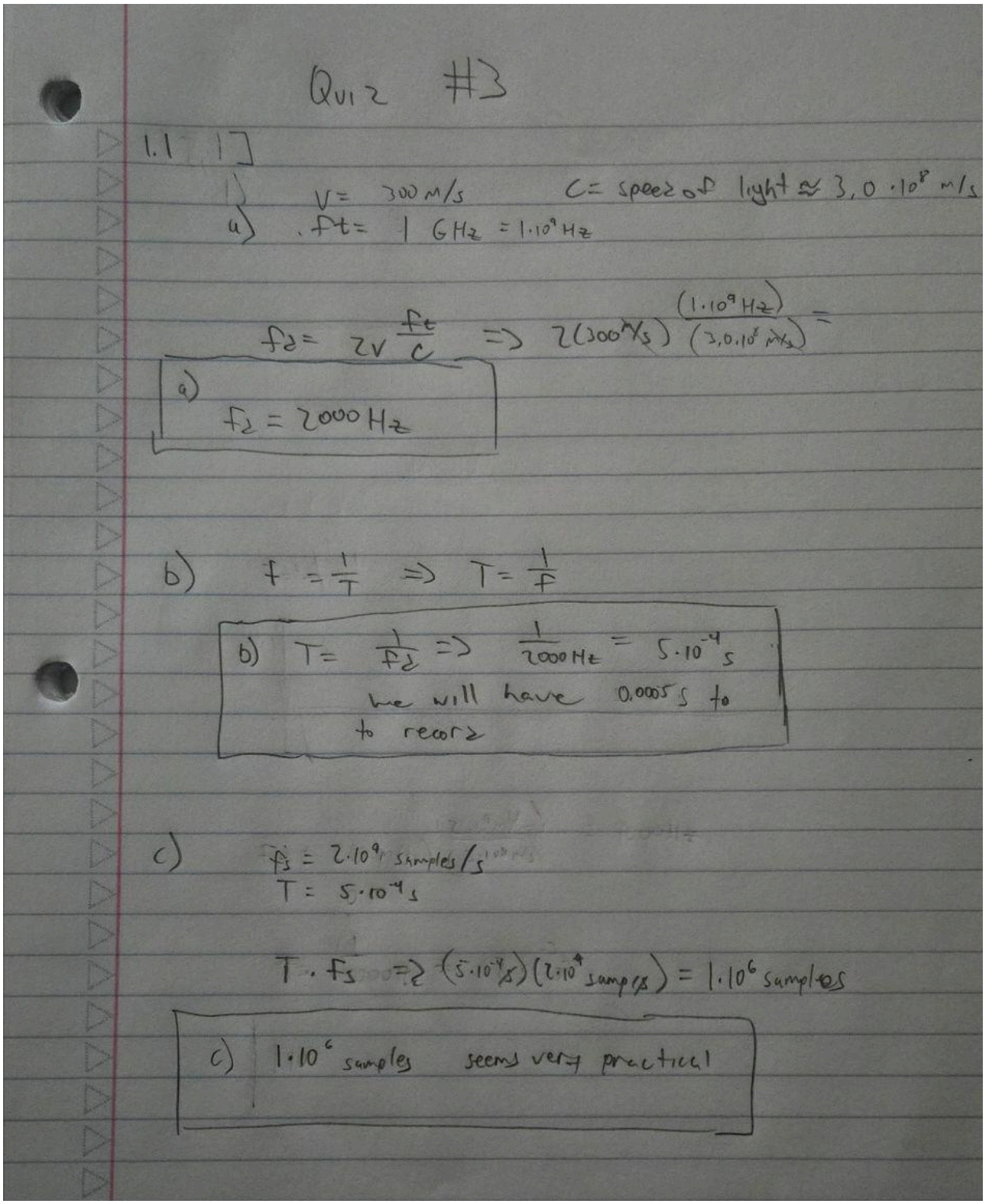
Problem 1.1



Quiz #3

1.1]

