

Task 0

I don't mind if the lecture is digital or physical, but I would really like if the lectures are recorded as the lecture collides with something else for me. I read the powerpoints but I don't feel like this is sufficient.

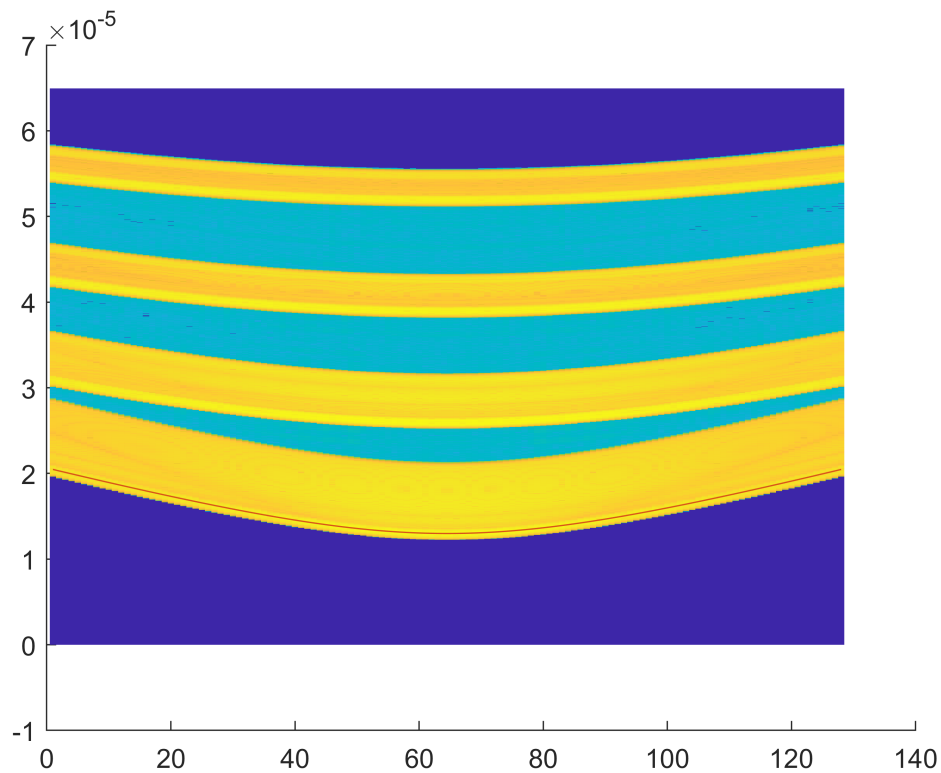
And I think either the assignments should be out earlier or the assignment lecture should be moved to Monday or Tuesday, as the time from getting the assignment to the assignment lecture/aid is very short.

Loading in the files and setting global variables given in assignment.

```
invivo_data = load("invivoData.mat");  
sim_data = load("simdata.mat");  
c = 1540;
```

Task 1

```
sim_elpos = sim_data.elPosX;  
sim_Rf = sim_data.RFdata;  
sim_Rf_t = sim_data.RF_t;  
x1 = 0;  
z1 = 0.01; %meter  
TOF_sim = TOF(z1,c,x1,sim_elpos);  
[sim_rows, sim_cols] = size(sim_Rf);  
sim_xaxis = linspace(1,sim_cols,sim_cols);  
%colormap(gray(256));  
%imagesc(sim_Rf');  
figure(1);  
imagesc('XData',sim_xaxis,'YData',sim_Rf_t,'CData', log(abs(sim_Rf)));  
hold on;  
plot(TOF_sim);
```



```
x = linspace( -2e-2, 2e-2, 256); %x-coordinates
zlen = 512;
z = linspace( 0, 4.5e-2, zlen).'; %z-coordinates
sim_elpos = permute(sim_elpos, [3 2 1]);
[X, Z] = meshgrid( x, z); %make X and Z matrices
% initialize TOF-matrix
%TOF_sim_0 = zeros( length(z), length(x), length(sim_elpos) );
TOF_sim_mat = TOF(z,c,x,sim_elpos);
```

Arrays have incompatible sizes for this operation.

