ISS – project 2021/22

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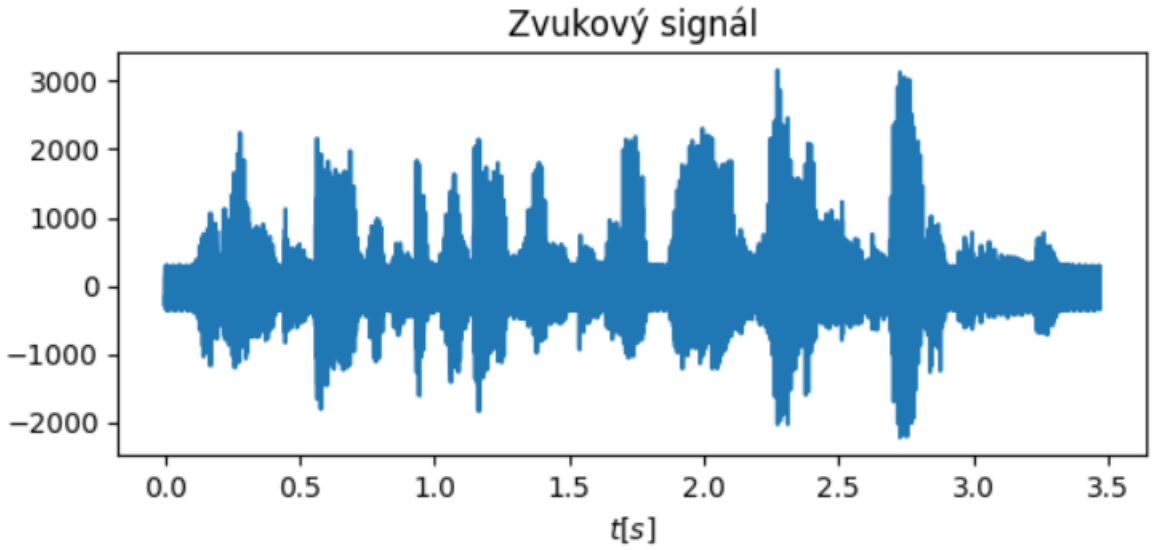
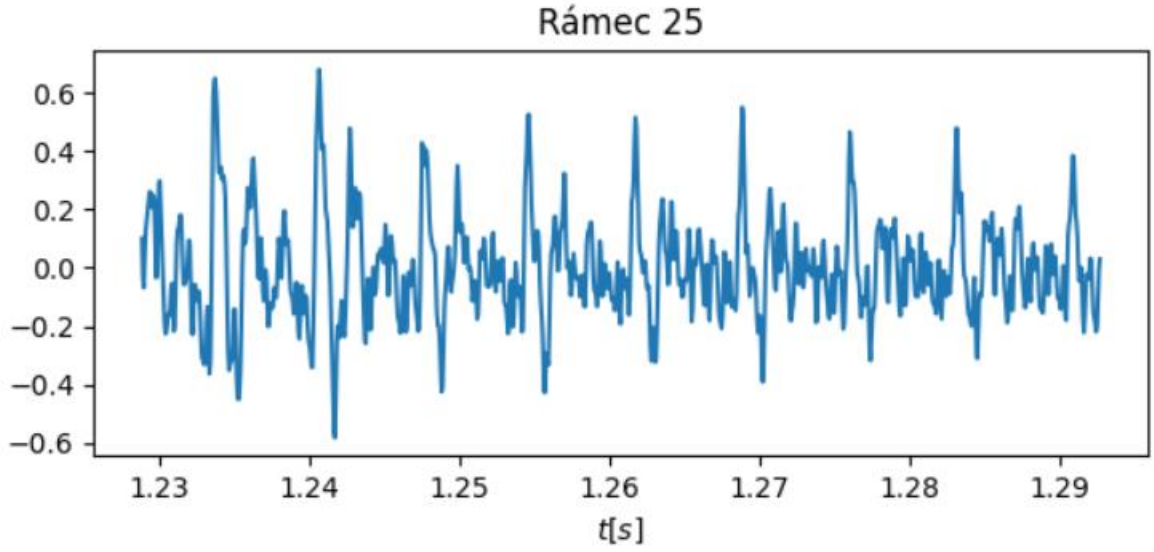
1. Základy

Vstupný z 55501 vzorkov a 3.4688125 sekundy, minimálna hodnota signálu je -2220 a maximálna hodnota signálu je 3156.