a) $V = 300\ m/s$ C = speed of light $\approx 3.0 \cdot 10^8\ m/s$

$f_t = 1\ GHz = 1 \cdot 10^9\ Hz$

$f_2 = 2V\frac{f_t}{C} \Rightarrow 2(300\ m/s)\frac{(1 \cdot 10^9\ Hz)}{(3.0 \cdot 10^8\ m/s)} =$

a) $f_2 = 2000\ Hz$

b) $f = \frac{1}{T} \Rightarrow T = \frac{1}{f}$

b) $T = \frac{1}{f_2} \Rightarrow \frac{1}{2000\ Hz} = 5 \cdot 10^{-4}\ s$

we will have 0.0005 s to to record

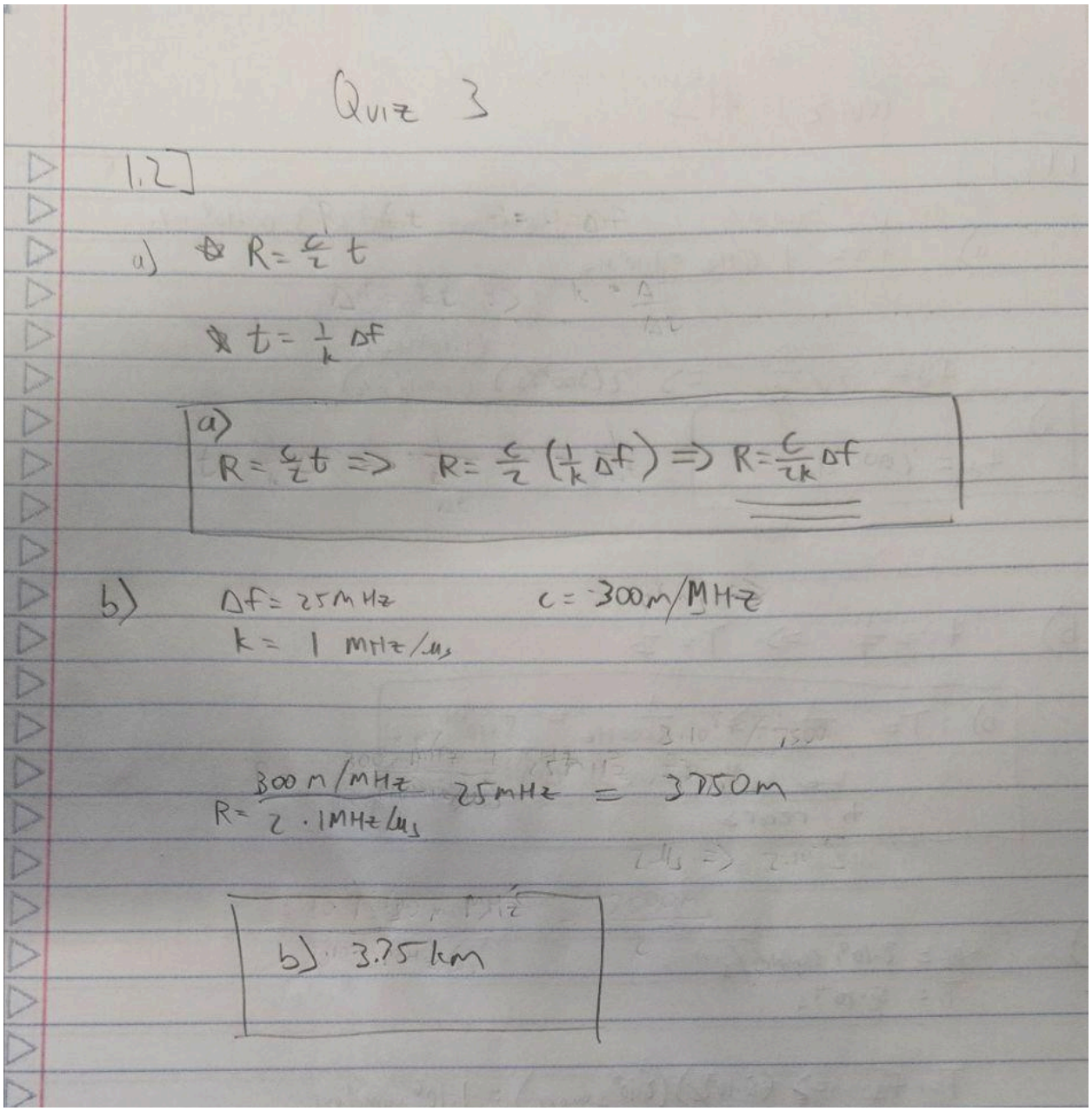
c) $f_s = 2 \cdot 10^9$ samples/s

$T = 5 \cdot 10^{-4}\ s$

$T \cdot f_s \Rightarrow (5 \cdot 10^{-4}\ s)(2 \cdot 10^9\ samples/s) = 1 \cdot 10^6\ samples$

c) $1 \cdot 10^6$ samples seems very practical

Problem 1.2



Quiz 3

1.2]

a) $R = \frac{c}{2} t$

$t = \frac{1}{k} \Delta f$

a)
$R = \frac{c}{2} t \Rightarrow R = \frac{c}{2} \left(\frac{1}{k} \Delta f\right) \Rightarrow R = \frac{c}{2k} \Delta f$

