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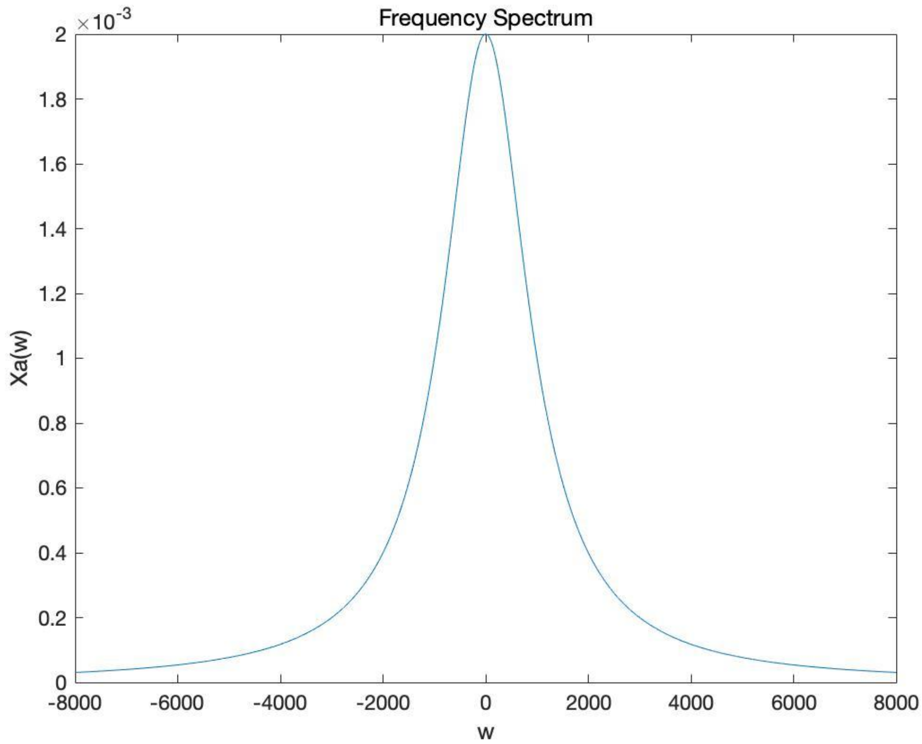
Assignment 2

Task 1

1. Code

```
a=1000;
w=linspace(-8000,8000,100000);
for k=1:length(w)
   Xa(k)=2*a/(a^2+w(k)^2);
end
plot(w,Xa);
title('Frequency Spectrum');
xlabel('w');
ylabel('Xa(w)');
```

2. Graph



3. Comment

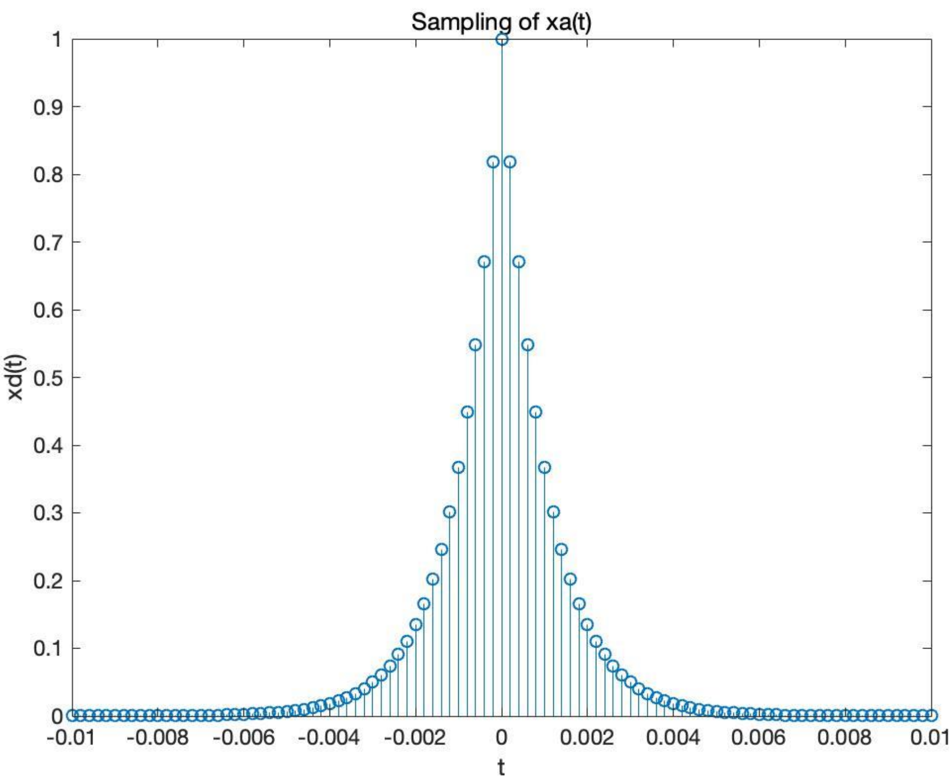
The main task of Task1 is to plot the spectrum of Xa(t), also known as Xa(omega), by means of analysis. This allows us to compare it with the spectrum formed later by sampling the signal afterwards.