2. Předzpracování a rámce

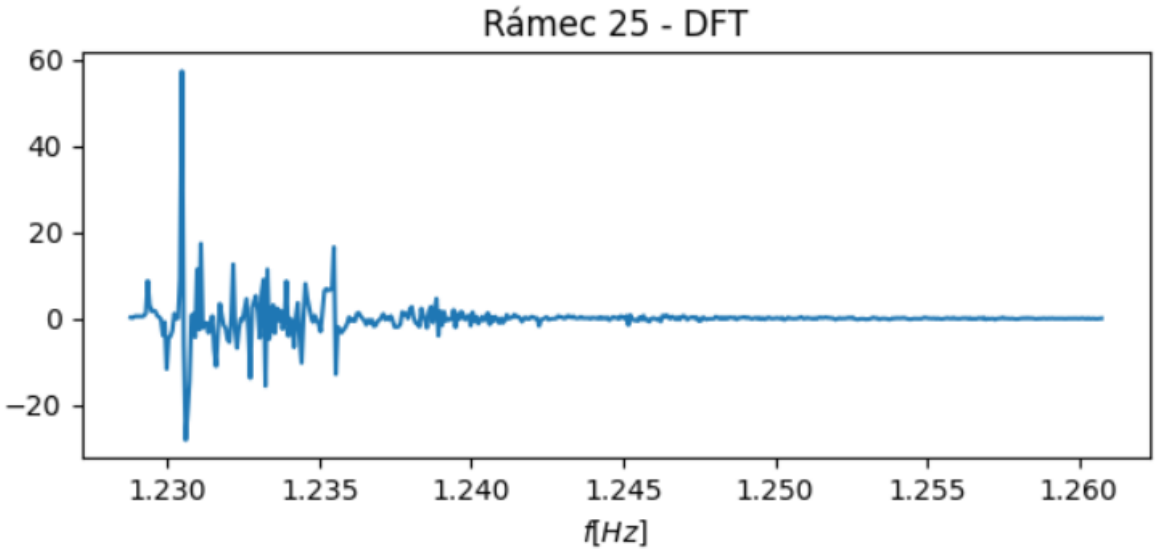
Zobrazujem rámec 25 už ustredneného a znormalizovaného signálu.