b) $\Delta f = 25\,MHz$ $\quad c = 300\,m/MHz$

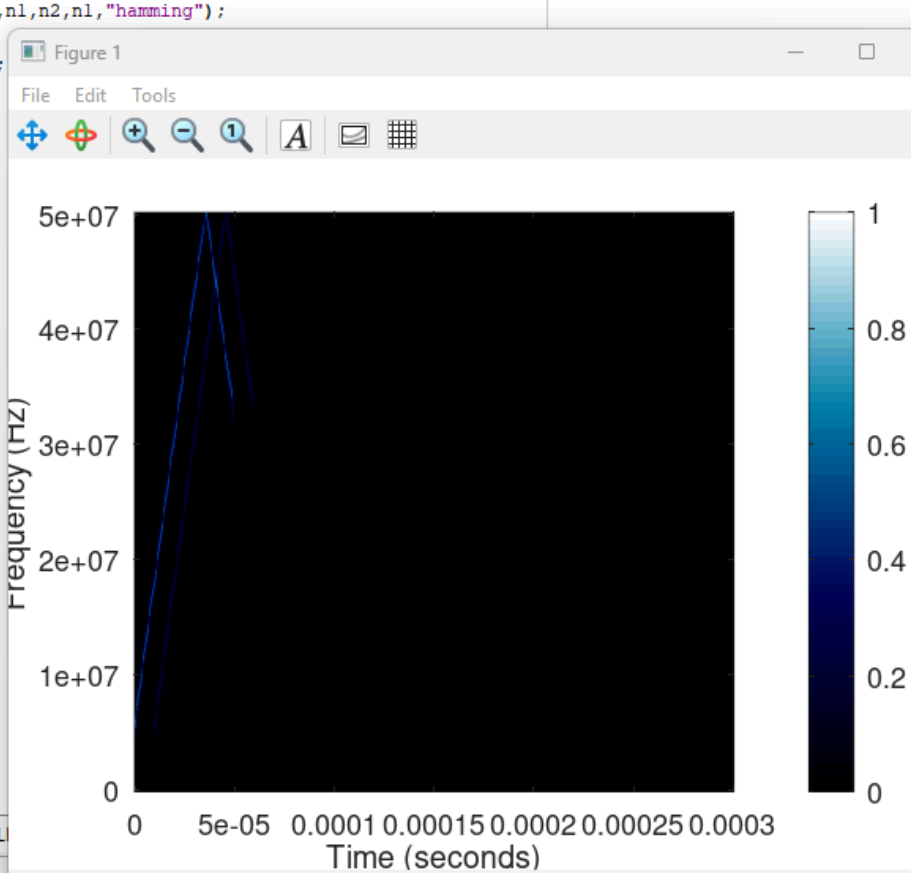
$k = 1\,MHz/\mu s$

$R = \frac{300\,m/MHz \cdot 25\,MHz}{2 \cdot 1\,MHz/\mu s} = 3750\,m$

b) 3.75 km

Problem 1.3

```
clear;
close;
home;

pkg load signal

data = load('DSPRadar.txt');
data = data(1:2:end,1:2);

n1 = 128;
n2 = 64;
T = data(end,1) - data(1,1);
dt = data(2,1) - data(1,1);

fs = 1/dt;

[sdata, info] = stft(data(:,2),n1,n2,n1,"hamming");
sdata = sdata(1:end/2,:);
[n_freq, n_time] = size(sdata);
fbins = [0 fs/2];
tbins = [0 T];
sdata = abs(sdata);

figure(1)
image(tbins,fbins,sdata)
xlabel('Time (seconds)')
ylabel('Frequency (Hz)')
h = colorbar();
colormap('ocean')
set(gca(),'fontsize',18)
set(h,'fontsize',18)
set(gca(),'YDir','normal');
```

