

**UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE**

PROCESSAMENTO DIGITAL DE SINAIS



# **PROJETO PDS**

**Filtro FIR, dizimação, FFT e IFFT**

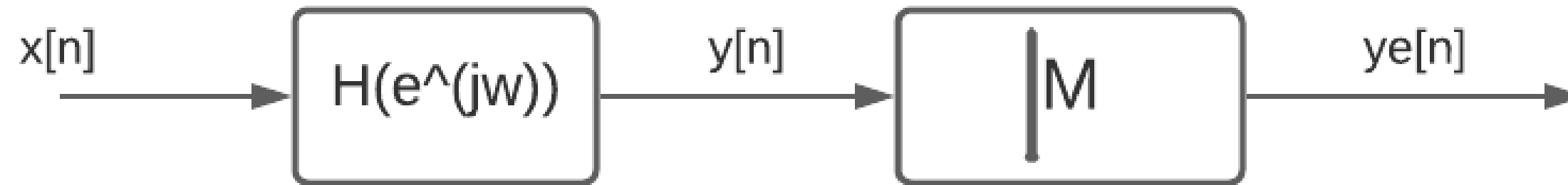
Igor Dias

Júlia Costa

Matheus Santos

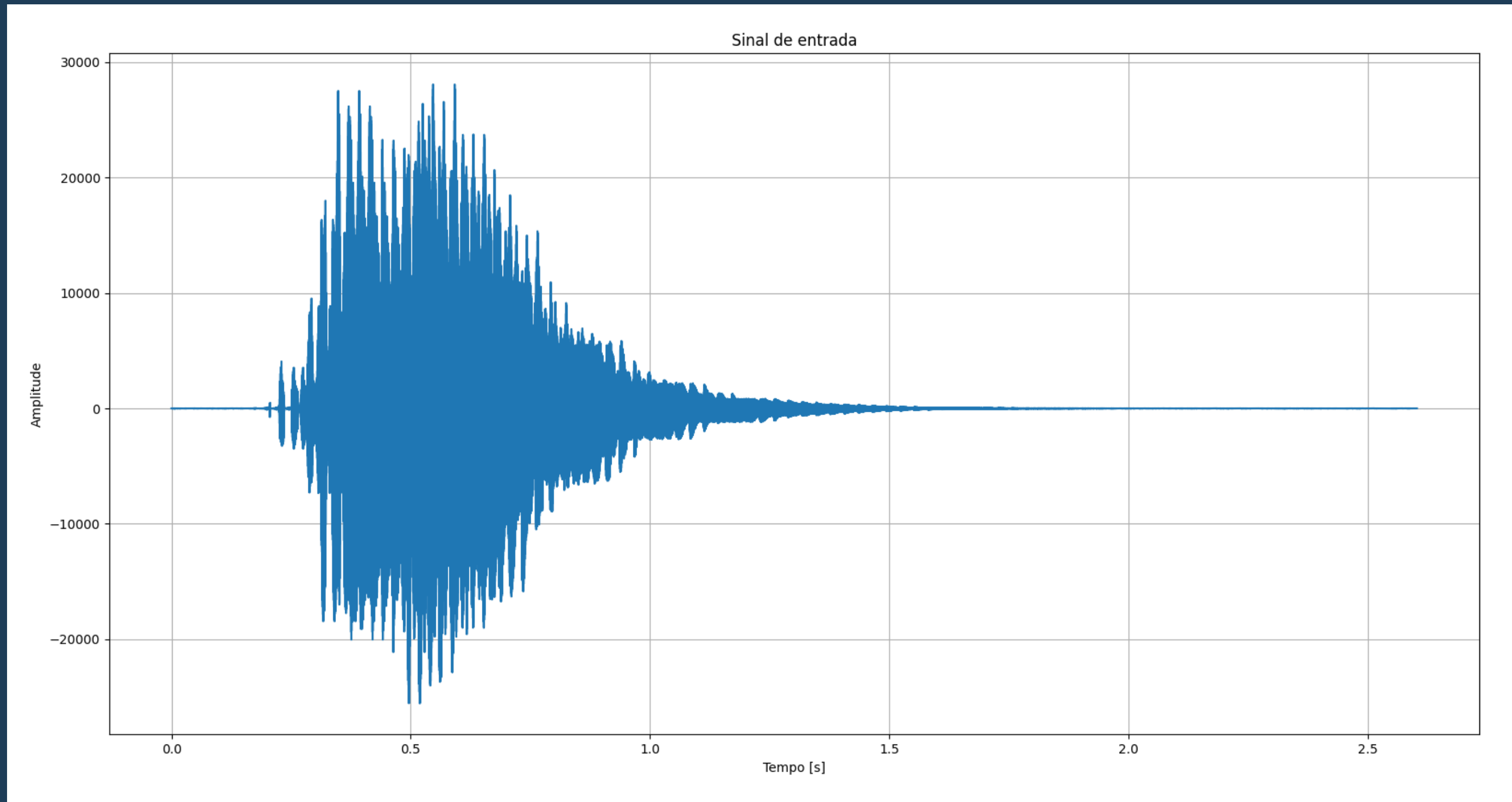
Reilta Christine

# Sistema de tempo discreto



# Sinal de entrada

## Original



