## FMCW Waveform Design:

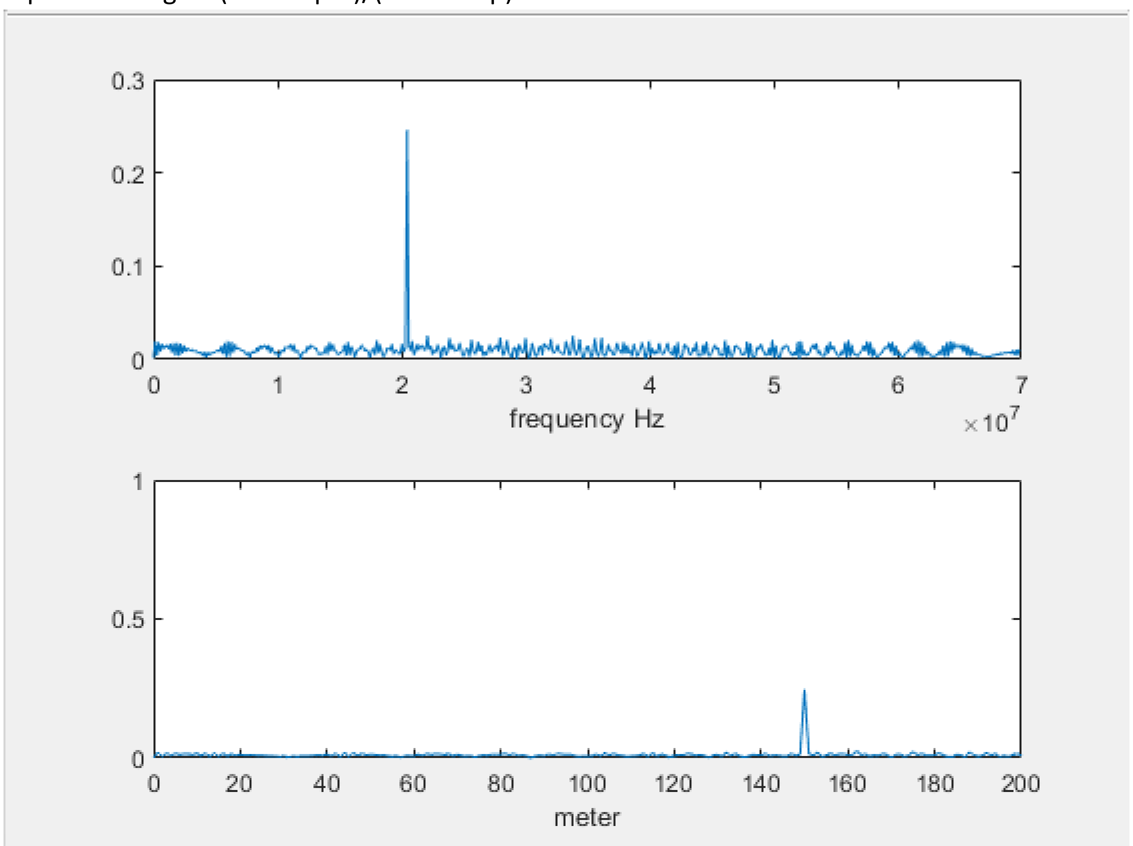
- Apply equation Bsweep = C/2/resolution, Tchirp = 5.5*2*(Max Range)/C, and Slope = Bsweep/Tchirp to calculate slope.

## Simulation Loop:

- Loop through each time stamp. Calculate position of the car based on constant speed model and the theoretical time(td) that receiver will receive the return radar signal. Use current time(t) to calculate radar emitting signal(Tx) and time delay(t-td) to calculate the receiving signal(Rx). Then, generate final detected signal = Tx*Rx.