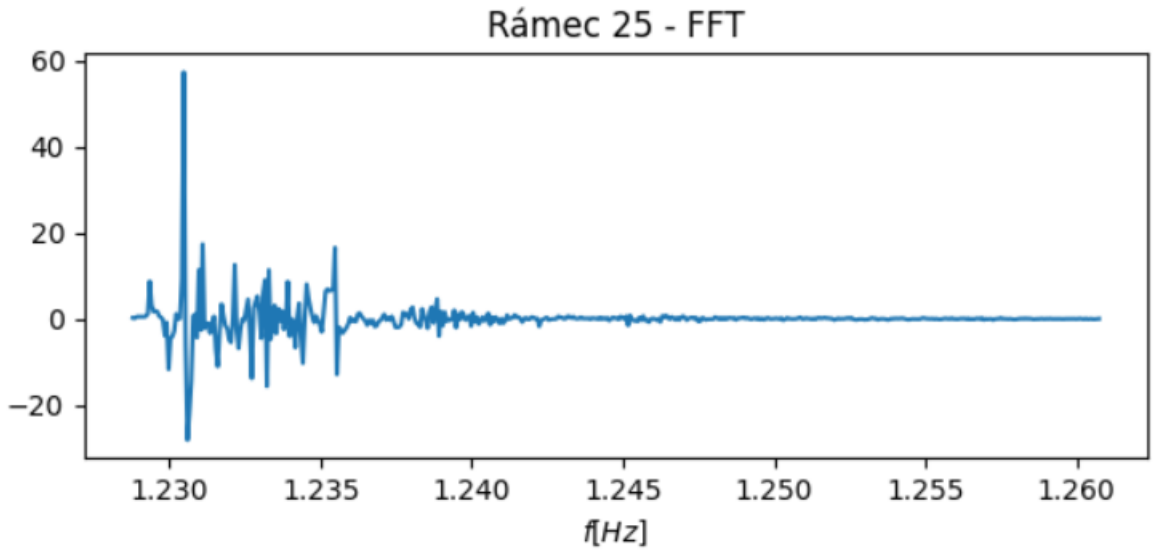


3. DFT

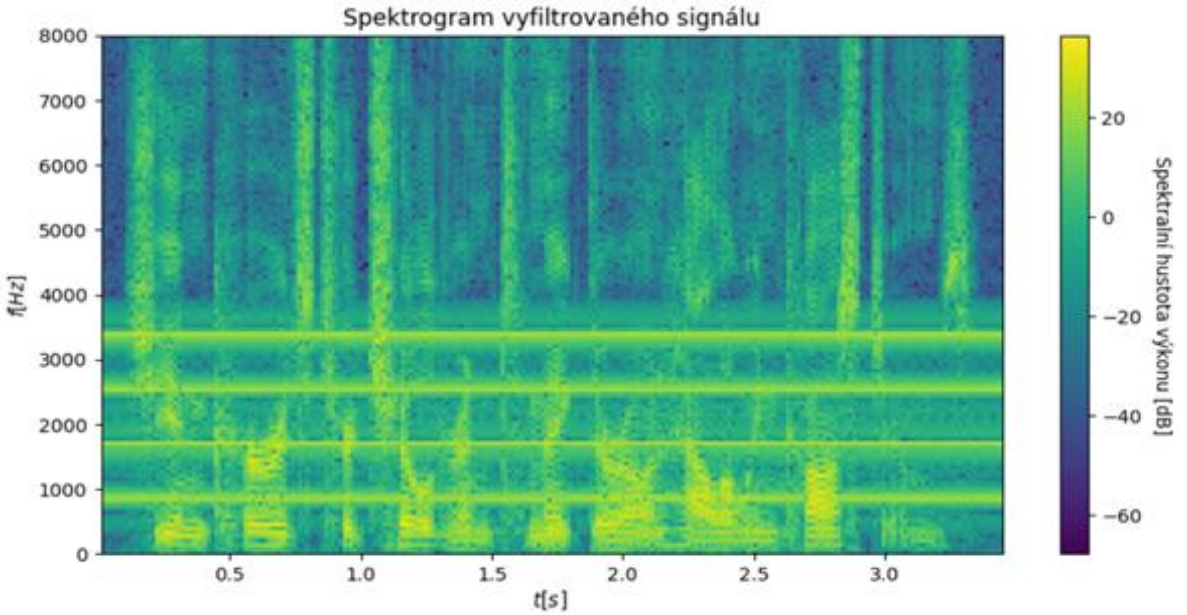
Implementácia DFT

```python
def dft(x):
    dft = np.ndarray((1024))
    for j in range(0, 1024):
        temp = 0
        for k in range(0, 1024):
            temp += x[k] * np.exp(-1j * ((2 * np.pi) / 1024) * j * k)
        dft[j] = temp
    return dft
```





