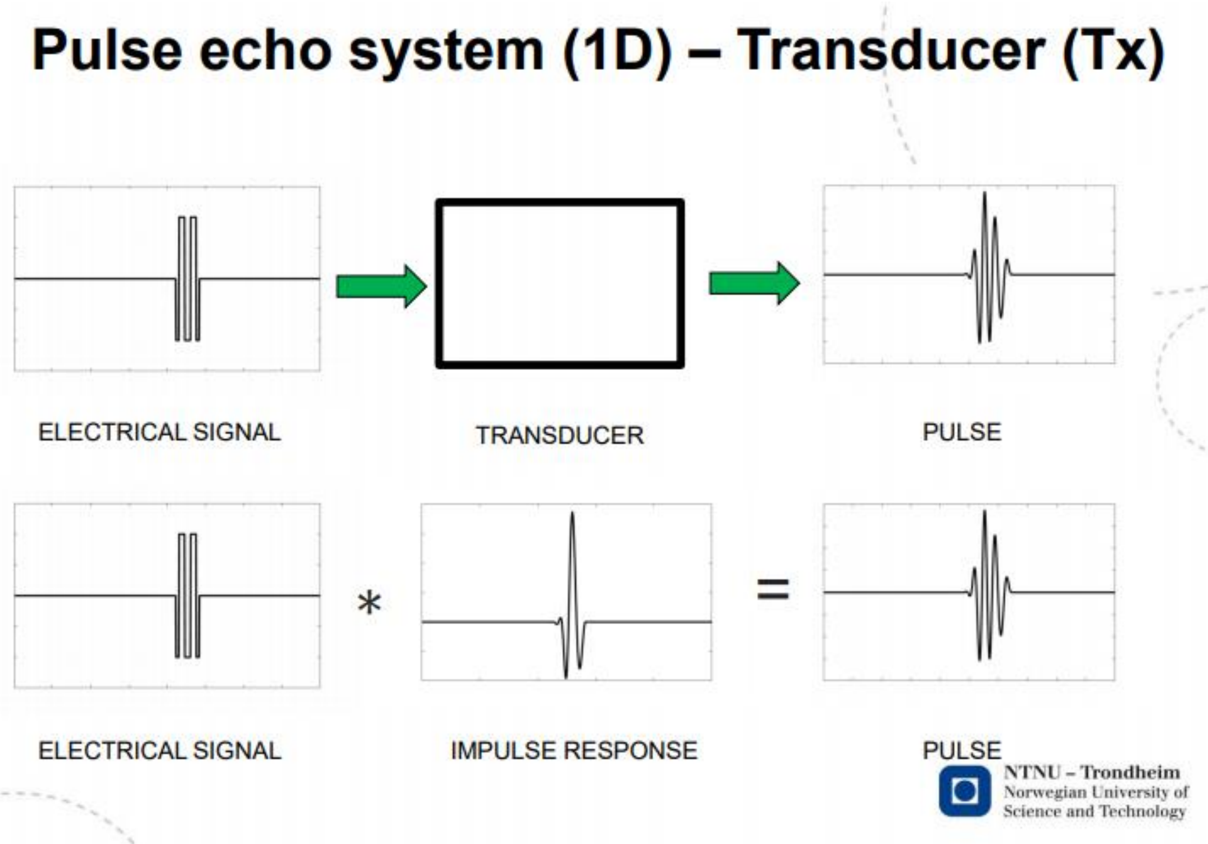
MEDT4165
Exercise 3
Abdullah Zahir
1)



2a) Higher frequency and shorter pulse length gives higher resolution. Higher frequency attenuate much faster with depth. Shorter pulse length gives higher resolution because when the signal gets reflected from a surface, the reflected signal will oscillate with the same length as the transmitted pulse length. By using shorter pulse length one can separate two targets close to each other.

In my case, the center frequency of 4MHz and pulse length of 0,5*10^-6 s gave best resolution.