# Transformada

## Código

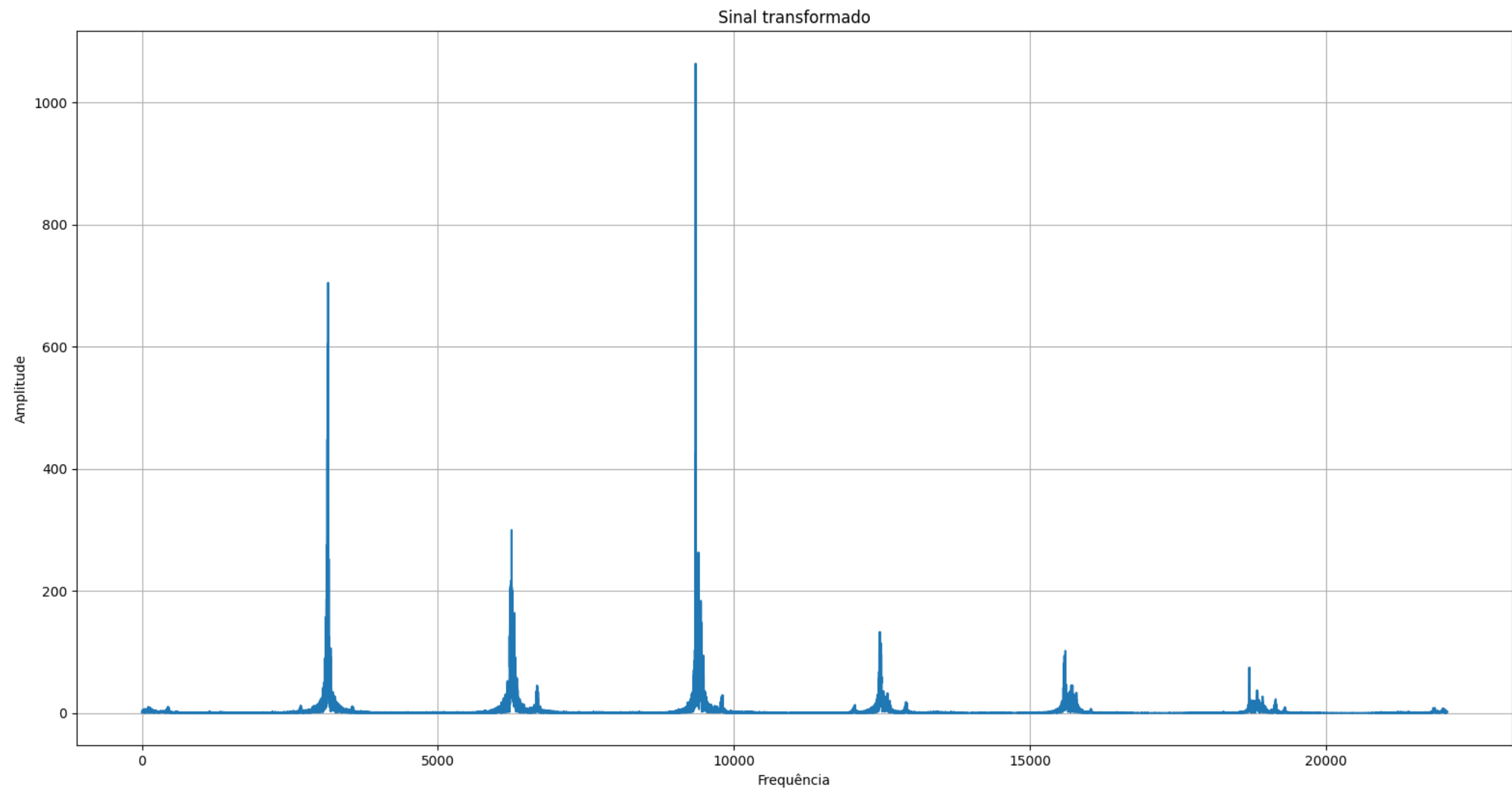
```
N = audio.size #Número de amostras do canal direito

T = 1.0/freqs #período
y = audio[:N]
yf = fft(y)
xf = fftfreq(N,T)

#Plotando a FFT
plt.figure(1)
plt.plot(xf[0:N//2],2.0/N*abs(yf[0:N//2]))
plt.title("Sinal transformado")
plt.xlabel("Frequência")
plt.ylabel("Amplitude")
plt.grid()
plt.show()
```