Error in ass6_code>TOF (line 115)
`t_rx = (sqrt((x-elposx).^2 + z.^2))/c;`

Related documentation

```
%TOF_sim_mat = permute(TOF_sim_mat,[3,2,1])
```

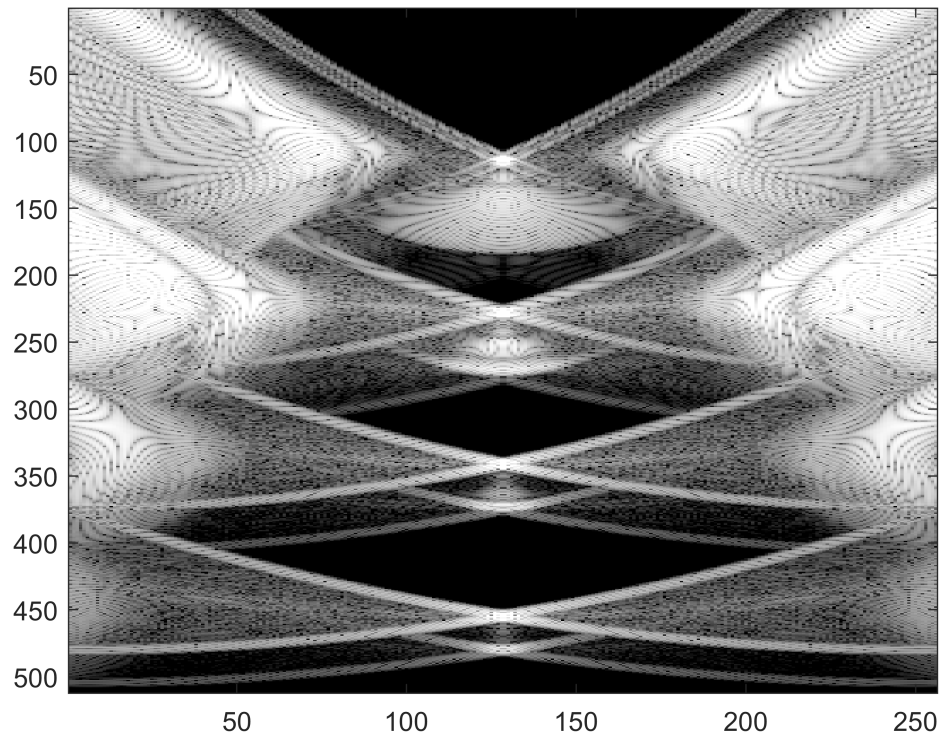
Task 2

```
gain = -80;
dyn = 80;
```

```

delayed_data = interpTOF(sim_Rf, sim_Rf_t, TOF_sim_mat);
bf_sim_rf = squeeze(sum(delayed_data,1));
figure(2), imagesc( 20*log10( abs( bf_sim_rf) ) )
caxis([-dyn 0]-gain);
colormap("gray");