Task 2

1. Code

```
a=1000;
n=-50:50;
Fs=5000;
Ts=1/Fs;
t=n*Ts;
xd=exp(-a*abs(t));
stem(t,xd);
title('Sampling of xa(t)');
xlabel('t');
ylabel('xd(t)');
```

2. Graph



3. Comment

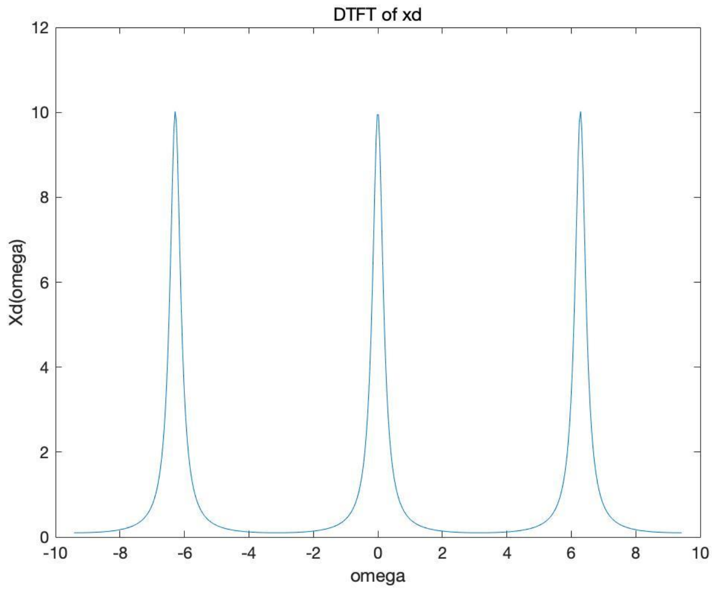
In Task2, we set the sampling frequency, the sampling period, and set the matrix n to form the range we are sampling. By this method, we obtain a discrete signal obtained by sampling the original signal with Xa (t).

Task 3

1. Code

```
w = linspace(-3*pi,3*pi,500);
Xd = zeros(1,length(w));
for k=1:length(w)
   Xd(k)=sum(xd.*exp(-1i*w(k)*n));
end
plot(w,abs(Xd));
title('DTFT of xd');
xlabel('omega');
ylabel('Xd(omega)');
```

2. Graph



3. Comment

$$X(\omega) = \int_{-\infty}^{\infty} x(t)\cdot e^{-j\omega t}\cdot dt := \frac{1}{T}\sum_{n=-50}^{50} X(\omega - n\omega_d$$

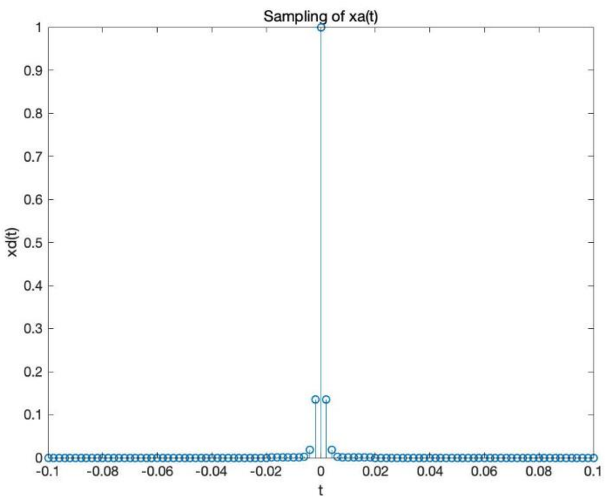
When we perform the Fourier transform on xd, we find that it is the sum of the scaled and shifted X(omega) obtained by performing the Fourier transform on xa itself. This is why the image we obtain is in period 2*pi. Comparing the plots obtained by Task3 with those obtained by Task1, we can clearly find similarities, and in terms of peaks, exactly the results that should be obtained by multiplying the set Fs.

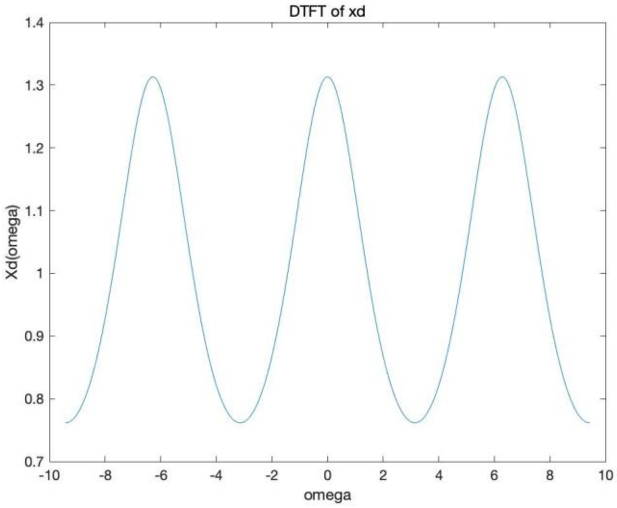
Task 4

1. Code

We changed the value of Fs from 5000 to 500.

2. Graph





3. Comment

1. After turning down the value of Fs, the sampled frequency is reduced and the obtained images are not as close as those obtained by Task2.
2. As the Fs decreases, the ws takes a lower value as a result, and comparing this with the CTFT of the previous continuous signal, a more pronounced distortion can be found. This is more clearly contrasted in the upper and lower peaks.