2b) by decreasing the frequency from 4MHz to 2.5MHz and increase the pulse length from 0.5 to 1*10^-6 s gives higher SNR.

2c) By increasing the frequency from 2.5MHz to 3MHz and have a pulse length of 1*10^-6, I get a good resolution and high SNR.

3) If the thickness of the fat layer is lambda/2 I get lower SNR due to destructive interference. If the fat layer is lambda/4 I get high SNR due to constructive interference. The reason for this is that we get a phase shift from the first interface due to pressure release, and a rigid reflection from the second interface. So, the reflected waves from the lambda/4 add up in phase, while the reflected waves from lambda/2 will not add up.

For lambda/4:

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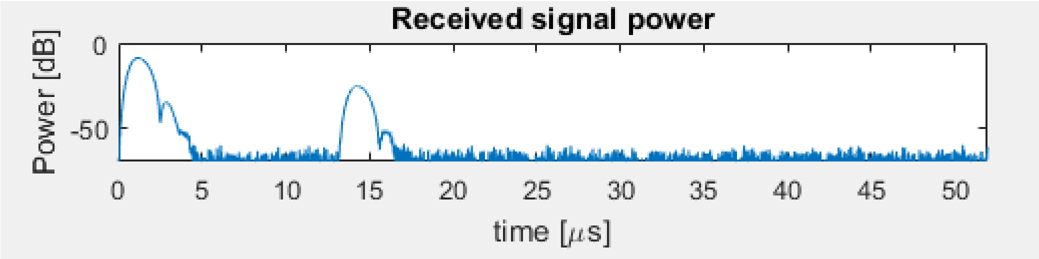
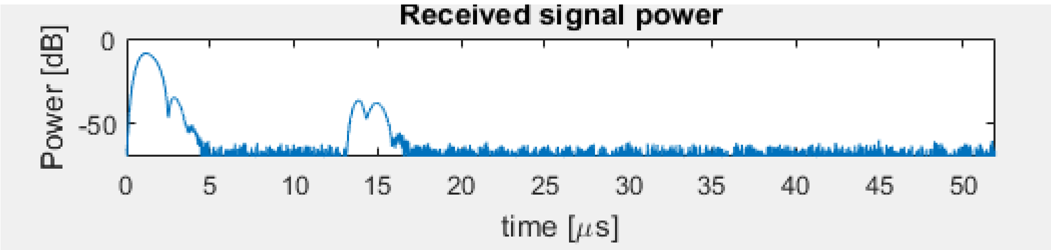
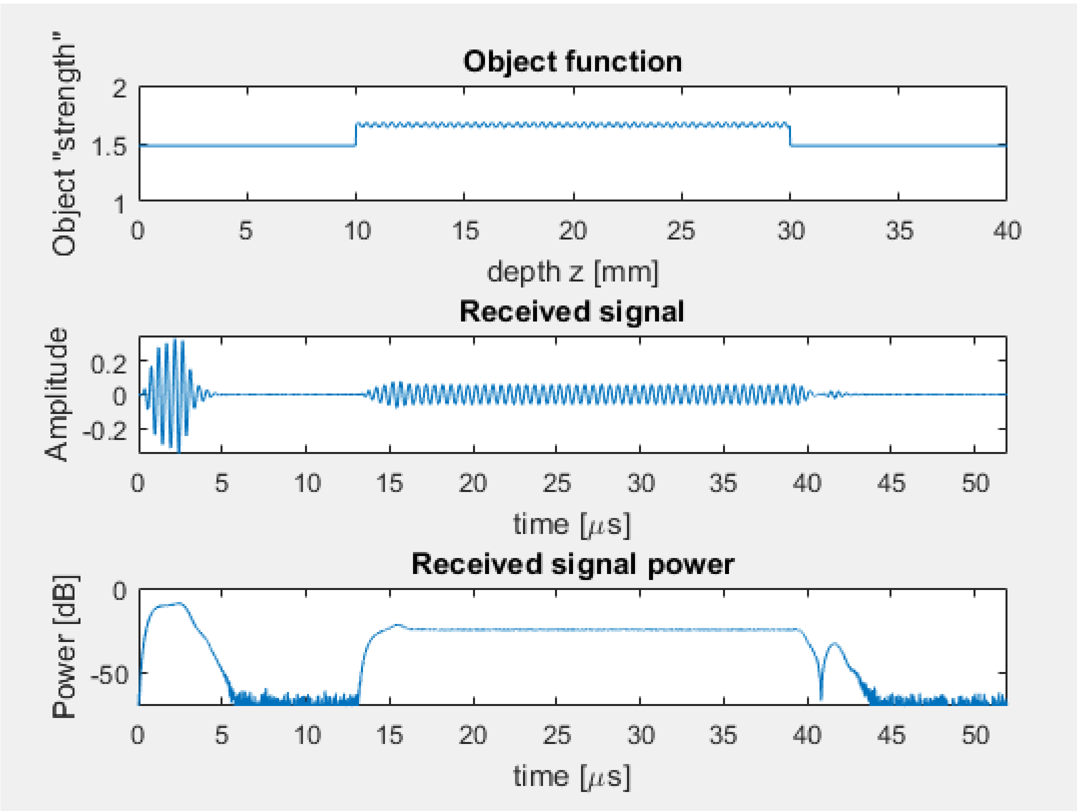


