Digitale Signalverarbeitung SS 2025/26 – 2. Aufgabe

Analog Signals and Systems

Gruppennummer 211
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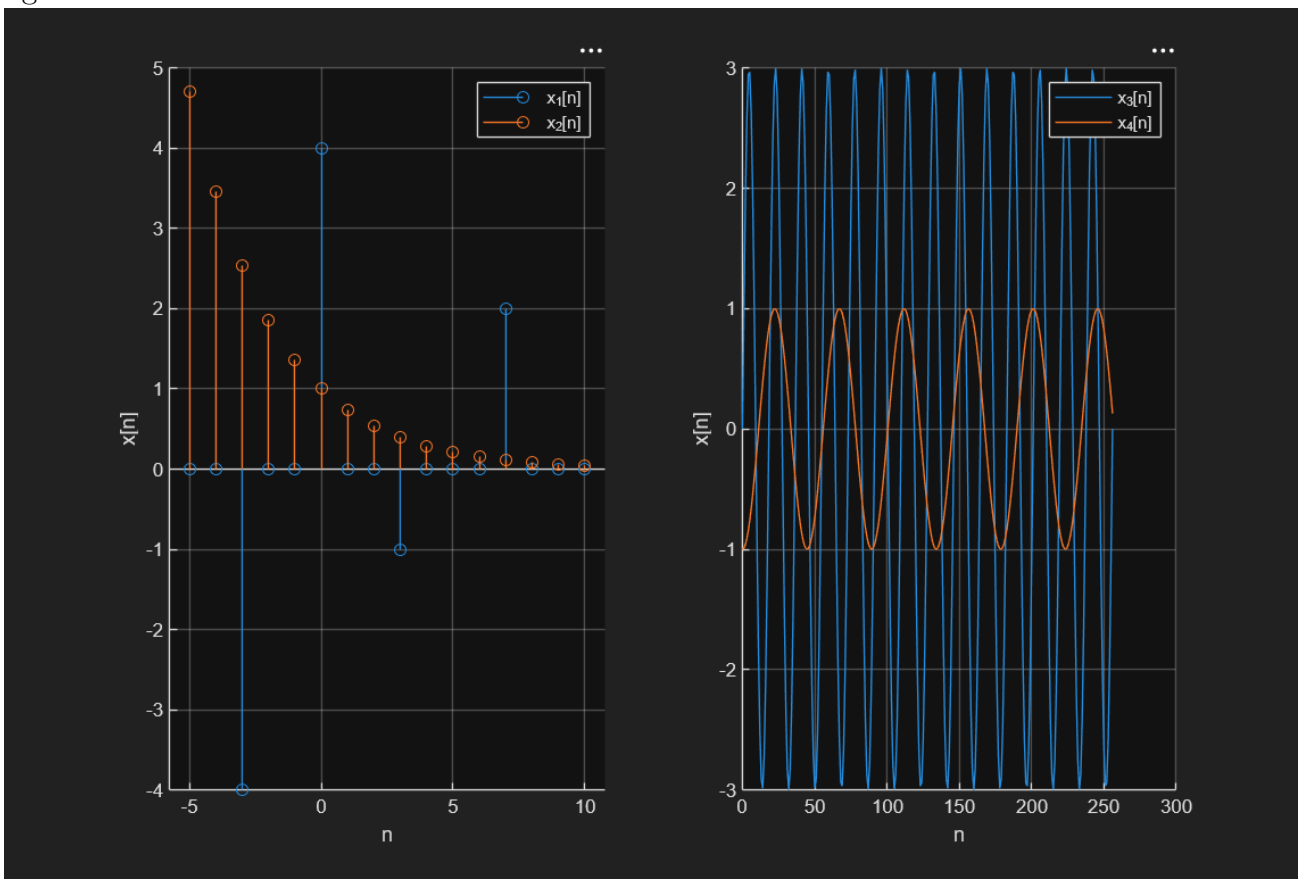
1. Exercise

a) figure:



b)

$$\Omega_3 = 2\pi\frac{3.5}{64}$$
$$\Omega_4 = \frac{9}{64}$$

c)

$$\frac{\Omega_3}{2\pi} = \frac{3.5}{64} = \frac{7}{128}$$
$$N_{0,3} = 128$$
$$\frac{\Omega_4}{2\pi} = \frac{9}{64 \cdot 2\pi} = \frac{9}{128\pi}$$
$$\Longrightarrow \text{ Irational because of } \pi$$
$$\Longrightarrow \text{ Not periodic}$$

d) (see assignment2_1.m)

e) (see assignment2_1.m)

f) table:

