**Lab 1：Introduction**

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| **Introduction**  **Lab results & Analysis**：  **Verification of used lowpass filter used in Q1.**      Magnitude(dB)  **Q2. Get Range-Doppler Spectrums**  Traverse doppler frequency and range to find estimated delay difference and doppler frequency that make fuzzy function Cor(c, d) max. The spectrum will show the location of the specific (c, d) in the traverse range. The followings are range-doppler spectrum of the 20 time segments.                                          **Q3. Get the Time-Doppler Spectrum**  Connect the row corresponding to estimated delay difference of each range-doppler spectrum of the 20 time segments got in Q2. And this forms Time-Doppler spectrum.    According to the spectrum:  The Doppler frequency is first above 0 and increases and then decreases to negative and then increases to around 0 when time lapsing.  According to formula connecting doppler frequency and target velocity:    The target velocity first increases and the target is approaching the receiver radar. And then the velocity decrease to zero and the target begin to move away the receiver radar. And then the absolute value of the target begins to decrease and the target gradually stops. | |
| **Experience** | |
| **Score** |  |

**Code:**

**Verification of used lowpass filter used in Q1.**

clear; clc; close all;

load data\_1.mat

[lpf\_b, lpf\_a] = butter(20, 10e6/(f\_s/2));

[h,f]=freqz(lpf\_b,lpf\_a,1024,f\_s); % Digital filter frequency response

figure;

plot(f,20\*log10(abs(h))); % in dB scale

hold on;

plot(f, ones(1, length(f)).\*(-3));

xlabel('Frequency (Hz) ');

ylabel('Magnitude');

title(sprintf("lowpass filter of cutoff=%d", 10e6))

**Q2. Get Range-Doppler Spectrums**

**Q3. Get the Time-Doppler Spectrum**

% Plot TD Spectrum

fig3 = figure(21);

ScreenSize = get(0,'ScreenSize');

set(fig3,'Position',[0.5\*ScreenSize(3)+50,50,0.25\*ScreenSize(3)-100,0.5\*ScreenSize(4)-150]);

[meshgrid\_Doppler,meshgrid\_start\_time] = ...

meshgrid(array\_Doppler\_frequency,[array\_start\_time,array\_start\_time(end)+duration]);

plot\_A\_TD = zeros(length(array\_start\_time),length(array\_Doppler\_frequency));

for idx\_start\_time = 1:length(array\_start\_time)

plot\_A\_TD(idx\_start\_time,:) = abs(squeeze(A\_TRD(idx\_start\_time,idx\_max\_range(idx\_start\_time),:)));

end

plot\_A\_TD = plot\_A\_TD./max(plot\_A\_TD,[],2);

plot\_A\_TD = 20\*log10(plot\_A\_TD);

plot\_A\_TD(plot\_A\_TD<thres\_A\_TRD) = thres\_A\_TRD;

plot\_A\_TD = [plot\_A\_TD;thres\_A\_TRD\*ones(1,size(plot\_A\_TD,2))];

surf(meshgrid\_Doppler,meshgrid\_start\_time,plot\_A\_TD)

view(0,90)

colorbar

xlim([array\_Doppler\_frequency(1),array\_Doppler\_frequency(end)])

ylim([array\_start\_time(1),array\_start\_time(end)])

xticks([array\_Doppler\_frequency(1):20:array\_Doppler\_frequency(end)])

yticks([array\_start\_time(1):0.5:array\_start\_time(end)+duration])

xlabel('Doppler frequency (Hz)')

ylabel('Time (s)')

title('Time-Doppler Spectrum')