# Sinal de entrada

## Transformado



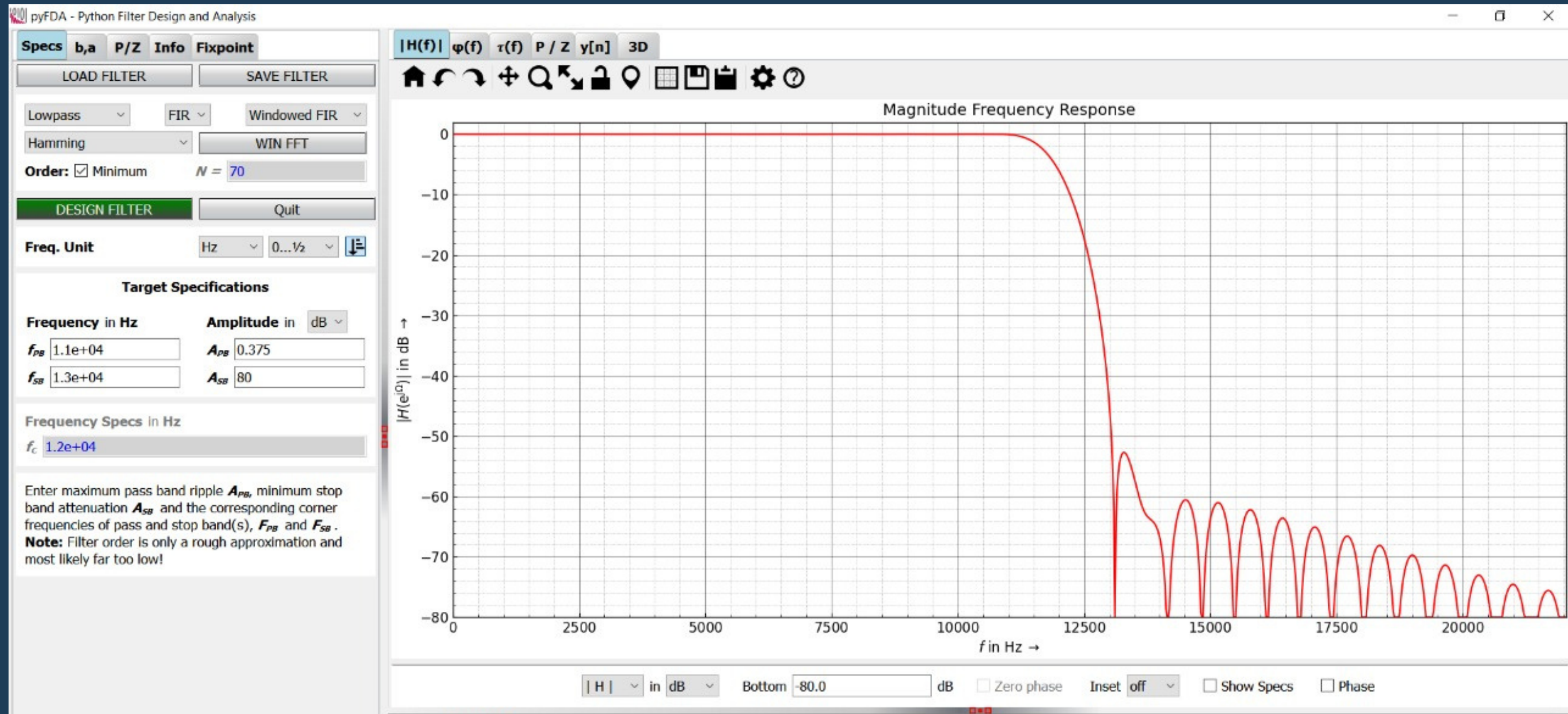
# Finite impulse response (FIR)