Signal	Energy	Power
$x_1[n]$	37	–
$x_2[n]$	48.0394	–
$x_3[n]$	1152	4.4825
$x_4[n]$	128.9565	–

Tabelle 1: Energy and Power Values

2. Exercise

a) $|x[n]| + |h[n]| - 1 = 5 + 4 - 1 = 8$

b)

$$A = \begin{bmatrix} 3 & 0 & 0 & 0 \\ -1 & 3 & 0 & 0 \\ 2 & -1 & 3 & 0 \\ 0 & 2 & -1 & 3 \\ 1 & 0 & 2 & -1 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \qquad x = \begin{bmatrix} 2 \\ 3 \\ 4 \\ 1 \end{bmatrix}$$

$$Ax = \begin{bmatrix} 6 \\ 7 \\ 13 \\ 5 \\ 9 \\ 5 \\ 4 \\ 1 \end{bmatrix}$$

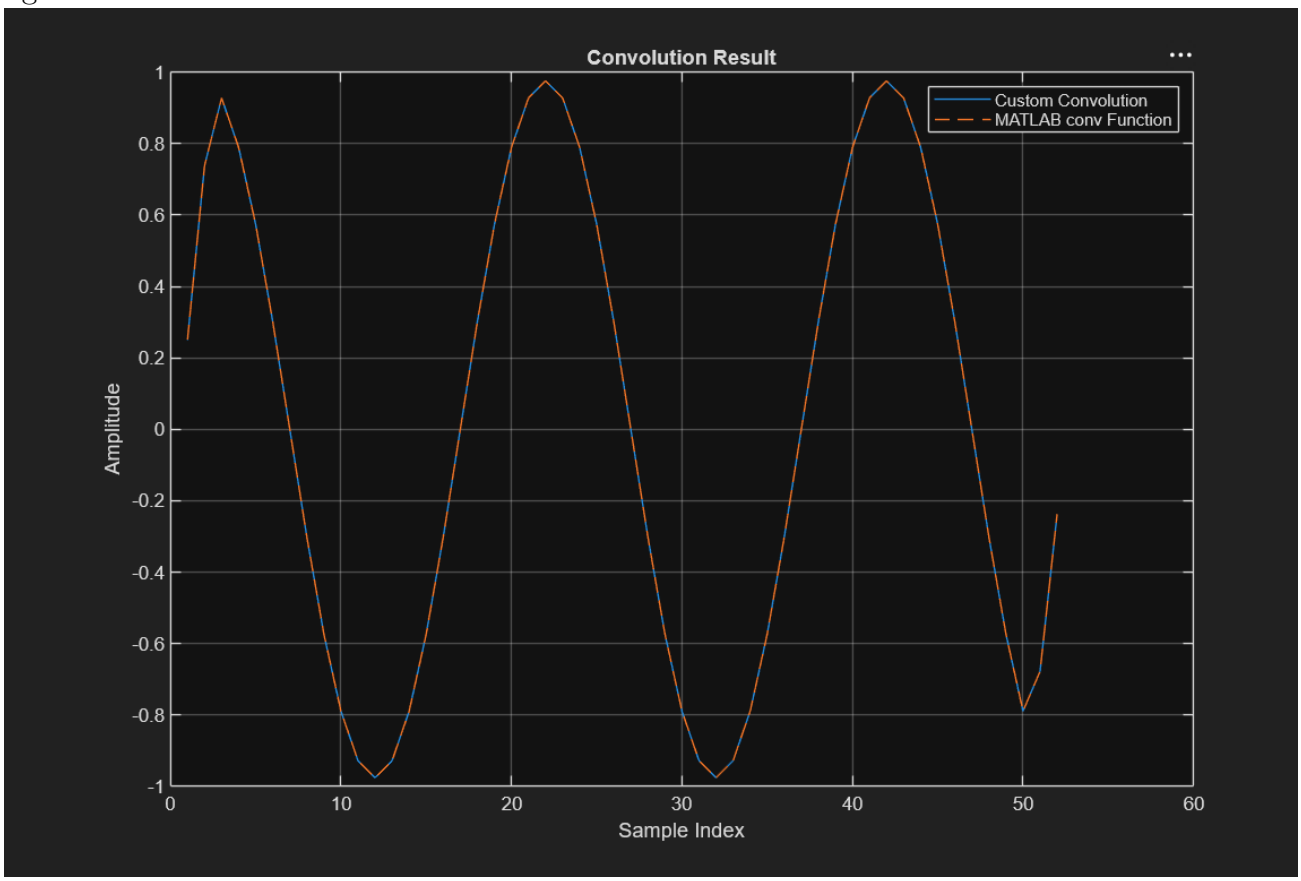
3. Exercise

a) $L_y = |x[n]| + |h[n]| - 1 = 50 + 3 - 1 = 52$

b) (see assignment2_3.m)

c) see d)

