

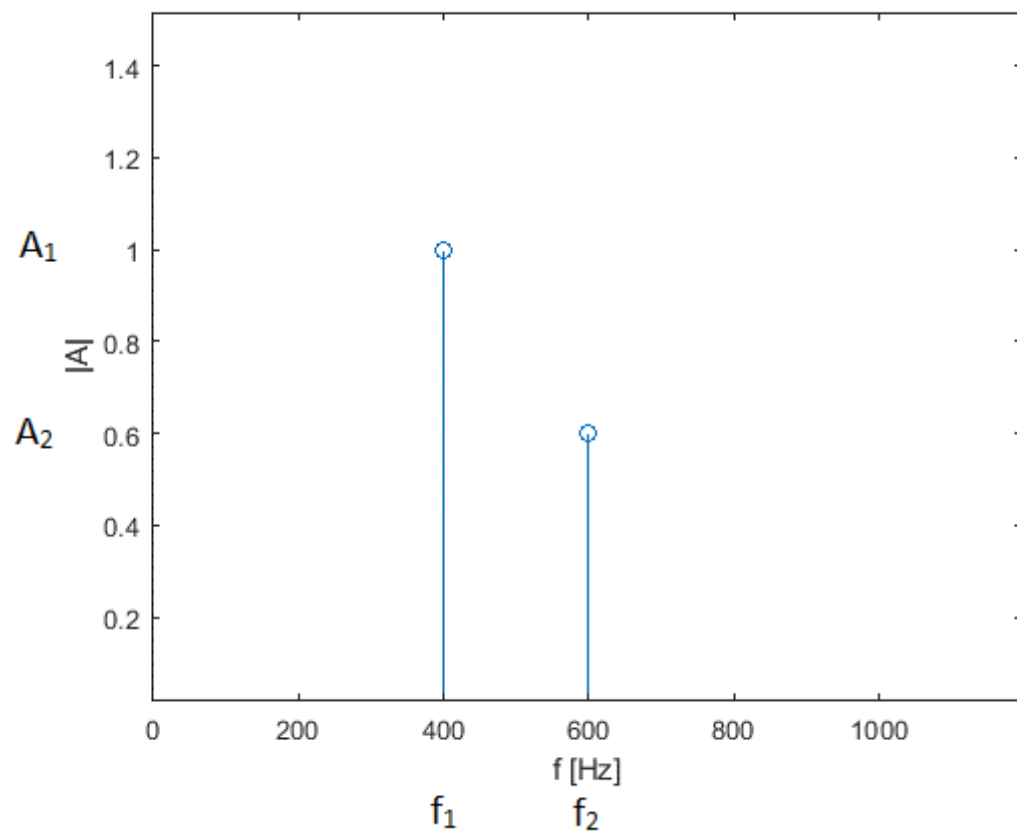
Signály a informace

6. cvičení

