HW 3: Medical Imaging Systems

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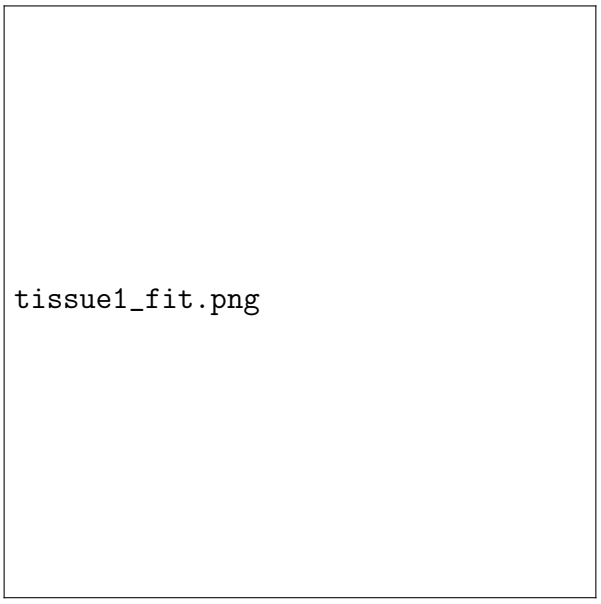
Q1

a: For question 1 I have re-drawn the sequence on the attached pages as can be seen in Drawing 1. The colors used correspond to the traversal of the K space in Drawing 2. On Drawing 2 a solid line designates a sampling and a dotted line signifies a traversal of the K space without sampling. The G_X axis is shown in red and the G_Y axis is shown in blue. The numbers labeling the traversals of the K space on Drawing 2 correspond to the different pulses in the sequence depicted in Drawing 1. In each case all of the G_X pulses are assumed to be equal (having equal area under the curve) except for the first G_X pulse which is assumed to have a an area under the curve that is half that of the subsequent ones. All of the G_Y pulses are assumed to have equal magnitude of area under the curve (some being negative). All traversals of the K space are thus given in a unit length. Following the trajectory from the origin first there is a dephasing pulse on G_X (1) that moves us to a position in the positive direction on the G_X axis of the K space to (1,0). Then there is a 180 pulse (2) that causes a traversal to a place on the negative G_X axis to (-1,0). Next there is a G_y pulse (3) that moves us to (-1.1) in the K space, followed by the first acquisition pulse (4) which acquires samples as we move from (-1,1) to (1,1). Next there is an inversion (5) that moves us to (-1,-1) followed by a negative G_Y pulse (6) that moves us to (-1,-2). Then another acquisition(7) as we move to (-1,-2) to (1,-2). Then an inversion (8) to (-1,2). Then a positive G_Y (9) to move to (-1,3). Then an acquisition (10) as we move to (1,3). Then an inversion (11) to (-1,-3). Then a negative G_Y (12) to move to (-1,-4). Then the final acquisition as we move to (1,-4).

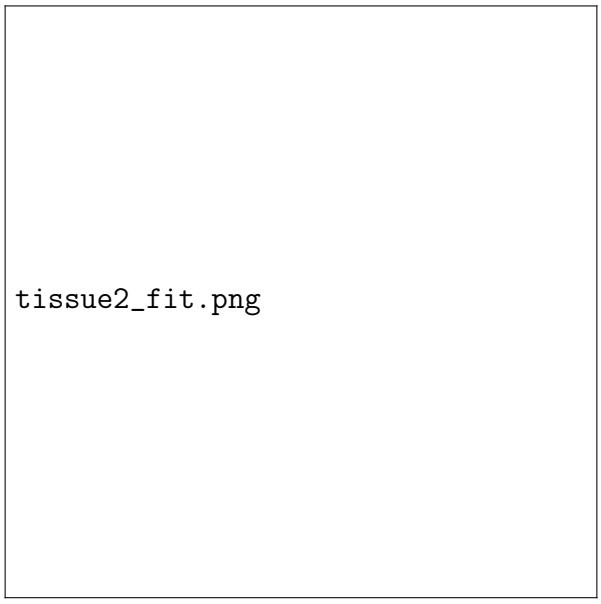
b:

```
%Q5
TI = [50 100 200 400 800 1600];
tissue1 = [-889 -684 -461 99.4 385 780];
tissue2 = [-261 -217 -108 118 254 339];

objFunc_tiss1 = @(param) LongMagIntensity(TI,tissue1,param);
optParams_tiss1 = fminsearch(objFunc_tiss1,[500,500]);
figure(1);clf();hold on;
plot(TI,tissue1,'r','linewidth',2);
plot([50:1600],optParams_tiss1(1).*(1-2*exp(-[50:1600]/
   optParams_tiss1(2))),'b','linewidth',2);
xlabel('TI (msec)');ylabel('intensity');set(gca,'fontsize',18);

objFunc_tiss2 = @(param) LongMagIntensity(TI,tissue2,param);
```

```
optParams_tiss2 = fminsearch(objFunc_tiss2,[500,500]);
figure(2);clf();hold on;
plot(TI,tissue2,'r','linewidth',2);
plot([50:1600],optParams_tiss2(1).*(1-2*exp(-[50:1600]/
   optParams_tiss2(2))),'b','linewidth',2);
xlabel('TI (msec)');ylabel('intensity');set(gca,'fontsize',18);

function cost = LongMagIntensity(TI,m,param)
M0 = param(1);
T1 = param(2);
cost = sum((m - M0 * (1 - 2*exp(-TI/T1))).^2);

end
```



(a)



(b)

Figure 1: Results of fitting the data for each tissue (red) and plotting using the fit parameters (blue) and Eq **??**. (a) shows the data and fit for tissue 1, while (b) shows the data and fit for tissue 2.