Filtro passa-baixa



# Filtro

## pyFDA

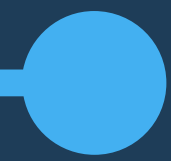


# Convolução em bloco

Overlap and add







# Convolução

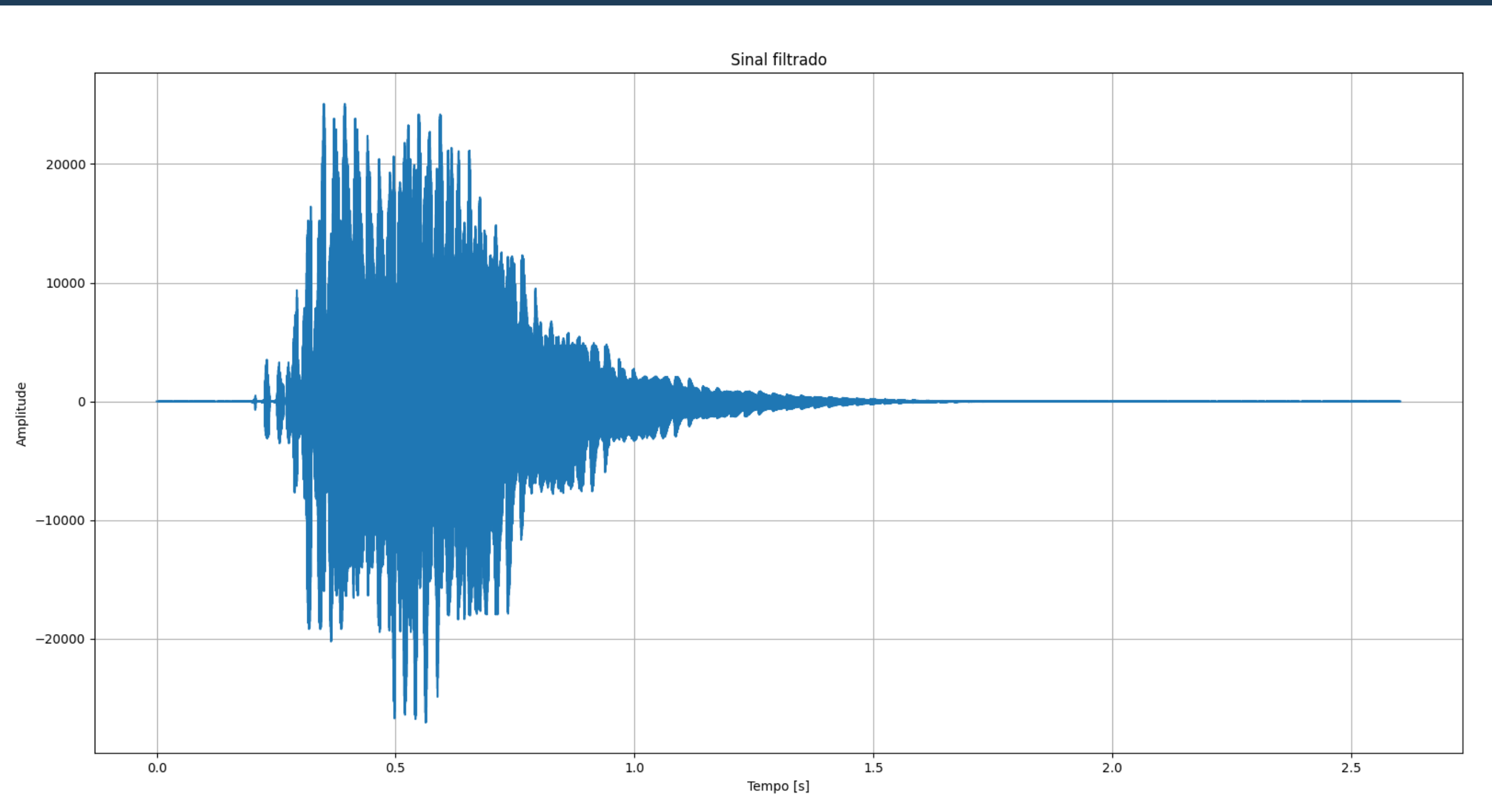
## Código

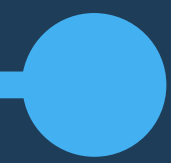
```
def convSobreposSoma(filtro, sinal):  
    M = filtro.shape[0] #comprimento do filtro  
    N = 2<<(M-1).bit_length() #comprimento do bloco com os zeros  
    L = N - M + 1 # comprimento do sinal a ser filtrado sem os zeros  $N=L+M-1 \rightarrow L=N-M+1$   
    L_sig = sinal.shape[0] # comprimento do sinal de entrada  
    blocos = range(0, L_sig, L)  
    y = np.zeros(L_sig+N)  
  
    FDir = rfft(filtro, n=N)  
  
    # overlap and add  
    for n in blocos:  
        y[n:n+N] += irfft(rfft(sinal[n:n+L], n=N)*FDir)  
  
    return y[:L_sig]
```