4. Spektrogram

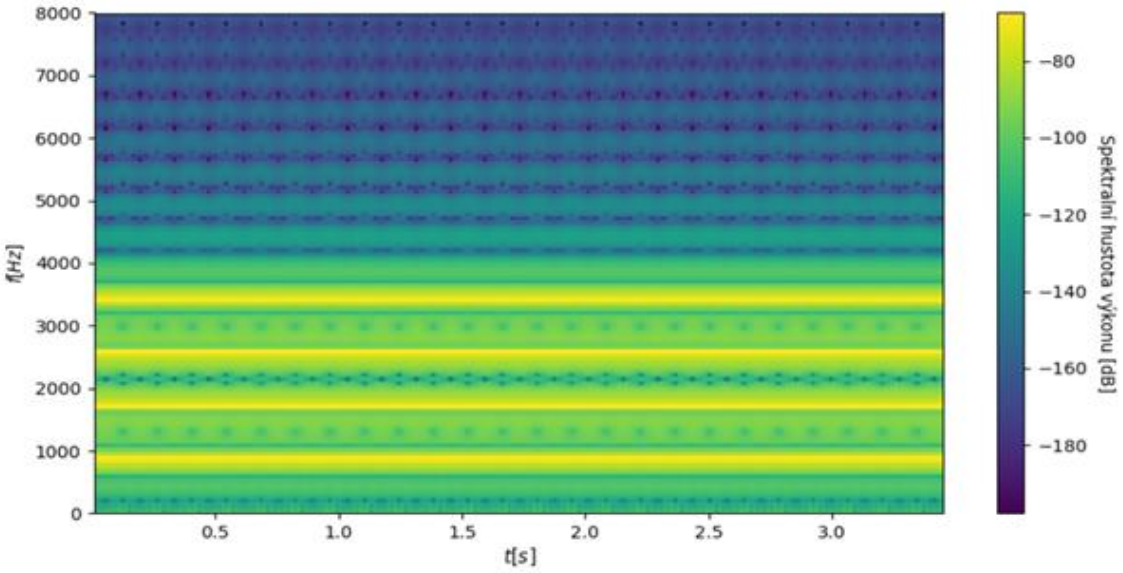


5. Určení rušivých frekvencí

Rušivé frekvencie som určil odčítaním zo spektogramu. (f1 = 840Hz, f2 = 1680Hz, f3 = 2520Hz, f4 = 3360Hz). Rušivé cosínusovky sú harmonicky vztažené.

6. Generování signal

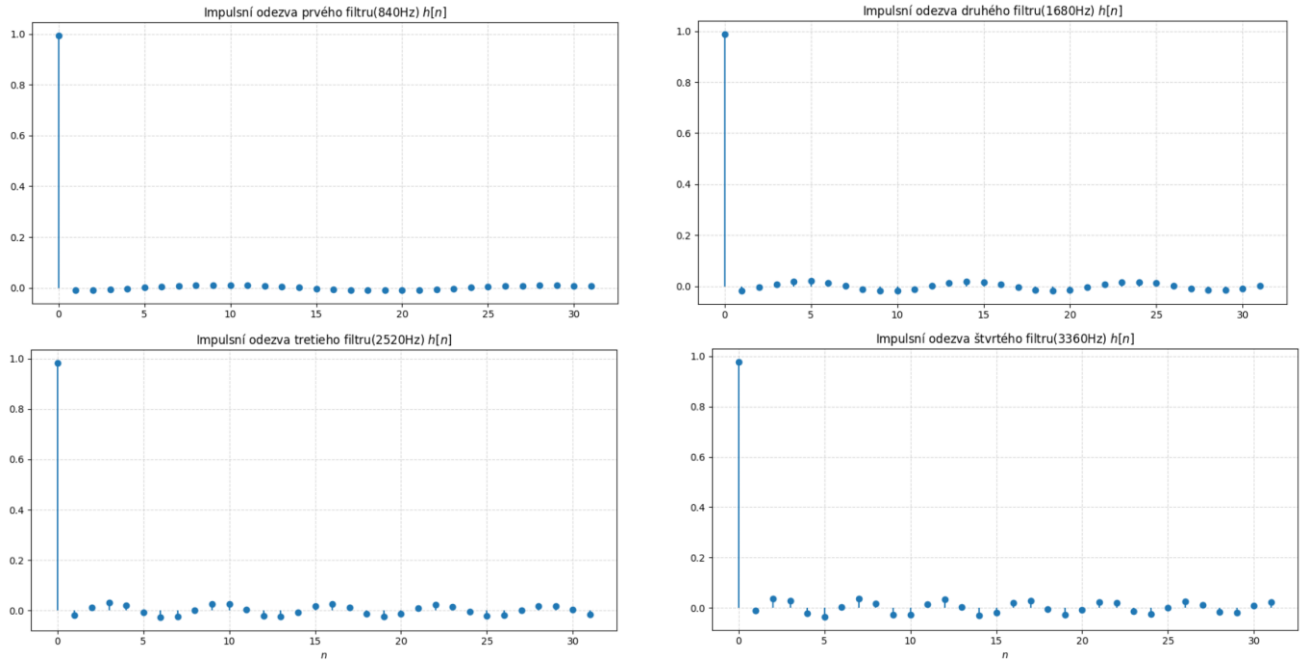
```
y1 = np.cos(np.arange(pocet_vzorkov) * f1 * np.pi * 2 / fs)
y2 = np.cos(np.arange(pocet_vzorkov) * f2 * np.pi * 2 / fs)
y3 = np.cos(np.arange(pocet_vzorkov) * f3 * np.pi * 2 / fs)
y4 = np.cos(np.arange(pocet_vzorkov) * f4 * np.pi * 2 / fs)
y = (y1 + y2 + y3 + y4) / 192
```