For lambda/2:



4) With the center frequency of 2MHz:



With the center frequency of 4MHz:

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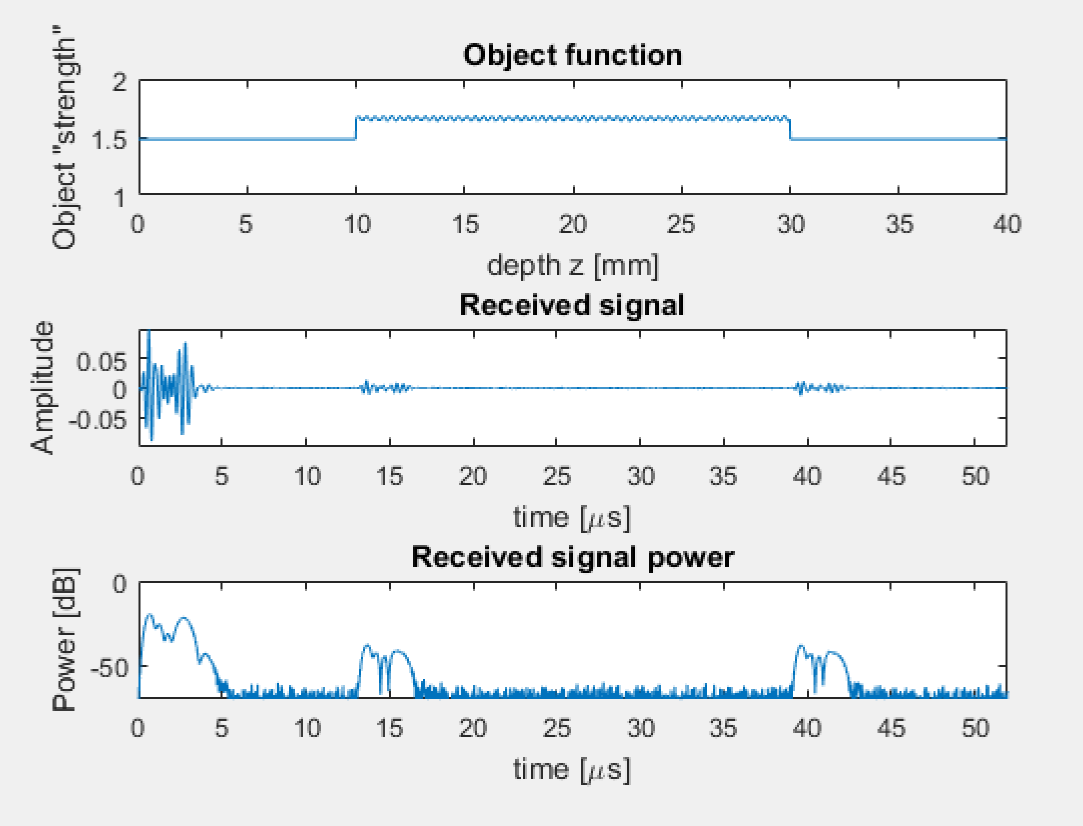