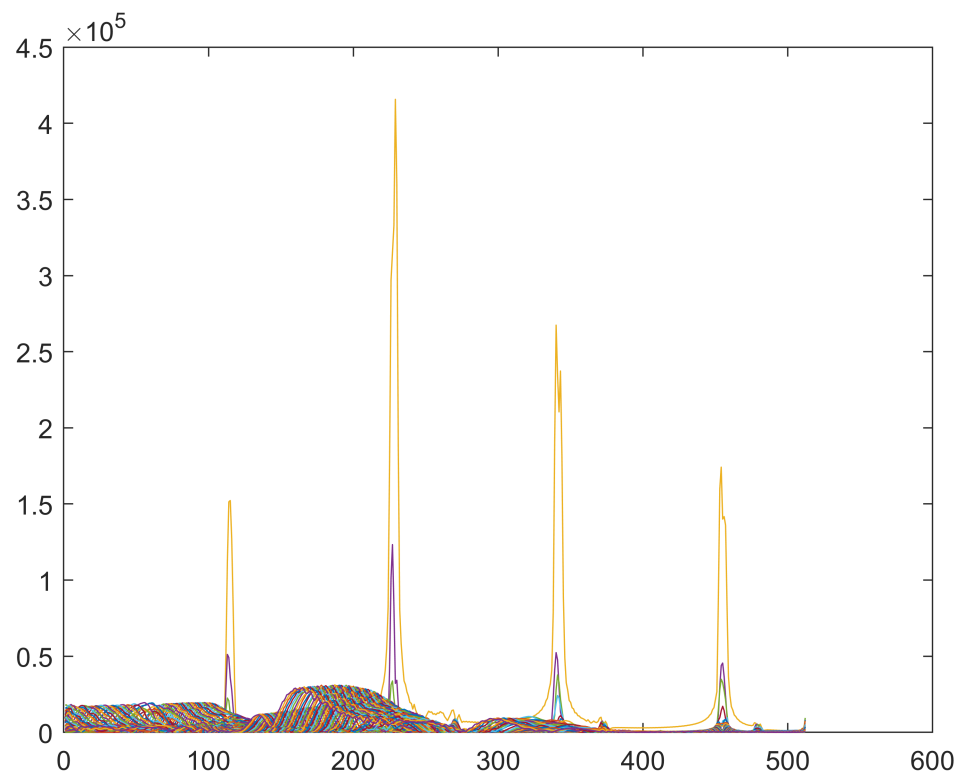
```



```

sim_envelope = abs(hilbert(bf_sim_rf));
figure(3);
plot(sim_envelope);

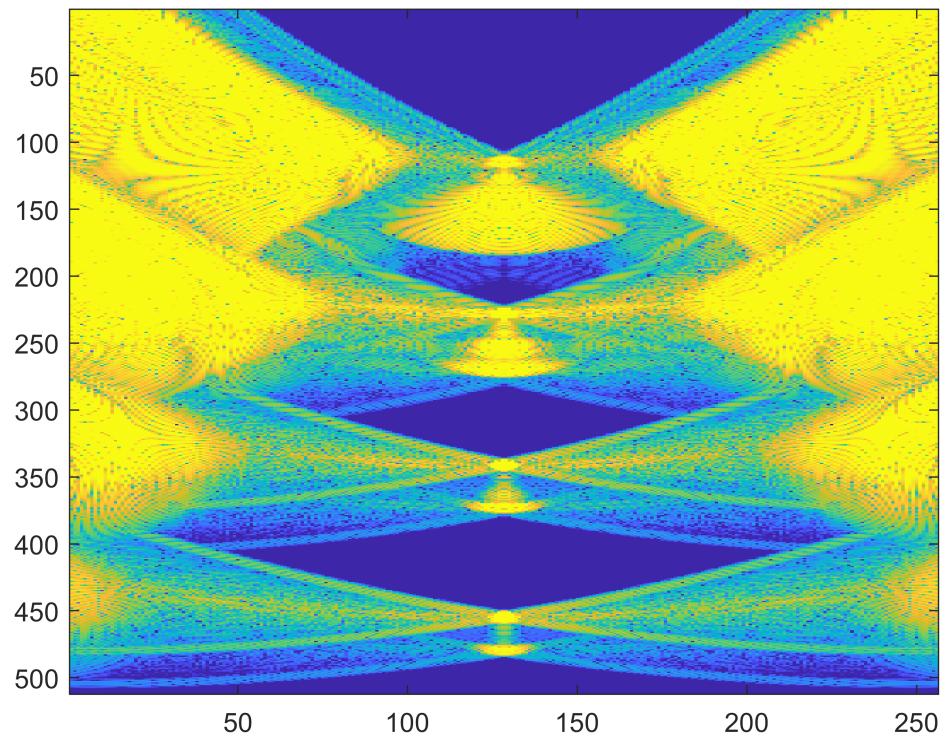
```



```

apod = hamming( size( delayed_data, 1) );
bf_sim_rf_apod1 = squeeze( sum( delayed_data.*apod) );
figure(4), imagesc( 20*log10( abs( bf_sim_rf_apod1) ) );
%colormap("gray");
dyn = 80;
gain = -60;
caxis([-dyn 0]-gain);

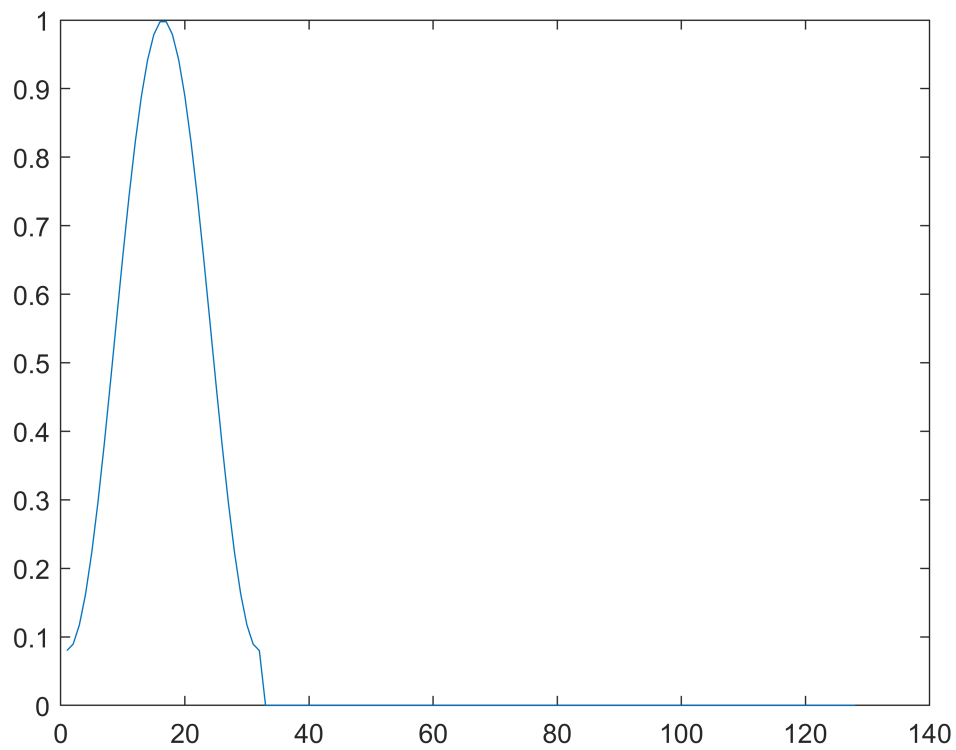
```