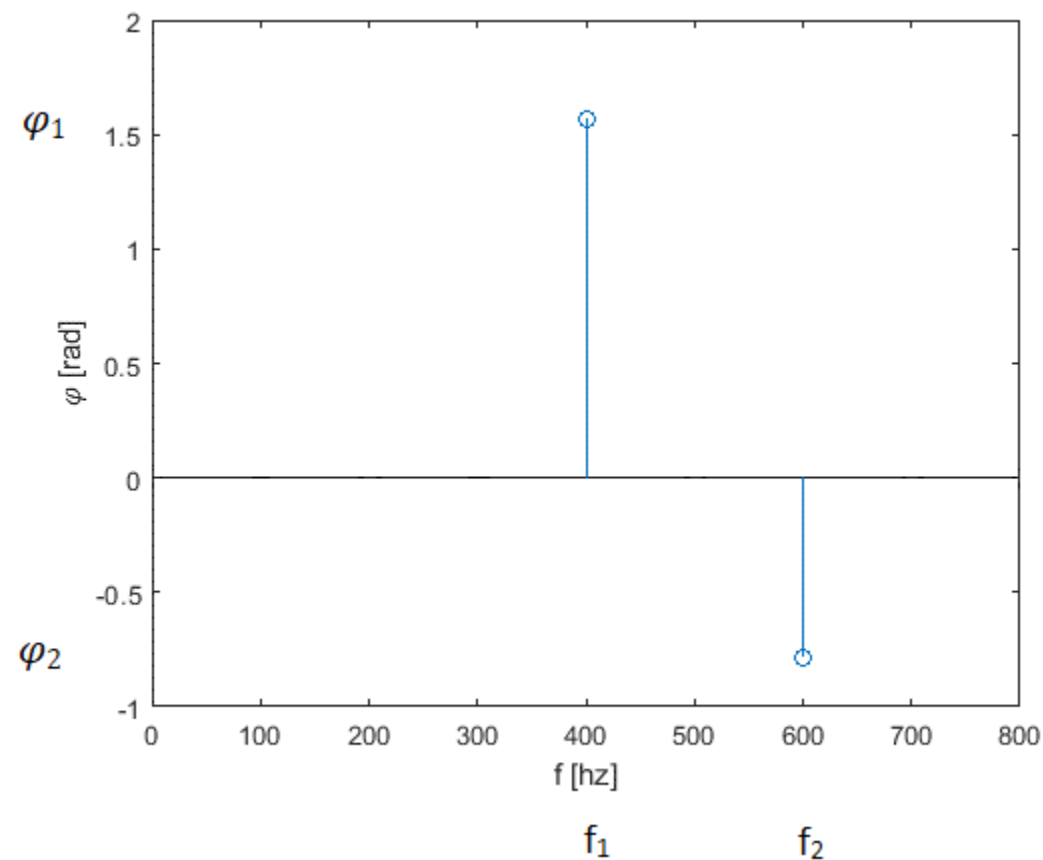
Frekvenční spektrum

Frekvenční spektrum

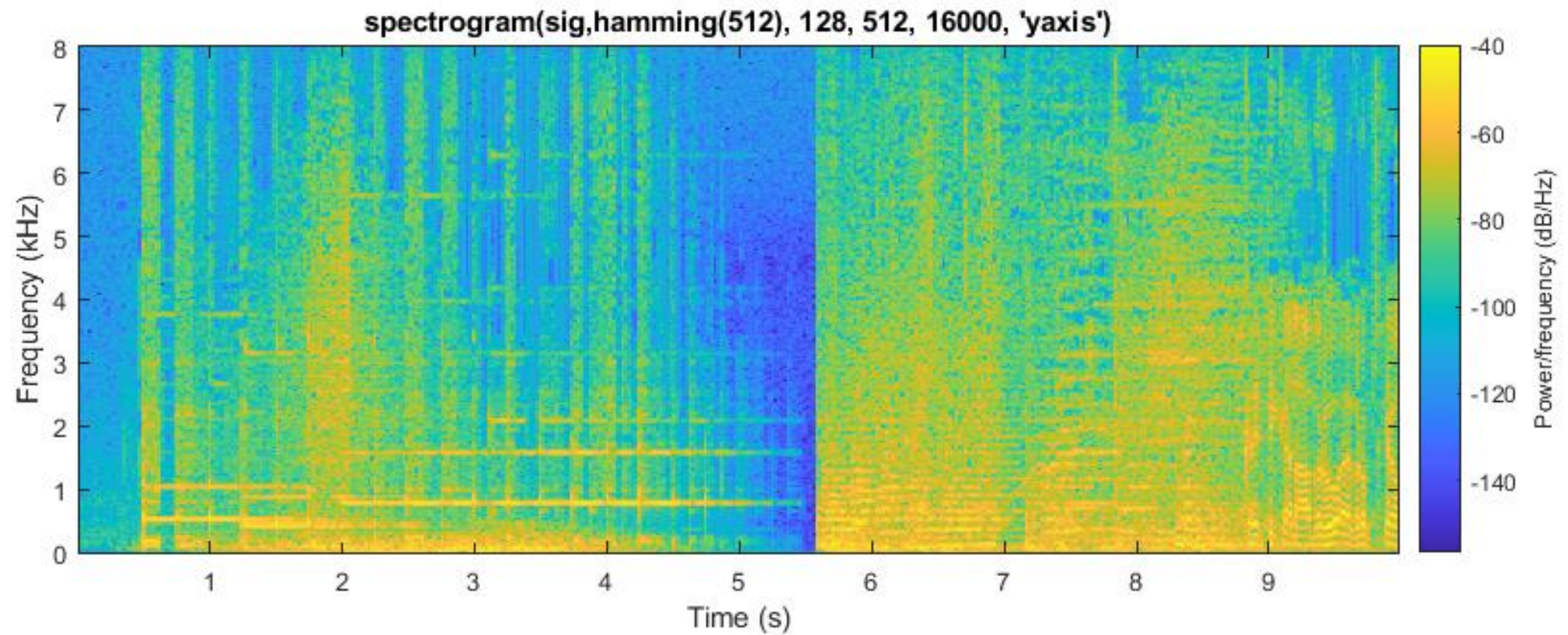