# Sinal filtrado

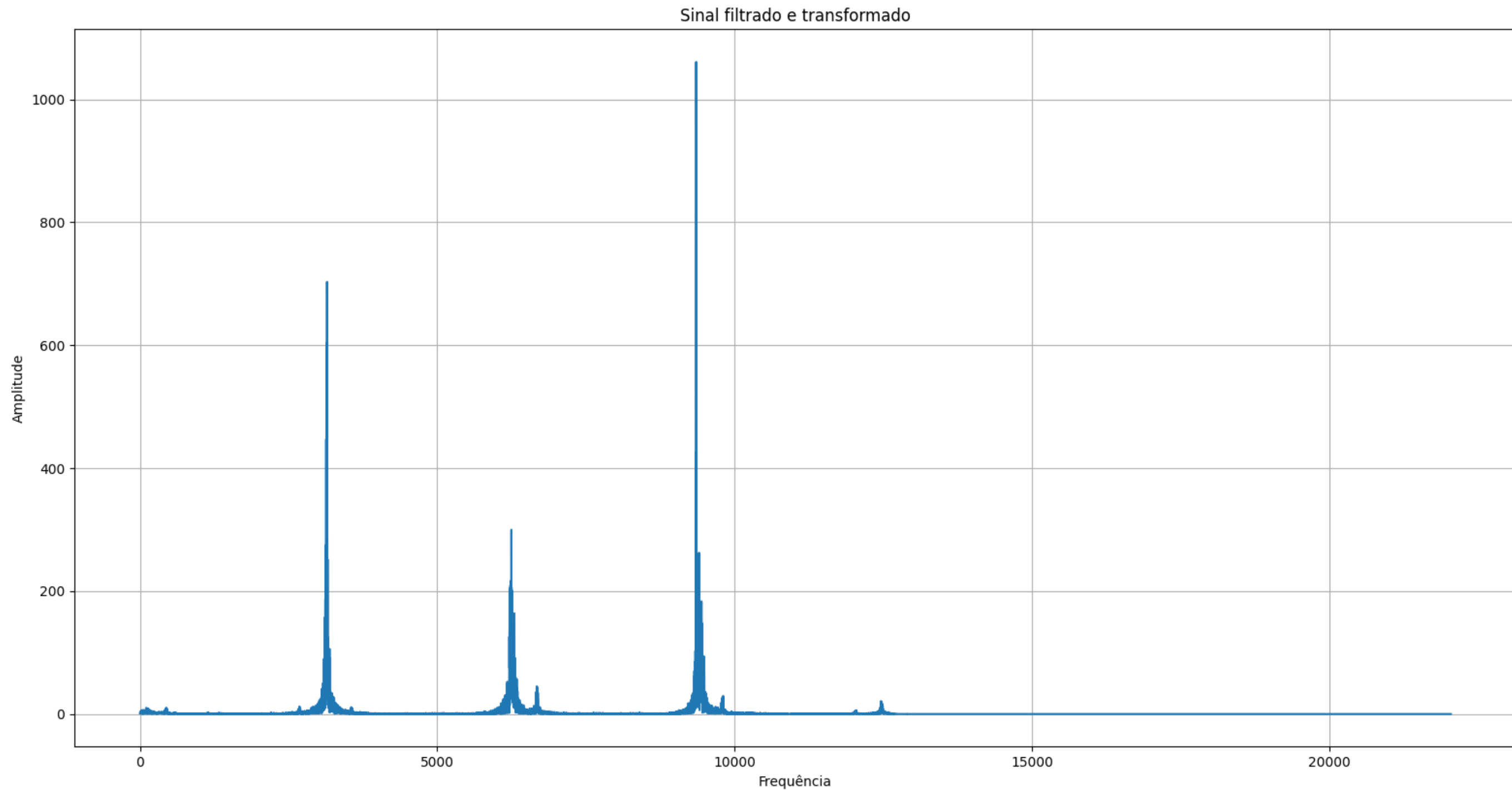
Tempo





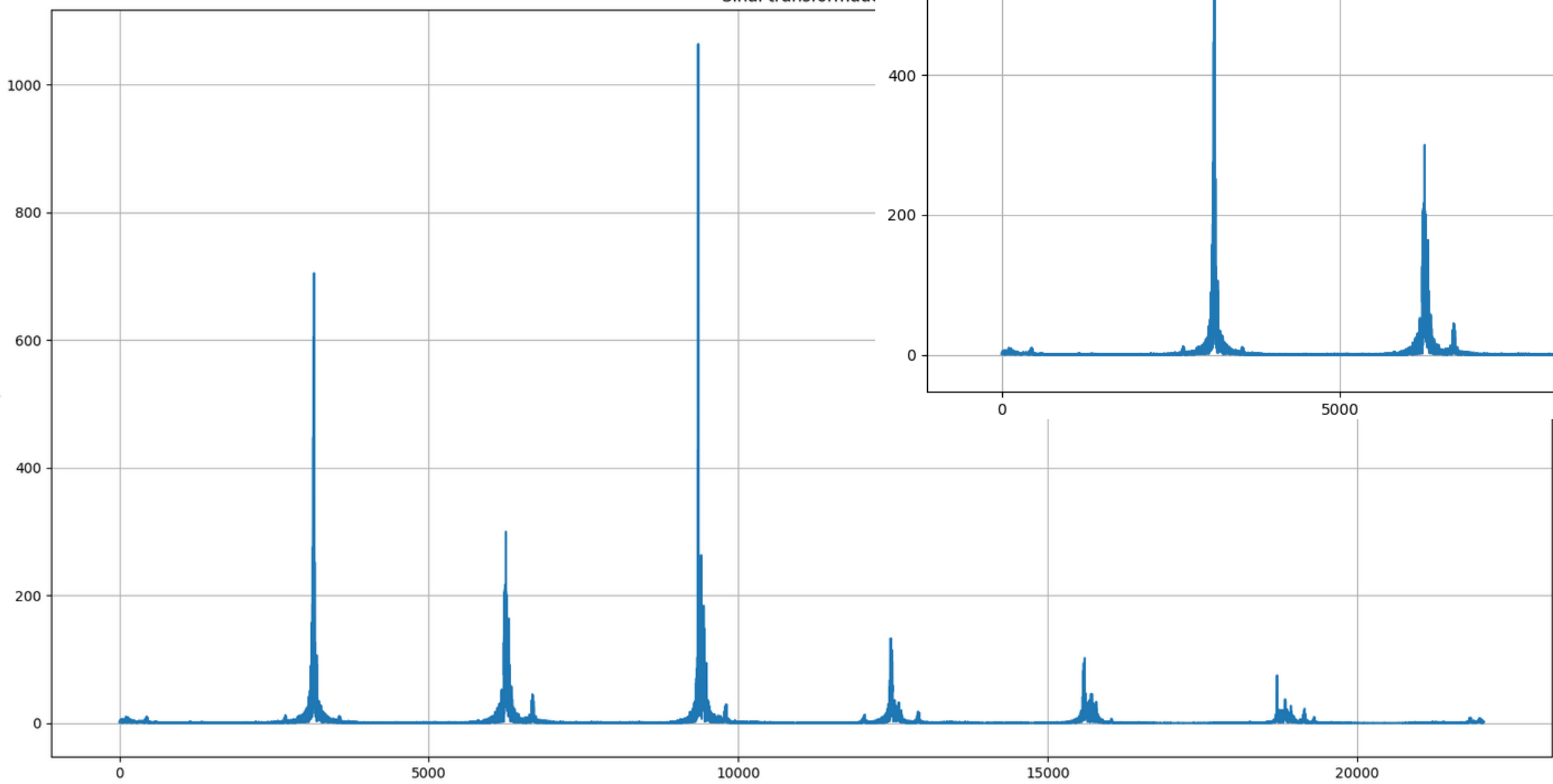
# Sinal filtrado

Frequência

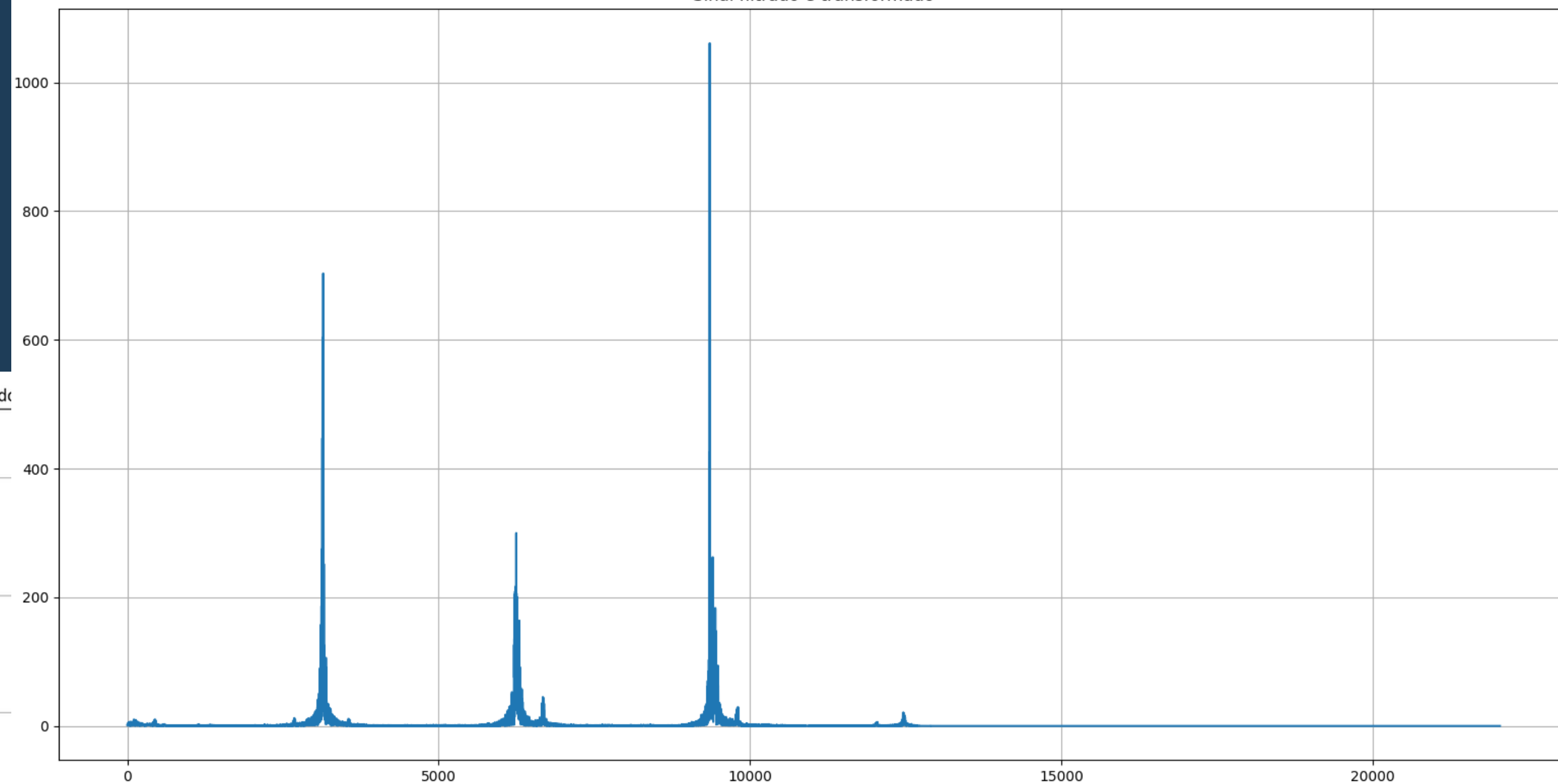


# Comparação

Sinal transformado