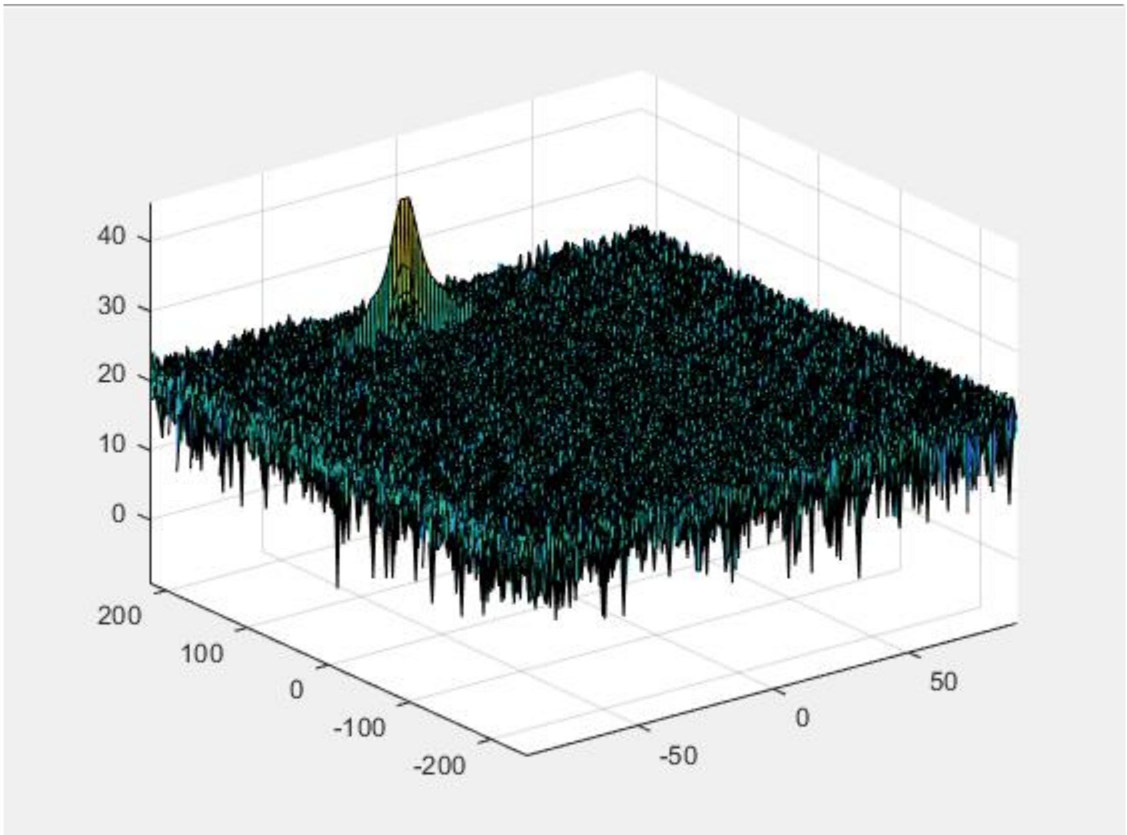
## Range FFT (1st FFT):

- Run 1D FFT along range axis. Plot two plots. The top one is frequency(f) vs the detected signal magnitude. The bottom one is range vs detected signal magnitude. The range is calculated by equation Range = (c*Tchirp*f)/(2*Bsweep).