Magnitudové spektrum



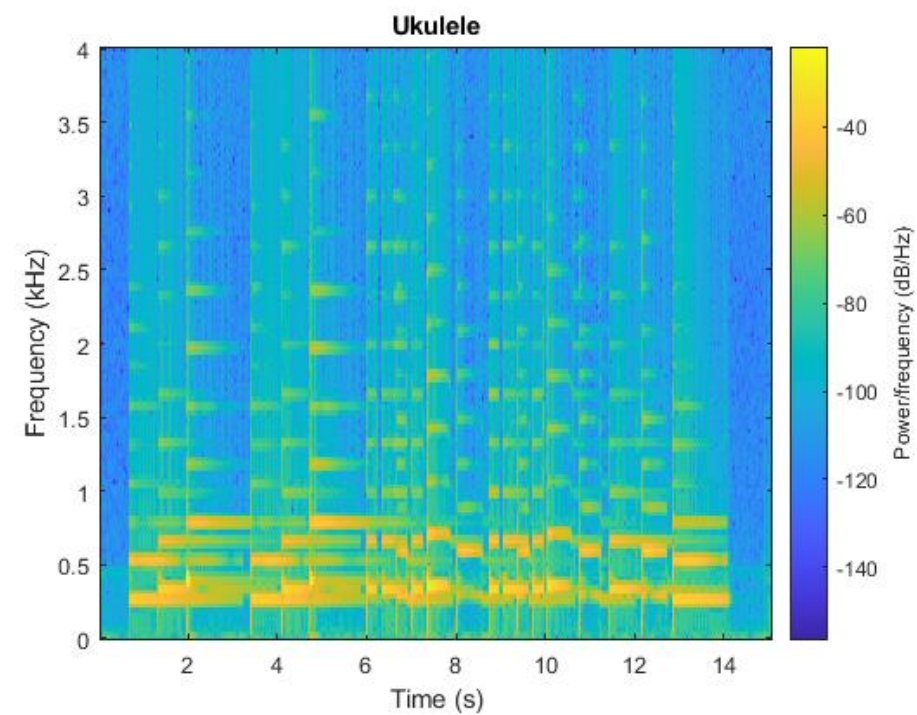