7. Čisticí filtr

Použil som 4 filtre typu pásmová zádrž. (filter1 má koeficienty a1,b1; filter2 má koeficienty a2, b2; filter3 má koeficienty a3, b3; filter4 má koeficienty a4, b4)

```
a1:  [ 1.          -1.88182474  0.98906444] , b1:  [ 0.99453222 -1.88182474  0.99453222]
a2:  [ 1.          -1.56312191  0.97824716] , b2:  [ 0.98912358 -1.56312191  0.98912358]
a3:  [ 1.          -1.08022744  0.96754562] , b3:  [ 0.98377281 -1.08022744  0.98377281]
a4:  [ 1.          -0.4866755   0.95695732] , b4:  [ 0.97847866 -0.4866755   0.97847866]
```



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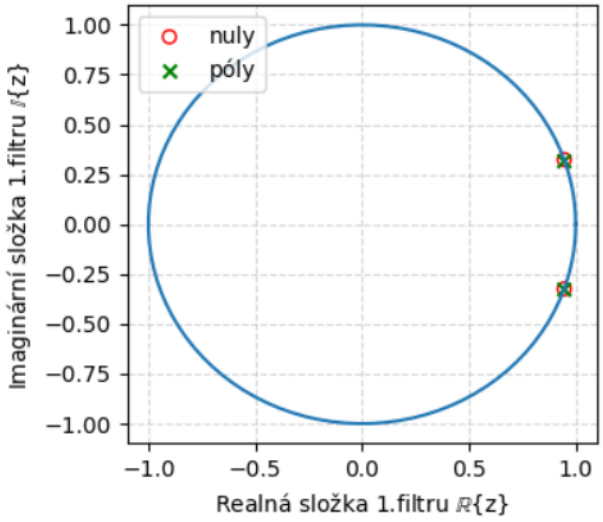
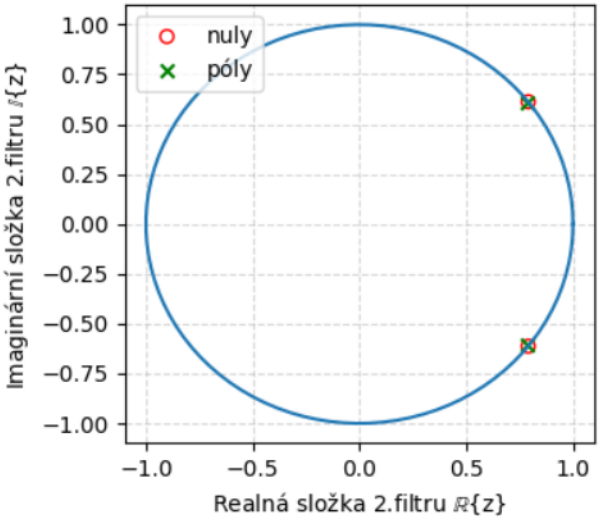
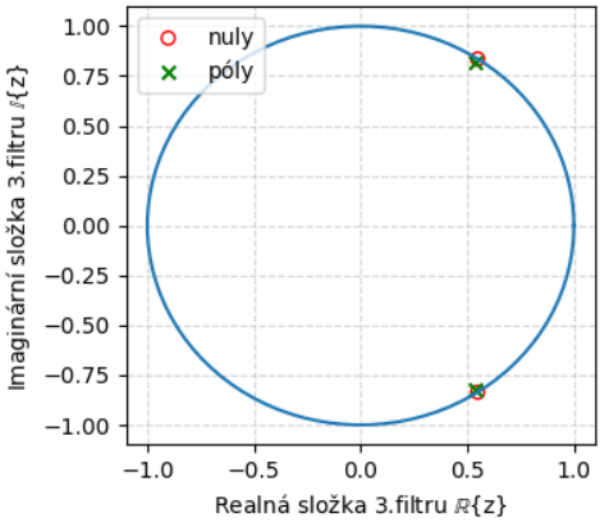
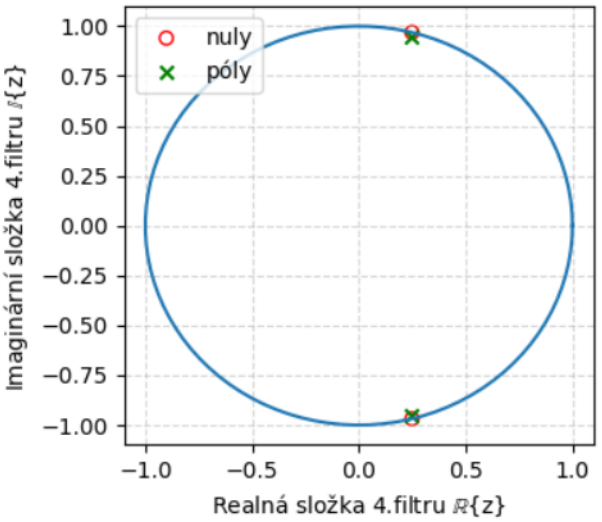
8. Nulové body a póly