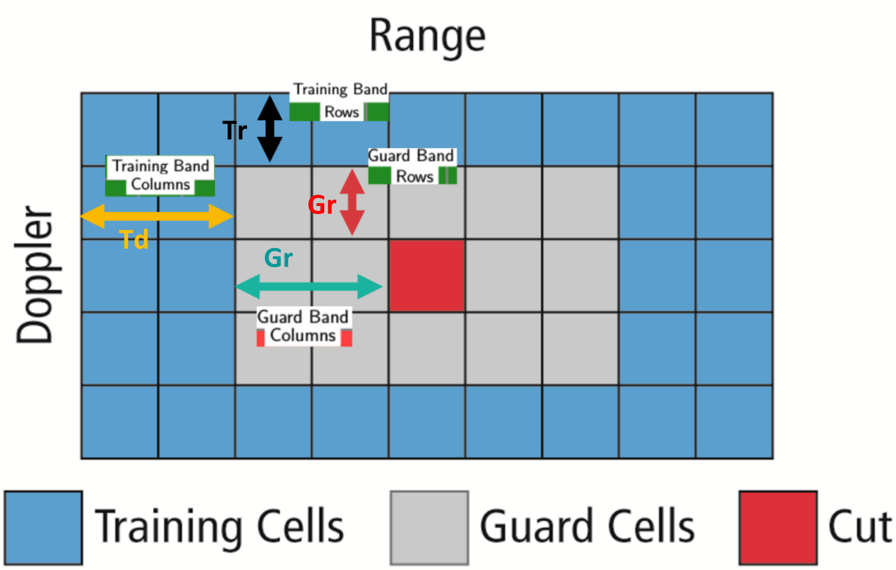


## 2D CFAR:

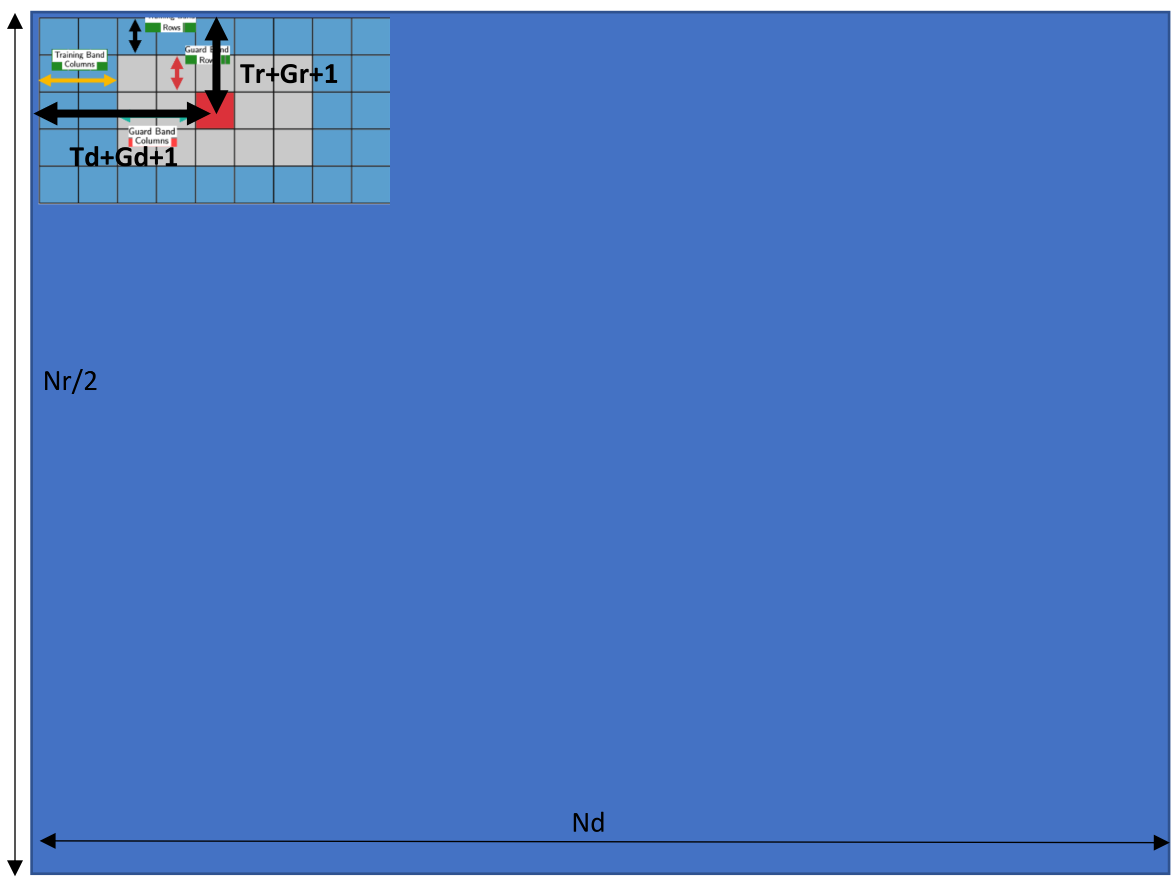
- Apply 2D FFT to process signal along both range and doppler axis. The following figure is the 2D FFT result (Radar Doppler Map (RDM)).



- Set training band length Tr and Td, and guard band length Gr and Gd for both range and doppler axes. Calculate total number of training cells. Create signal_CFAR matrix which will later be used to store final result. The dimension of signal_CFAR is the same as 2D FFT result. The initial value of signal_CFAR is zero.




- Slide this cell across the 2D FFT result with dimensions = (Nr/2, Nd). The starting position is (Tr+Gr+1, Td+Gd+1) and the end position is (Nr/2-Tr-Gr, Nd-Td-Gd).



- For each iteration, use function db2pow to get magnitude of each training cell from 2D FFT result. Then, average all the magnitude of training cell to create noise level. Afterwards, use threshold = pow2db(noise level) + offset) to create threshold.
- Compare 2D FFT result (RDM) at location (I, j) to threshold for each iteration, if RDM(I, j) > threshold, set signal_CFAR(I, j) = 1, otherwise set signal_CFAR(I, j) = 1.
- To deal with location (I, j) which is at the edge of the RDM map (i < Tr+Gr+1, i > Nr/2-Tr-Gr, j < Td+Gd+1 and j > Nd-Td-Gd), the signal_RDM(I, j) is set to 0. The following figure is the final result.