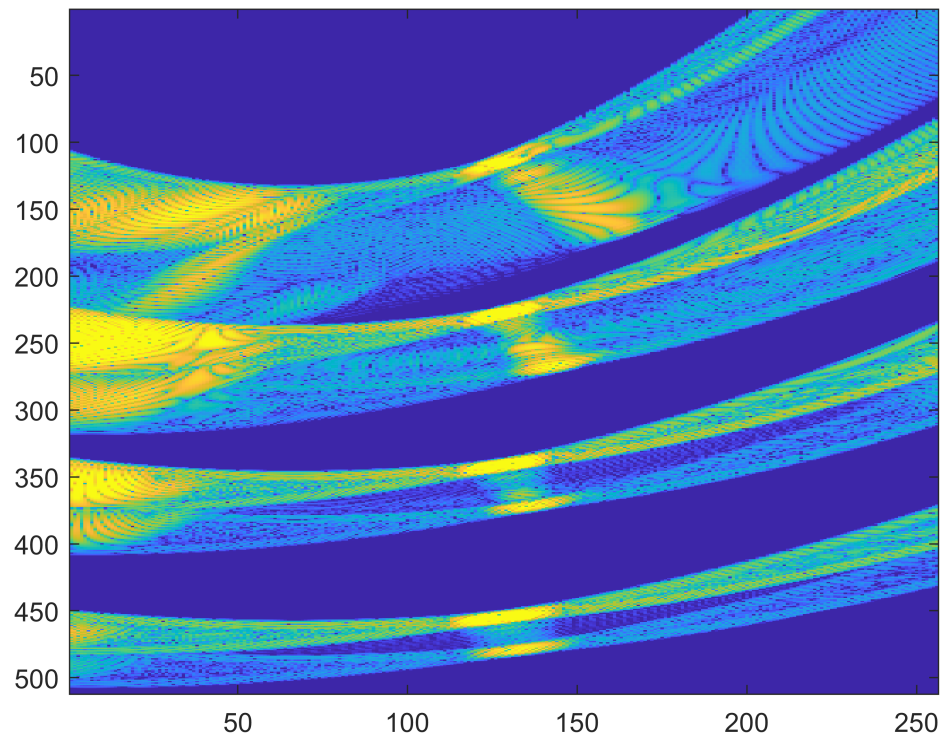
```

apod_32_first = zeros(size( delayed_data, 1),1);
apod_32_first(1:32) = hamming(32); %this didnt look right,
% but didnt quite understand how it should be done
bf_sim_rf_apod2 = squeeze( sum( delayed_data.*apod_32_first) );
figure(5);
plot(apod_32_first)