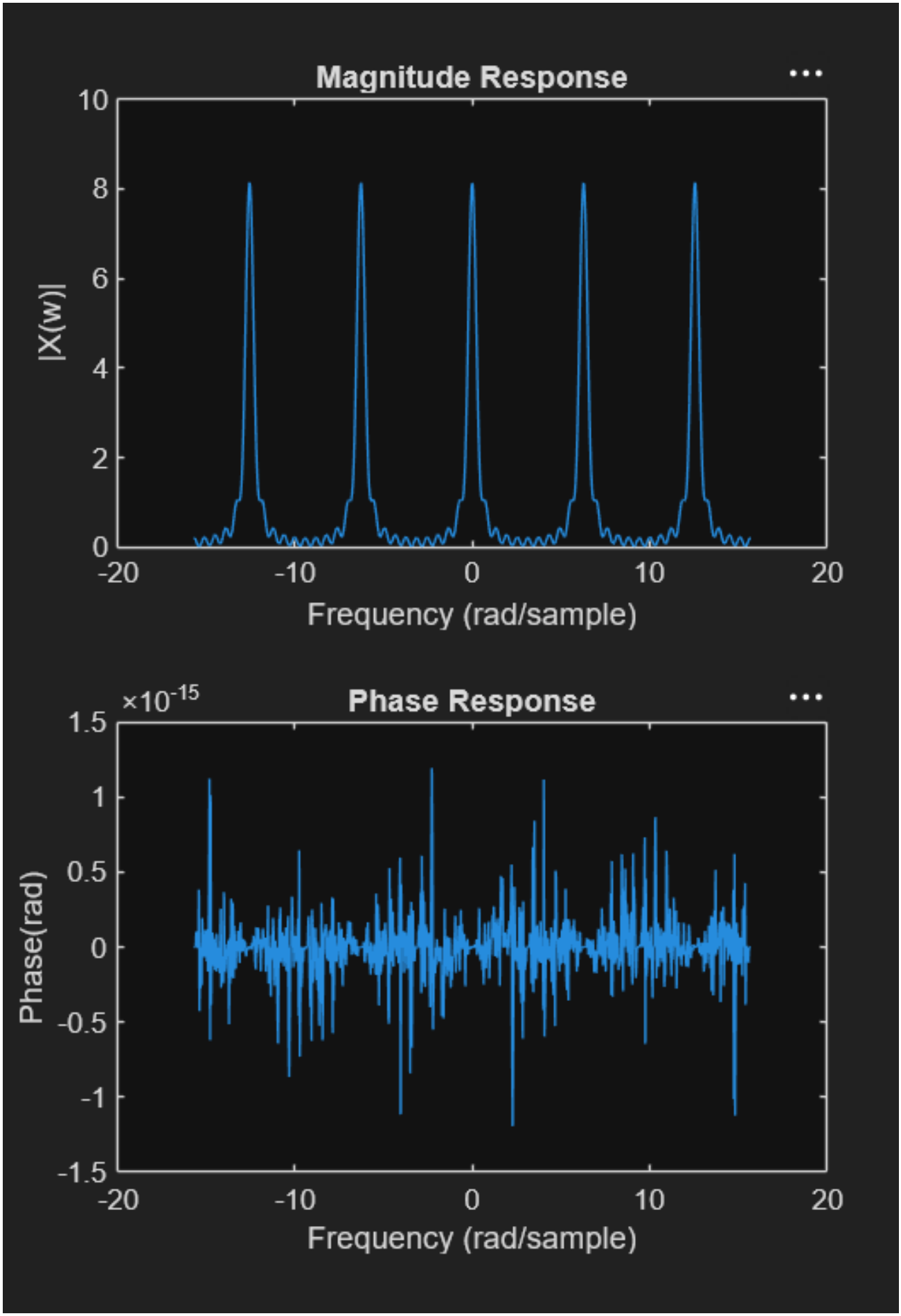
d) figure:



4. Exercise

a) (see assignment2_4.m)

b) Phase Response is very small in the realm of 10^{-15}. The signal contians multiple bigger spikes.