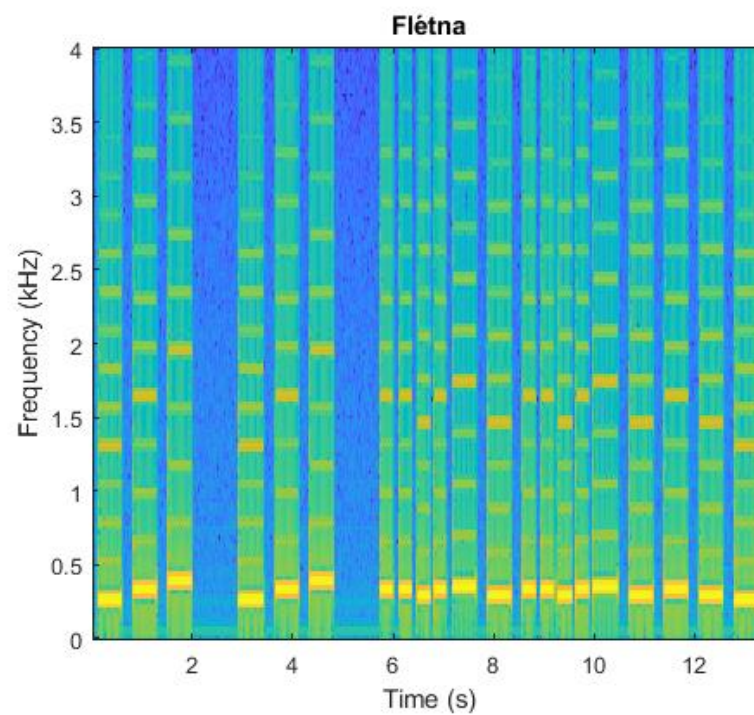
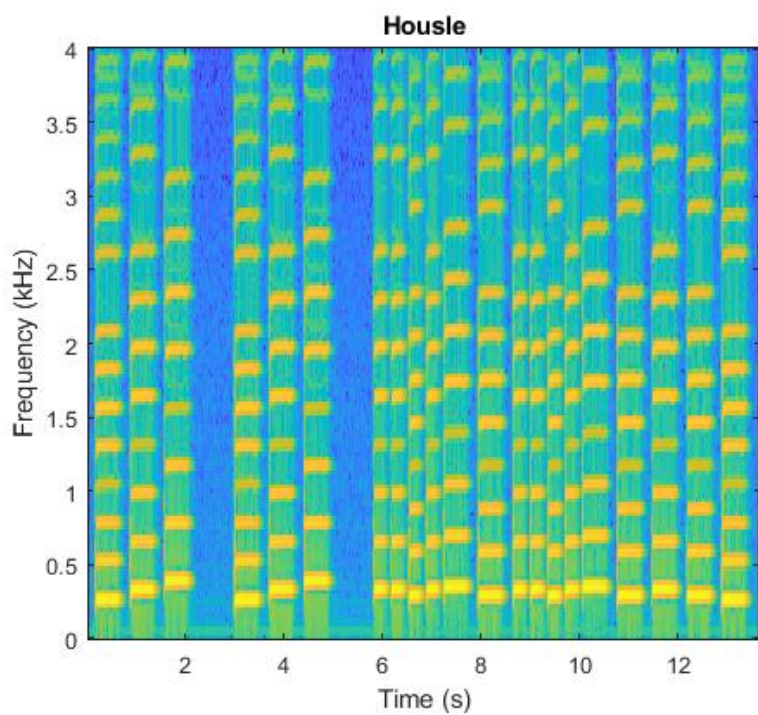
Fázové spektrum