Riešené podľa návodu v Jupyteri.









9. Frekvenční charakteristika

Riešené podľa návodu v Jupyteri.

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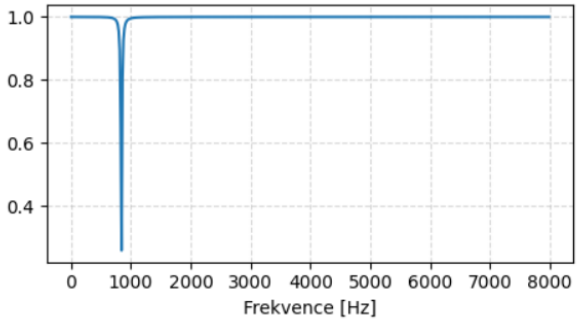
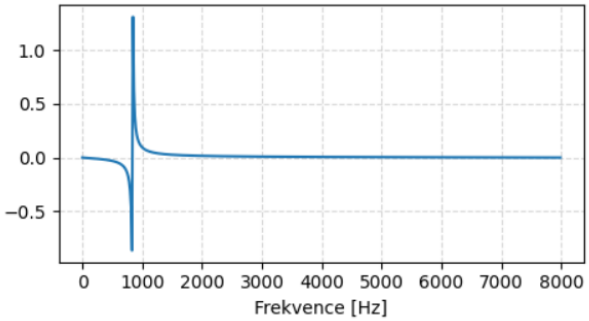
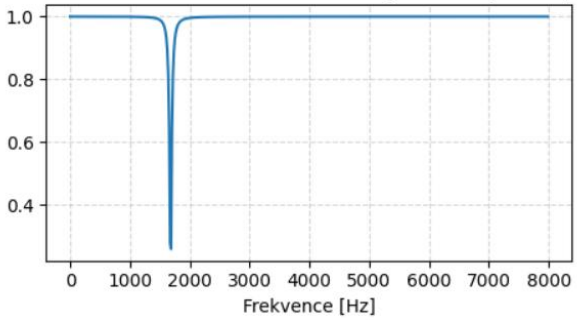
Modul frekvenční charakteristiky 1. filtru $|H(e^{j\omega})|$



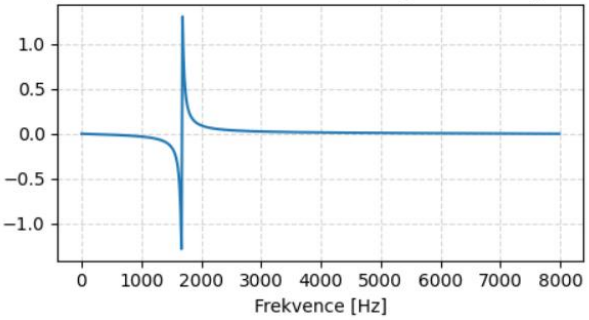
Argument frekvenční charakteristiky 1. filtru arg $H(e^{j\omega})$



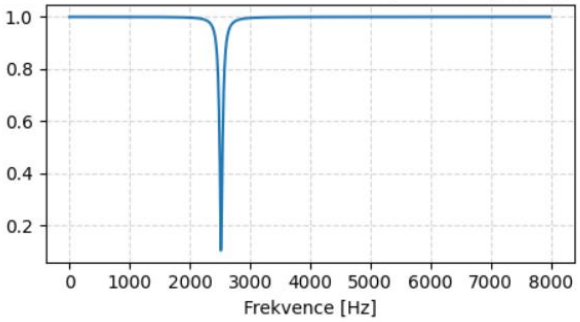
Modul frekvenční charakteristiky 2. filtru $|H(e^{j\omega})|$