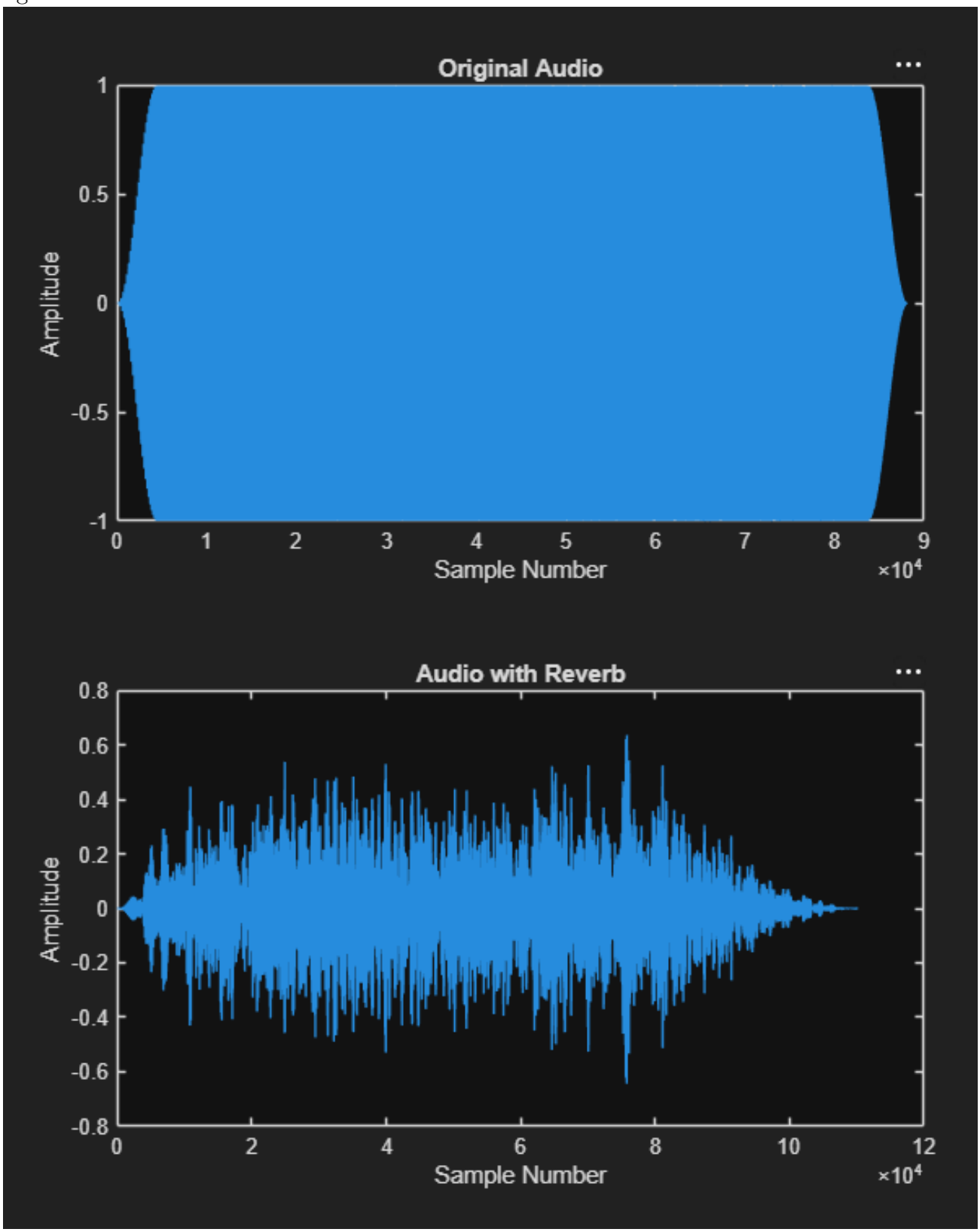
c) The magnitued seems to be repeating and the phase response seems to be mirrored accross the x and y axis.

5. Exercise

a) (siehe assignment2_5.m)

b) (siehe assignment2_5.m)

c) figure:



d) original energy: 41343
reverb energy: 2069.0506

rir energy: $9.9997 \cdot 10^3$
explanation: The rir energy is less than one which would explain why the outcoming signal is smaller than the original, because convulution scales proportionally.