Spektrogram

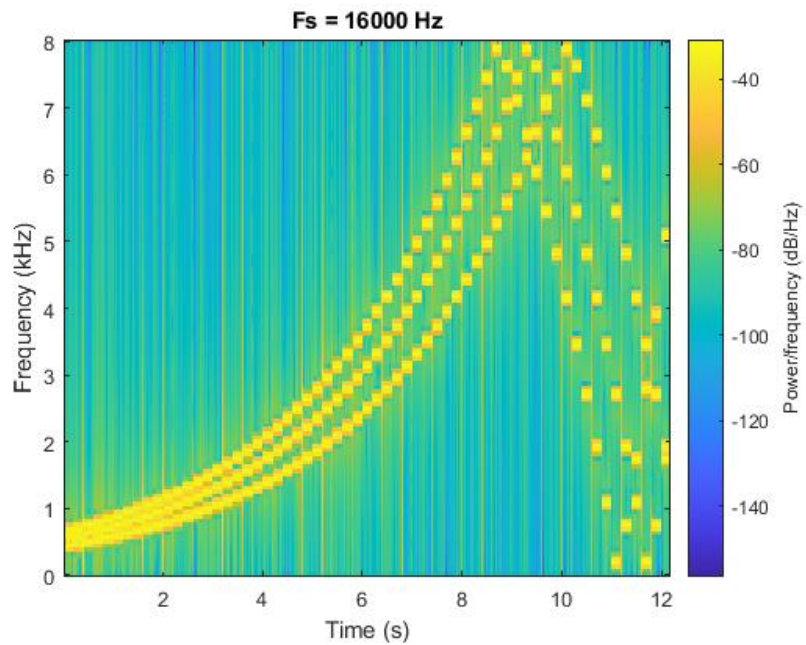


Spektrogram

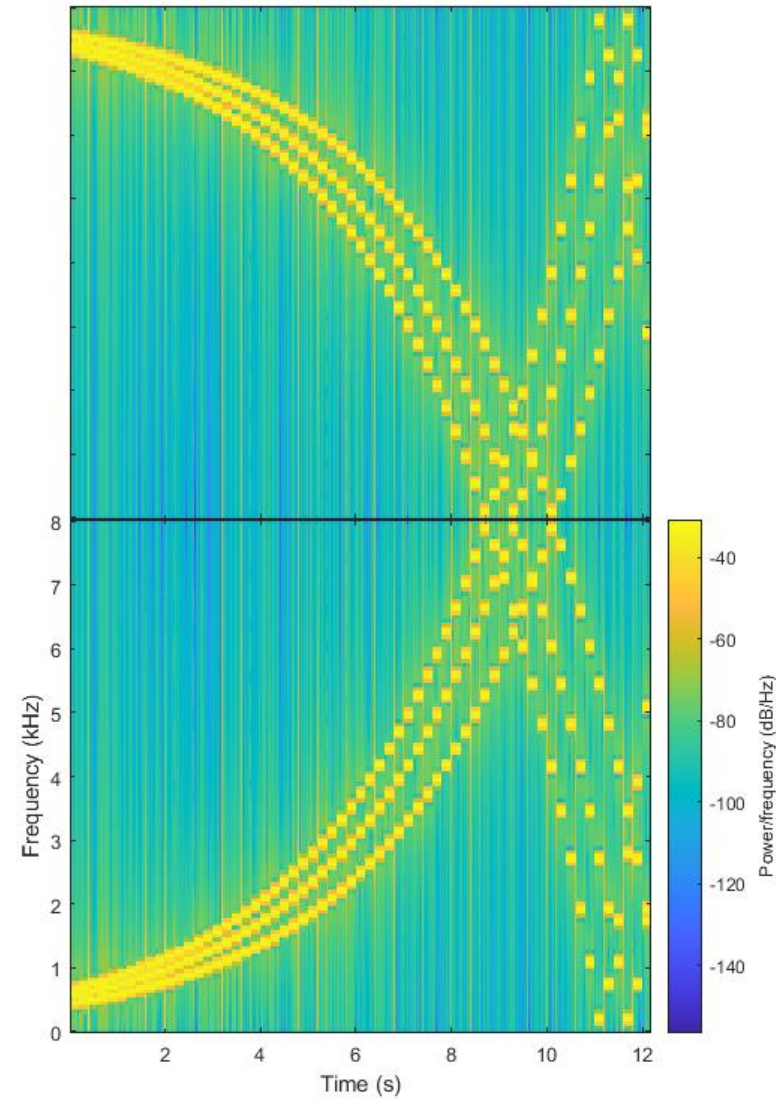
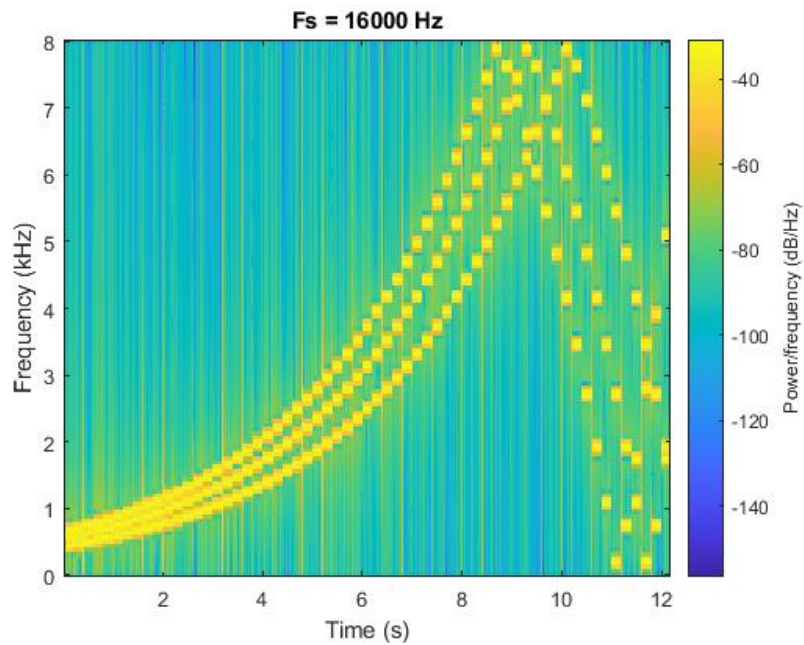