The explanation about this effect is that, since the variation of the medium is at 2MHz and the center frequency is 2MHz, we are moving with the variation in the medium. Meaning that we are detecting a signal from the medium throughout the whole medium (muscle tissue). So if we are in the medium(muscle), we are detecting. And since the transmitted frequency and the variation frequency are the same, the detected signal will in average ad up.

But when we increase the frequency to 4 MHz, we get variation in the transmitted frequency and the tissue frequency. Meaning that we are not getting any detection of the medium except at the boundaries.

Code:

```
Z=ones(size(z))*Z1;

for i=(1+round(z1/dz):1+round(z2/dz))
    Z(i)=1.66+0.02*sin(2*pi*(1/0.385e-3)*z(i));
end
```

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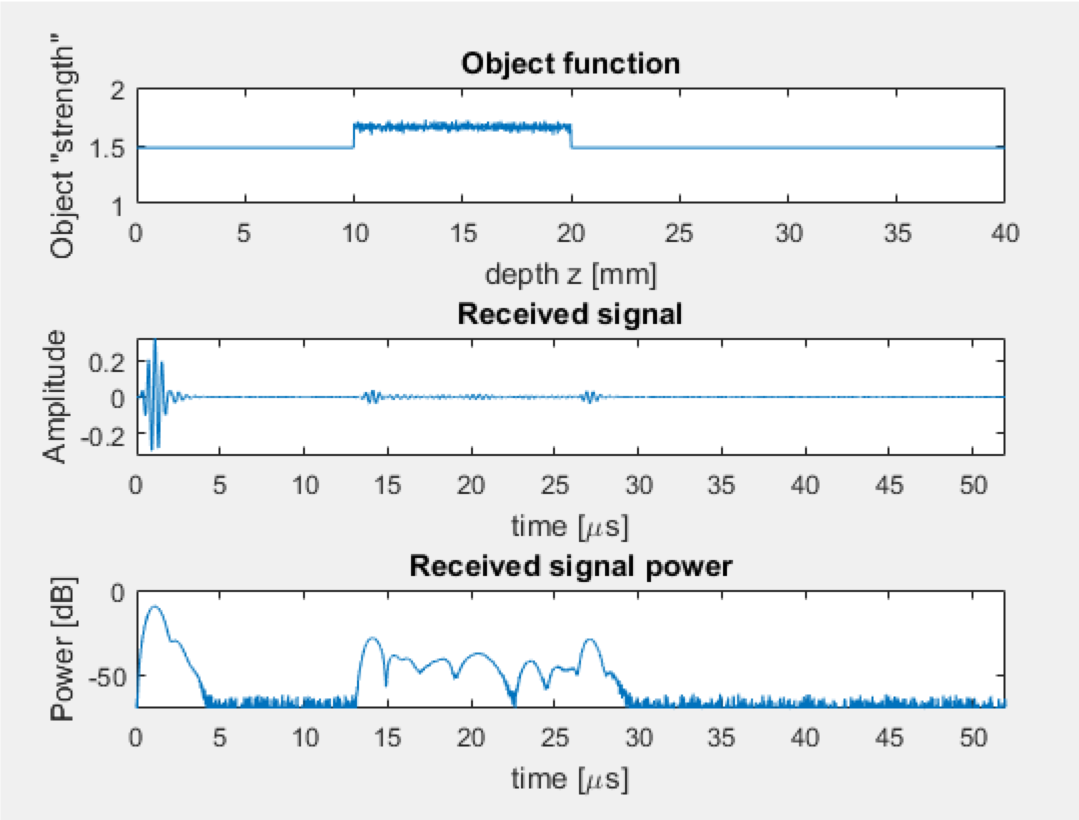
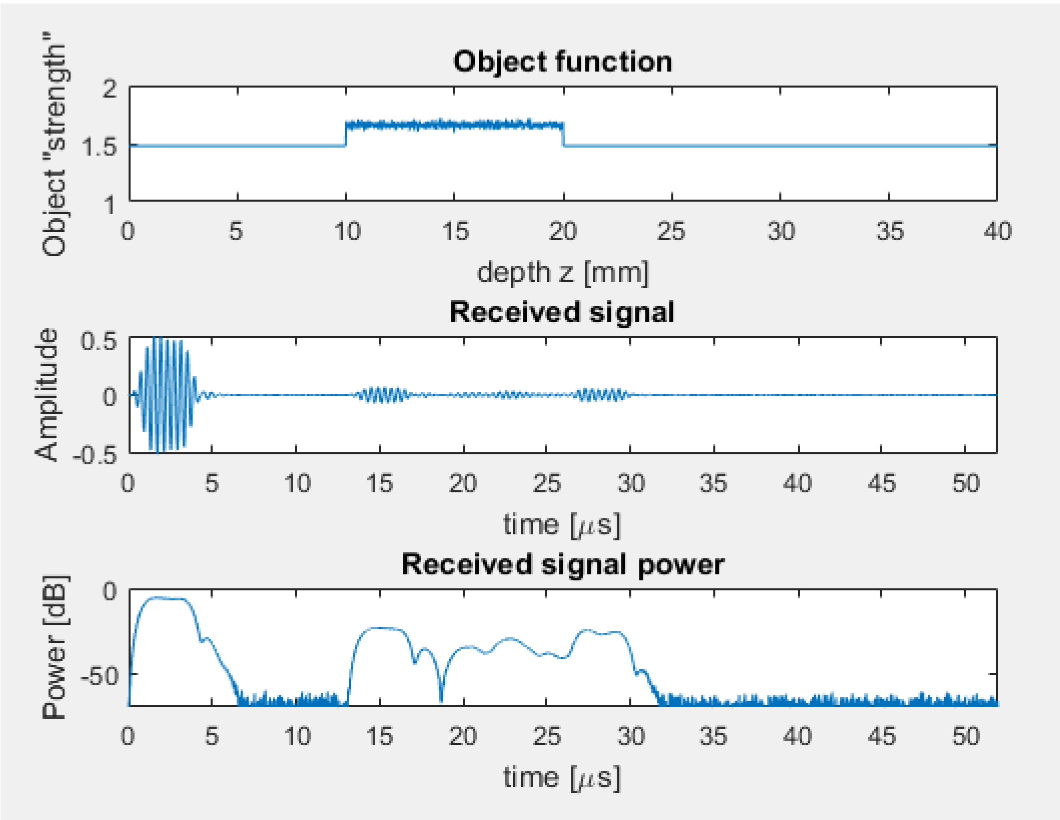
5) For Tp=0.6*10^-6s we get:



For Tp=3*10^-6s, we get:



As one can see, we get rapid variations of the received signal for Tp=0.6*10^-6s. This is because the bandwidth of the signal is smaller. The effect of smaller bandwidt is that the varations of the reflected wave at the interface is shorter, resulting in rapid change in the received signal. With a longer bandwidt hence longer pulslength, one gets longer variations of the reflected wave at the interface. This means that the rapid variations in the recievde signal is proportional to the puls lenght. This implies that the corrolation length is proportional to the puls length. So when the Tp is small, we get small corrolation length and rapid variations of the received signal, and vice versa.

Code:

```
Z=ones(size(z))*Z1;
%Z((1+round(z1/dz):1+round(z2/dz)));

Gn=normrnd(1.66,0.02,[size(Z),1]);

count=1;
for i=(1+round(z1/dz):1+round(z2/dz))%medium with fat/muscle
    Z(i)=Gn(count);
    count=count+1;
end
```