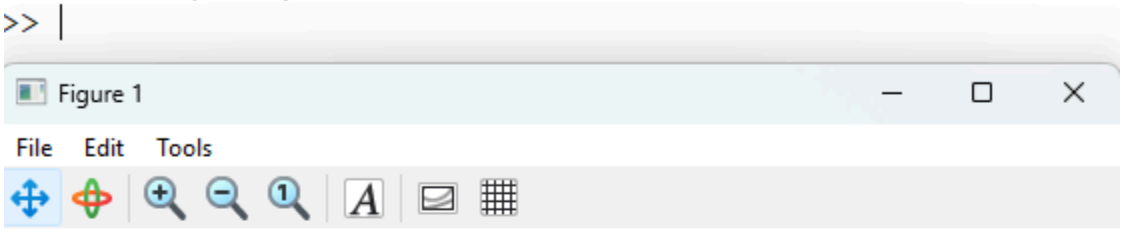


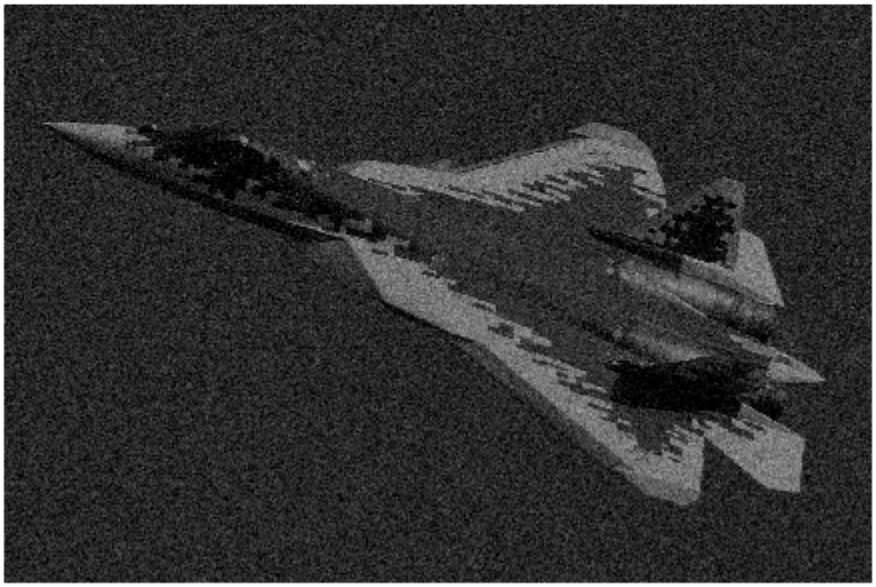
col: 28 encoding: UTF-8 eol: CRL

2.4

Problem 2.1

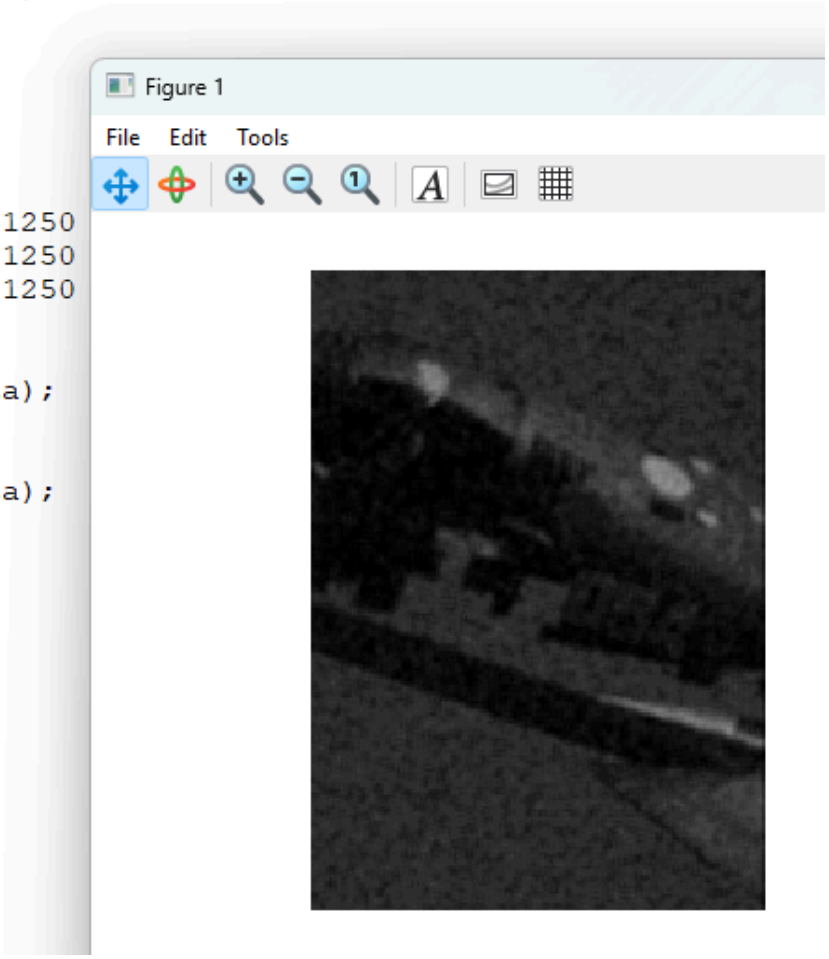
```
>> data = imread('aircraft.jpg');
>>
>> imshow(data)
>>
```





Problem 2.2

```
>> data = imread('aircraft.jpg');
>>
>> data = data(:,:,1);
>> data = data(1:450,1:450);
>>
>> imshow(data);
>>
>> k = ones(3)/9;
>> k
k =

    0.1111    0.1111    0.1111
    0.1111    0.1111    0.1111
    0.1111    0.1111    0.1111

>> proc = filter2(k,data);
>> imshow(proc)
>> proc = uint8(proc);
>> imshow(proc);
>> k = -ones(3)/8
k =

   -0.1250   -0.1250   -0.1250
   -0.1250   -0.1250   -0.1250
   -0.1250   -0.1250   -0.1250

>> k(2,2) = 1.0;
>> proc = filter2(k,data);
>> imshow(proc)
>> k = ones(3)/9;
>> proc = filter2(k,data);
>> proc = uint8(proc);
>> imshow(proc)
>>
```



Problem 2.3
Based on the image above it looks like the numbers are 054

Problem 2.4 (Jet Image)

The fighter jet is a Russian Su-57