```



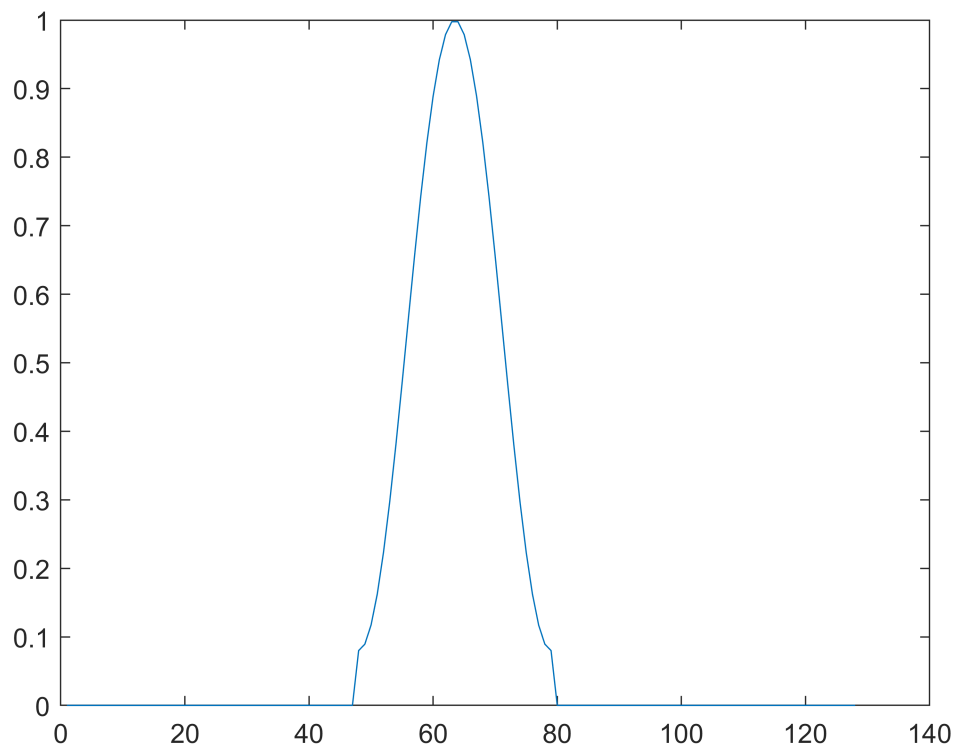
```
figure(6), imagesc( 20*log10( abs( bf_sim_rf_apod2) ) ); %dont know why  
% sometimes the color is blue and yellow and sometimes black and white.  
dyn = 80;  
gain = -60;  
caxis([-dyn 0]-gain);
```