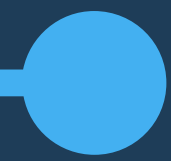
Sinal filtrado e transformado



# Dizimação

$$M = 2$$





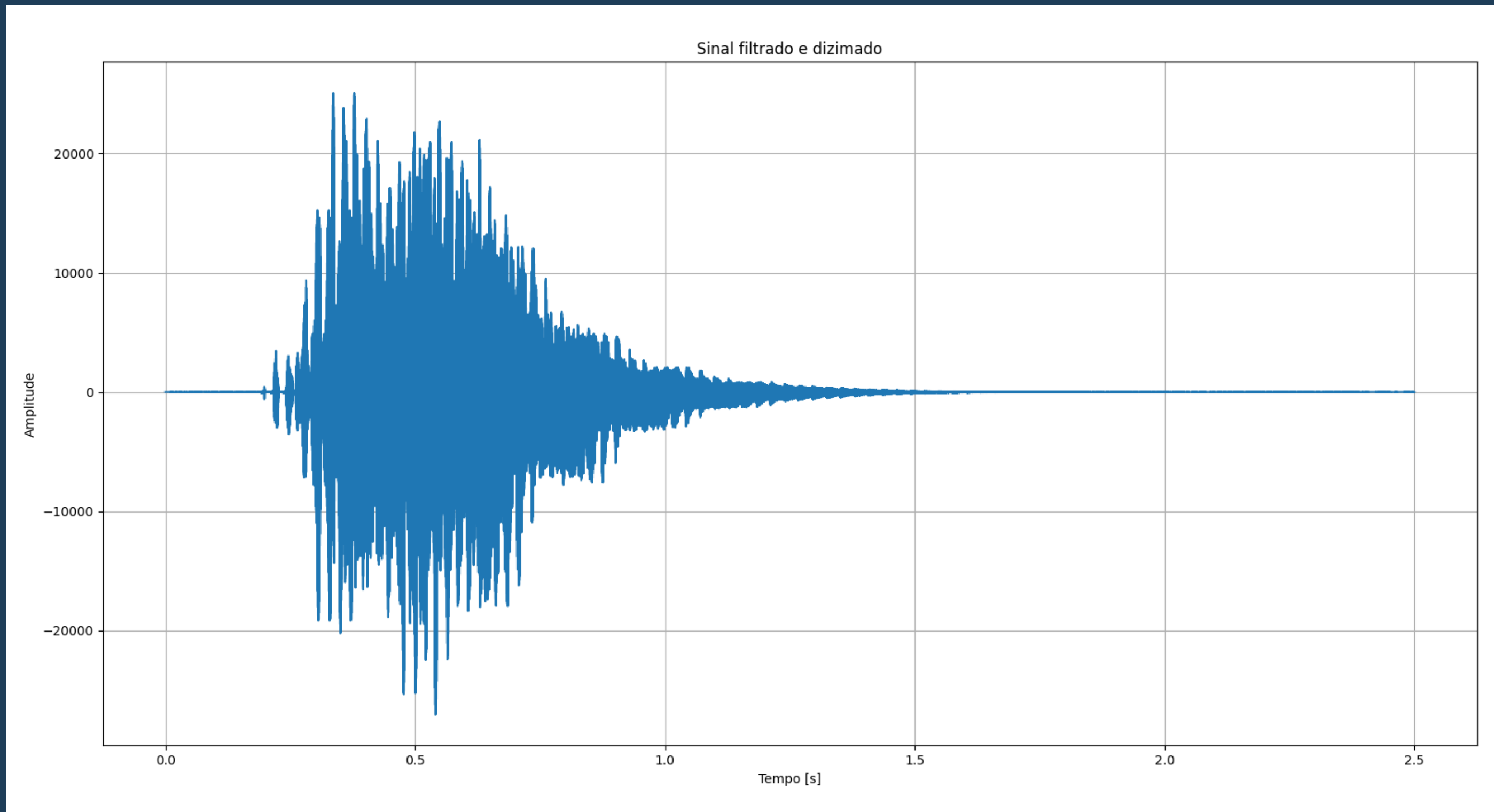
# Dizimação

## Código

```
def dizimacao1(fir,x,M):  