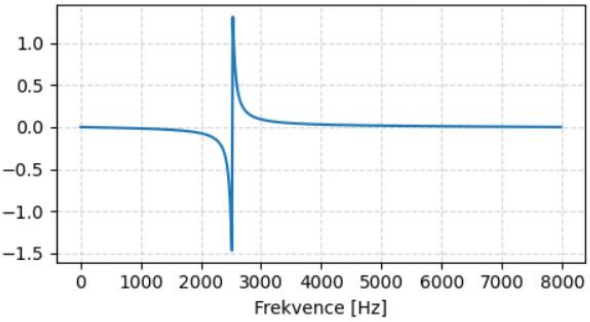
Argument frekvenční charakteristiky 2. filtru arg $H(e^{j\omega})$



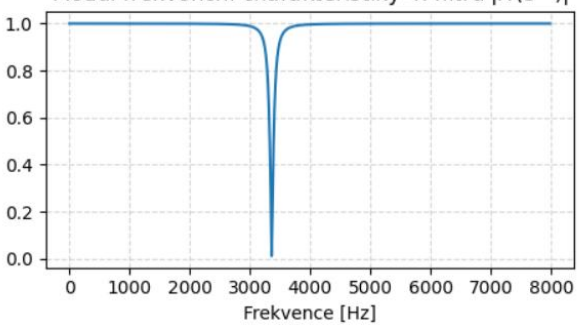
Modul frekvenční charakteristiky 3. filtru $|H(e^{j\omega})|$



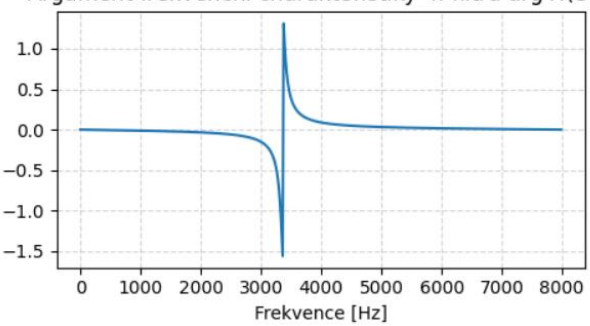
Argument frekvenční charakteristiky 3. filtru arg $H(e^{j\omega})$



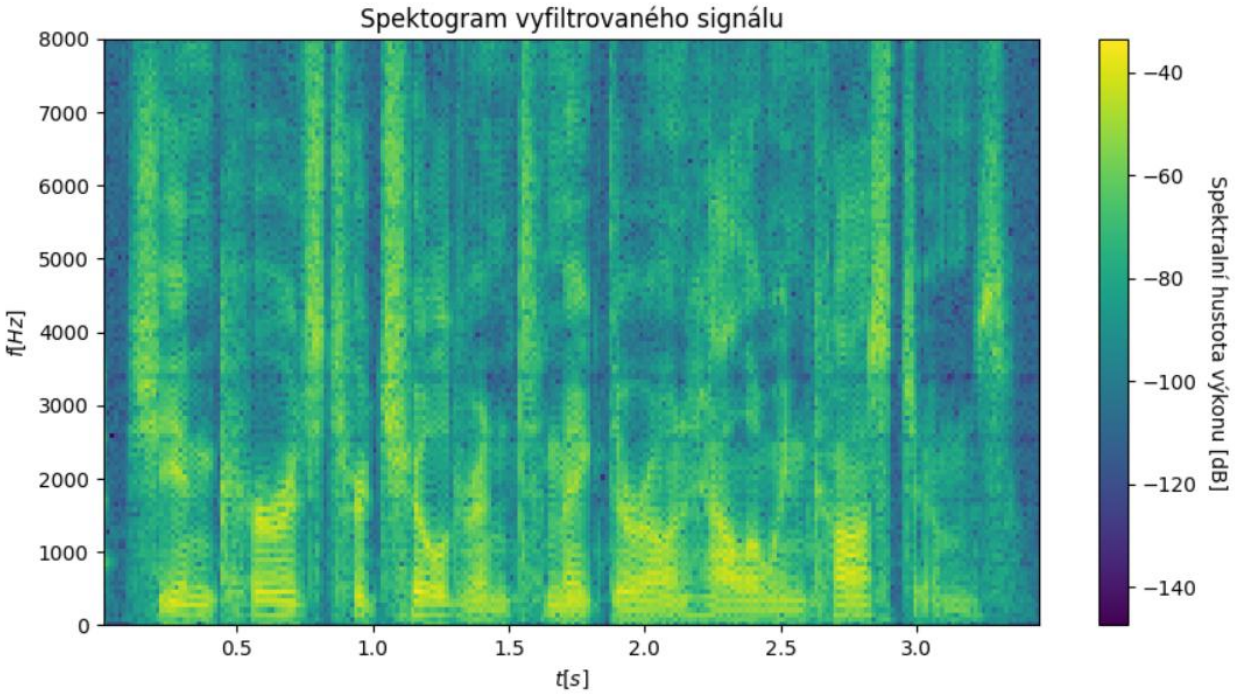
Modul frekvenční charakteristiky 4. filtru $|H(e^{j\omega})|$