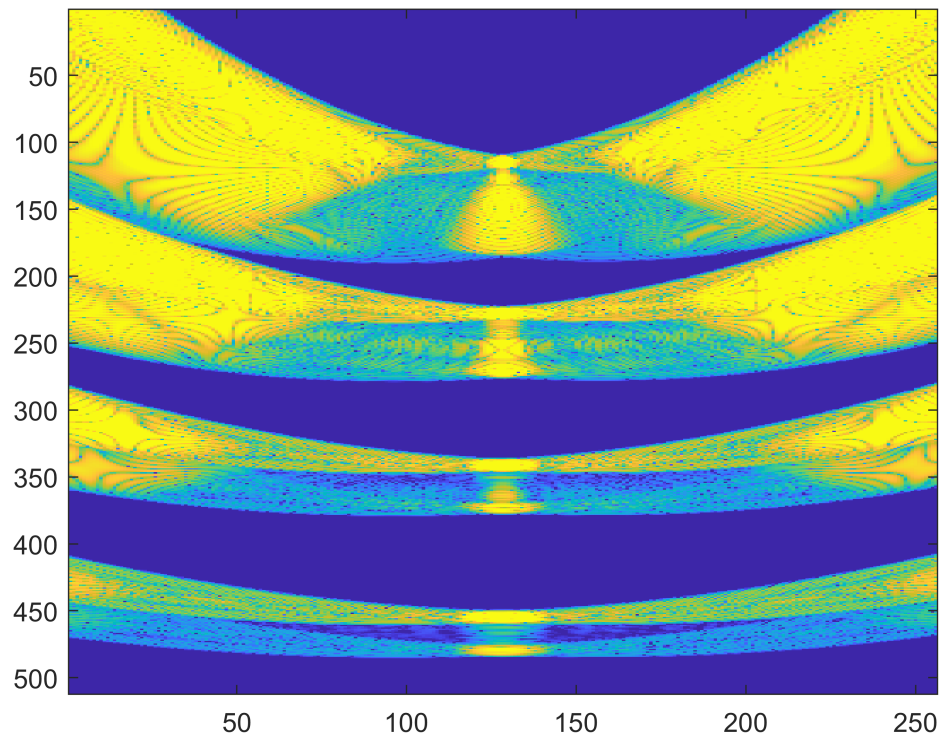
```

apod_32_center = zeros(size( delayed_data, 1),1);
apod_32_center(48:79) = hamming(32); %ich center
bf_sim_rf_apod3 = squeeze( sum( delayed_data.*apod_32_center) );
figure(7);
plot(apod_32_center)

```



```
figure(8), imagesc( 20*log10( abs( bf_sim_rf_apod3) ) ); %dont know why  
% sometimes the color is blue and yellow and sometimes black and white.  
dyn = 80;  
gain = -60;  
caxis([-dyn 0]-gain);
```