    cont = 0  
    y=[0]*(convolucao.size//M)  
    aux = 0  
    if convolucao.size%2==0:  
        aux = 0  
    else:  
        aux = 1  
    for i in range(0,convolucao.size-aux,M):  
        y[cont] = convolucao[i]  
        cont = cont + 1  
  
    return y
```

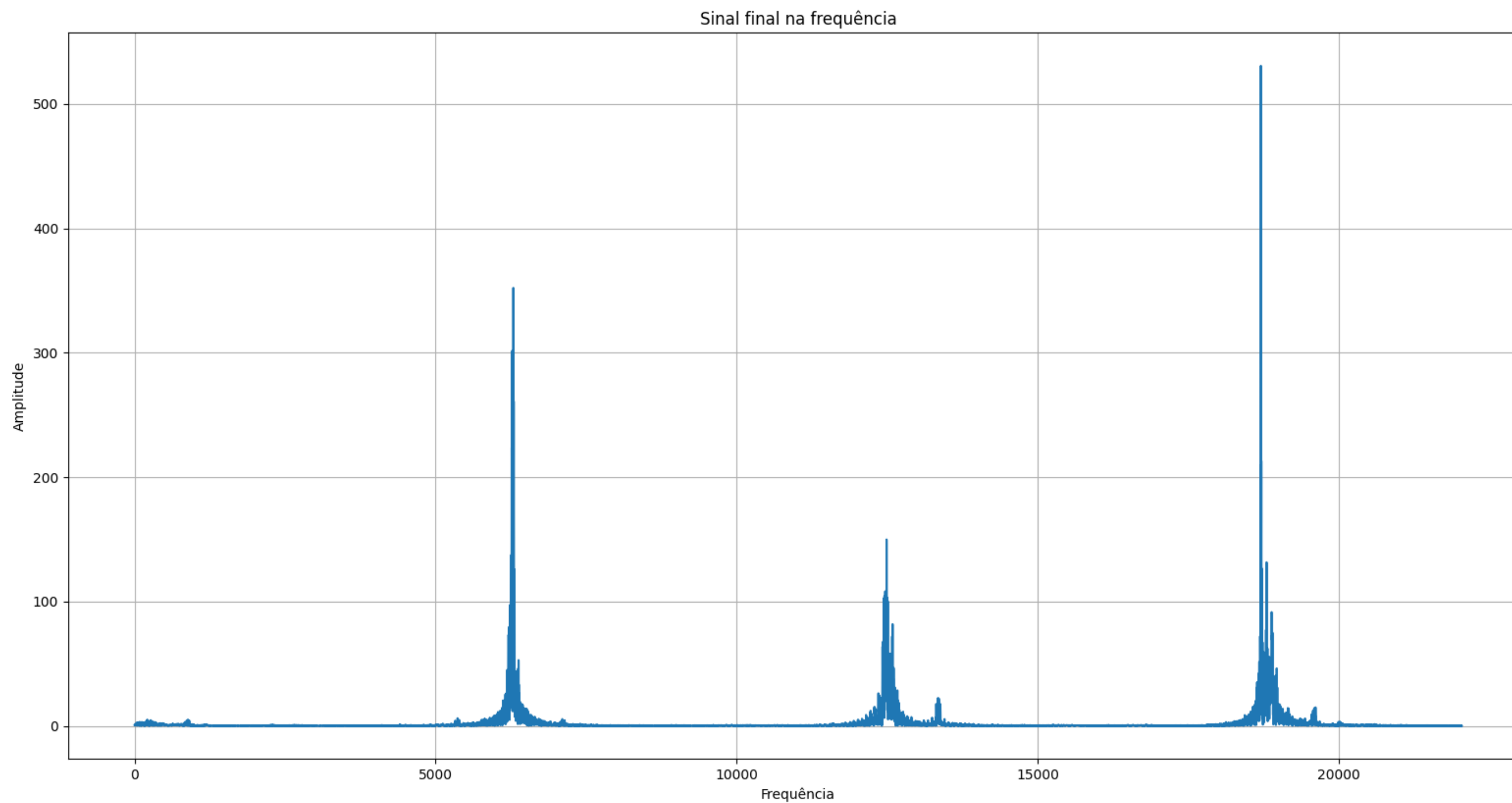
# Sinal de saída

## Tempo



# Sinal de saída

## Frequência





# ● Comparação