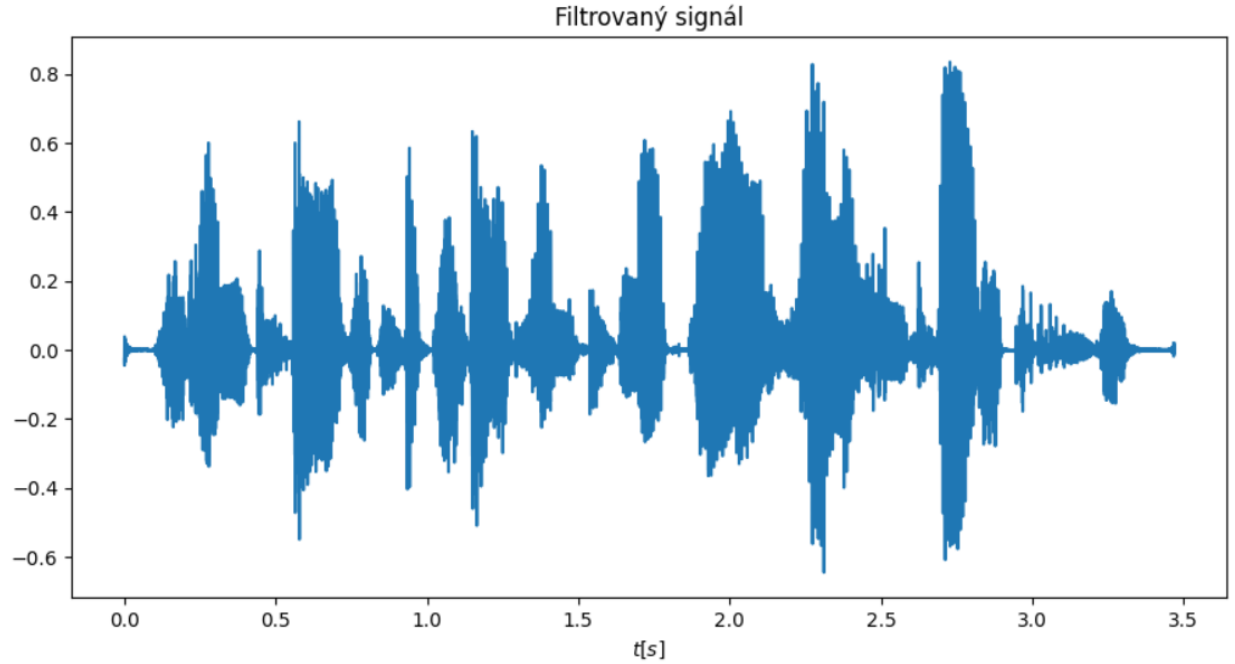


Argument frekvenční charakteristiky 4. filtru arg $H(e^{j\omega})$



10. Filtrace





Na grafe možme vidieť, že sme sa filtrovaním zbavili rušivého signal a je to vidieť tak, že medzi slovami sa hodnota blíži k nule a nezostáva tam žiadne rušenie ako v grafe úlohy č.1.