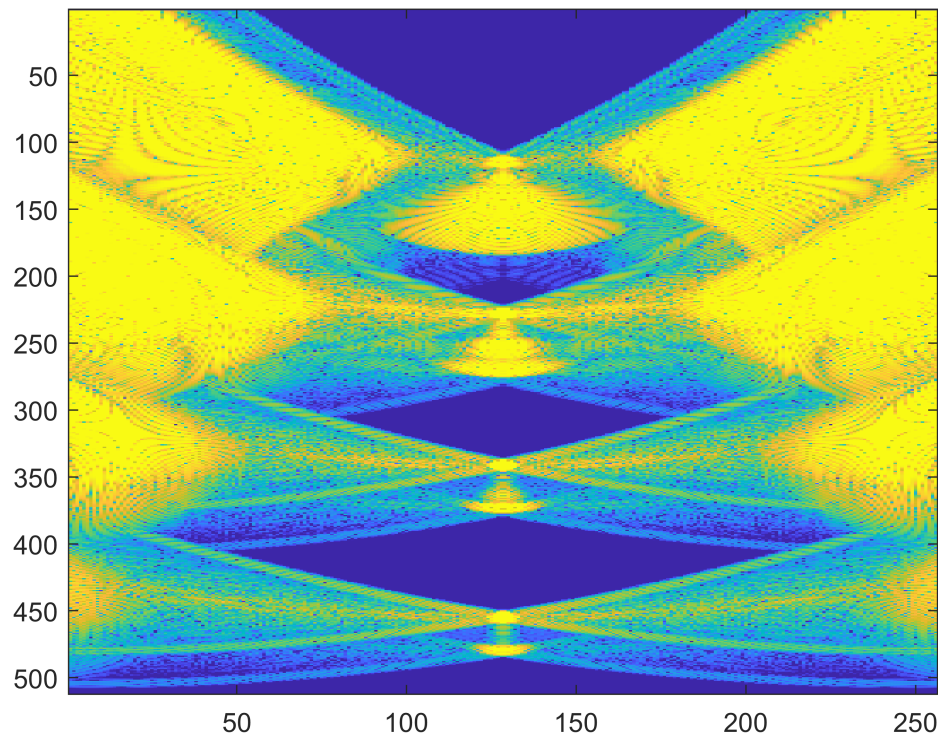



It seems like we are squeezing the image in different directions. And changing the size of the sidelobes.

Task 3

```
%for x = 0 amd fnumber = 1
F = 1;
expand_apod = zeros(length(sim_elpos),length(z),length(x));
for i = 1:length(x)
    expand_apod(:, :, i) = generateApod(sim_elpos, x(i), z, F);
end
bf_sim_rf_expand_apod= squeeze( sum( delayed_data.*expand_apod) );

figure(10);
imagesc( 20*log10( abs( bf_sim_rf_expand_apod) ) );
dyn = 80;
gain = -60;
caxis([-dyn 0]-gain);
```



```
%dont know why
% sometimes the color is blue and yellow and sometimes black and white.
```

With high $F\#$ the sidelobes gets distorted.

Task 4

```
viv_elpos = invivo_data.elPosX;
viv_Rf = invivo_data.RFdata;
viv_Rf_t = invivo_data.RF_t;

[viv_rows, viv_cols] = size(viv_Rf);
viv_xaxis = linspace(1,viv_cols,viv_cols);
```

```
% x = linspace( -2e-2, 2e-2, 256); %x-coordinates
% zlen = 512;
% z = linspace( 0, 4.5e-2, zlen).'; %z-coordinates
% viv_elpos = permute(viv_elpos, [3 2 1]);
% [X, Z] = meshgrid( x, z); %make X and Z matrices
% % initialize TOF-matrix
% %TOF_sim_0 = zeros( length(z), length(x), length(sim_elpos) );
% TOF_viv = TOF(z,c,x,viv_elpos);
```

Arrays have incompatible sizes for this operation.

```
Error in ass6_code>TOF (line 115)
    t_rx = (sqrt((x-elposx).^2 + z.^2))/c;
```

Related documentation

```
% delayed_data_viv = interpTOF(viv_Rf, viv_Rf_t, TOF_viv);
%
% F = 1;
% expand_apod_viv = zeros(length(viv_elpos),length(z),length(x));
% for i = 1:length(x)
%     expand_apod(:, :, i) = generateApod(viv_elpos, x(i), z, F);
% end
% bf_sim_rf_expand_apod= squeeze( sum( delayed_data.*expand_apod_viv) );
%
% bf_viv_rf_ea = squeeze(sum(delayed_data_viv.*exp_viv));
% figure(11), imagesc( 20*log10( abs( bf_viv_rf_ea) ) );
% caxis([-dyn 0]-gain);

%dont know why the tof didnt work now, this worked yesterday but when i
%tried today i get incompatible shapes
```

Functions

```
function t = TOF(z,c,x,elposx)
    t_tx = z/c;
    t_rx = (sqrt((x-elposx).^2 + z.^2))/c;
    t = t_tx+t_rx;
end
```