- Average the summed values for all of the training cells used. After averaging convert it back to logarithmic using pow2db.
- Further add the offset to it to determine the threshold.
- Next, compare the signal under CUT against this threshold.
- If the CUT level > threshold assign it a value of 1, else equate it to 0.

The process above will generate a thresholded block, which is smaller than the Range Doppler Map as the CUTs cannot be located at the edges of the matrix due to the presence of Target and Guard cells. Hence, those cells will not be thresholded.

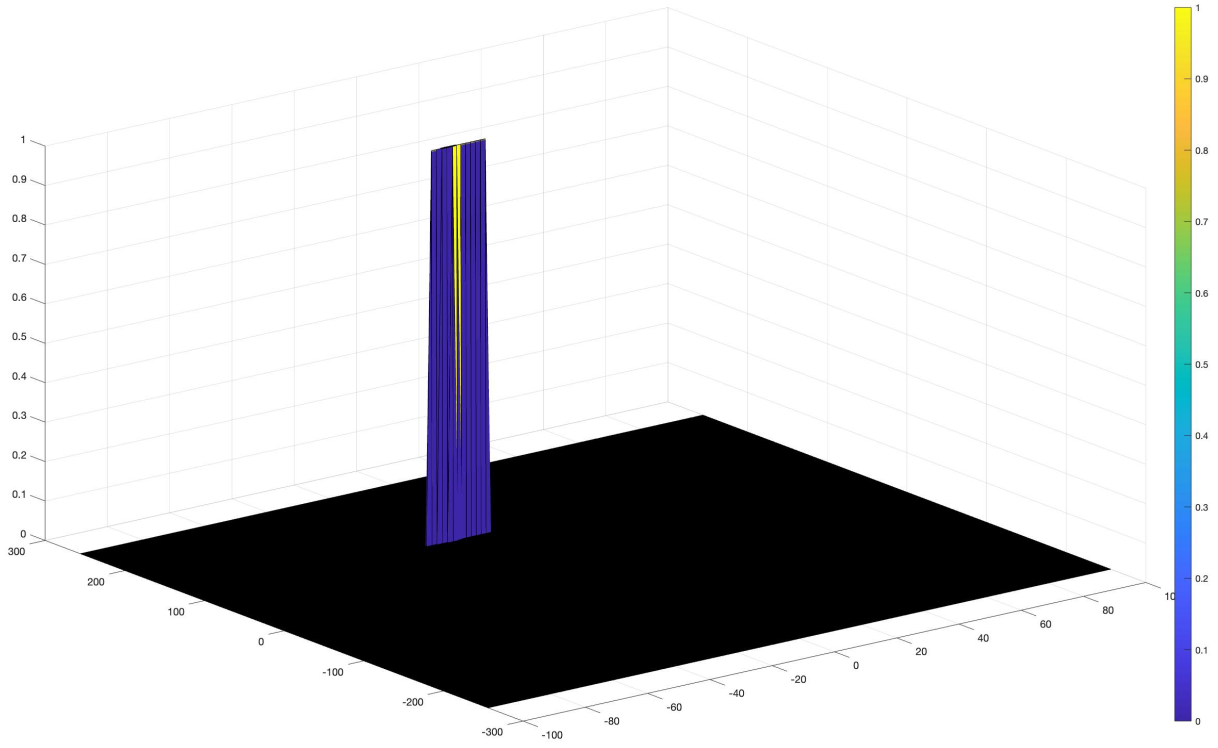
- To keep the map size same as it was before CFAR, equate all the non-thresholded cells to 0.

IMPLEMENTATION:



```
for i = Tr+Gr+1:(Nr/2)-(Gr+Tr)
    for k = Td+Gd+1:(Nd)-(Gd+Td)
        noise_level = zeros(1,1);
        for p = i-(Tr +Gr):i+(Tr+Gr)
            for q = k-(Td+Gd):k+(Td+Gd)
                if (abs(i-p) >Gr || abs(k-q) > Gd)
                    noise_level = noise_level+ db2pow(RDM(p,q));
                end
             end
        end
        threshold = pow2db(noise_level/(2*(Td+Gd+1)*2*(Tr+Gr+1)-(Gr*Gd)-1));
        threshold = threshold + offset;

        CUT = RDM(i,k);

        if (CUT < threshold)
            RDM(i,k)=0;
        else

            RDM(i,k)=1;
        end

    end
end
% *%TODO* :
% The process above will generate a thresholded block, which is smaller
%than the Range Doppler Map as the CUT cannot be located at the edges of
%matrix. Hence,few cells will not be thresholded. To keep the map size same
% set those values to 0.
RDM(RDM~=0 & RDM~=1) = 0;
```

OUTPUT:


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
300
200
100
0
-100
-200
-300
-100
-80
-60
-40
-20
0
20
40
60
80
10
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0