Spektrogram - Aliasing

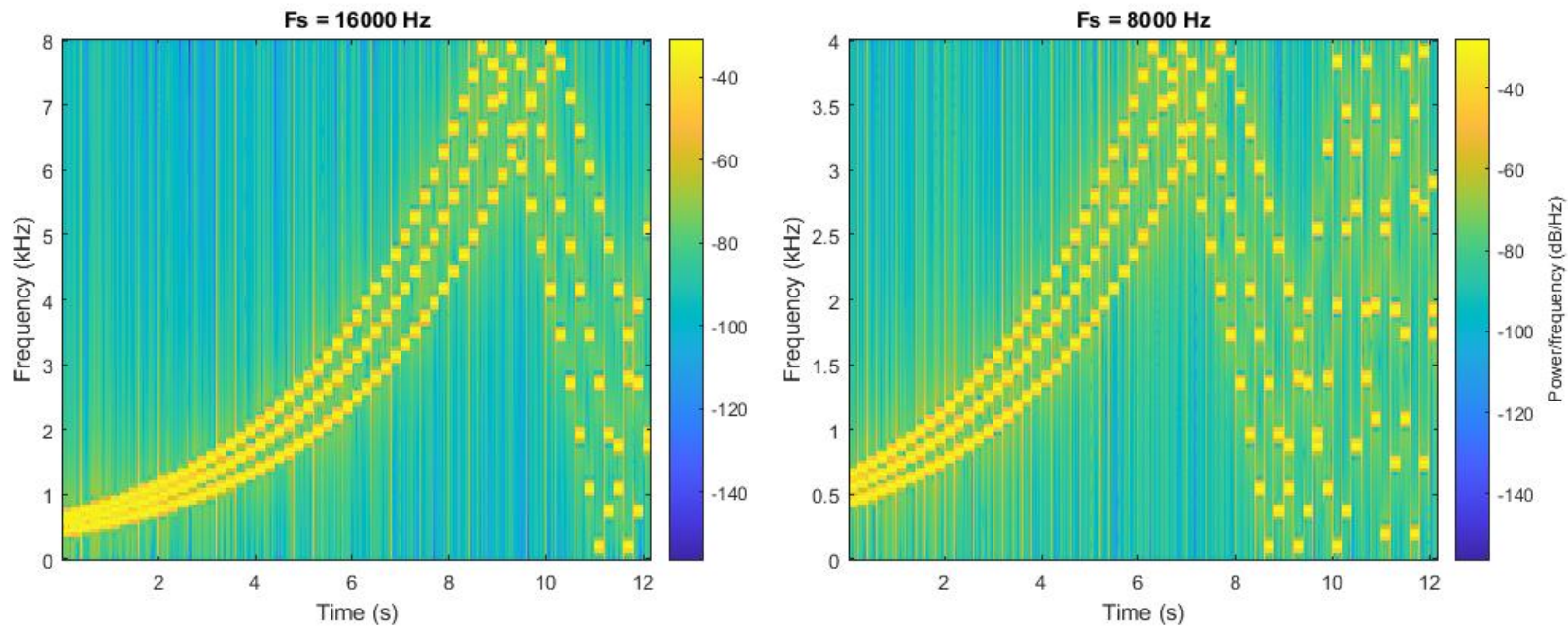
Spektrogram - Aliasing



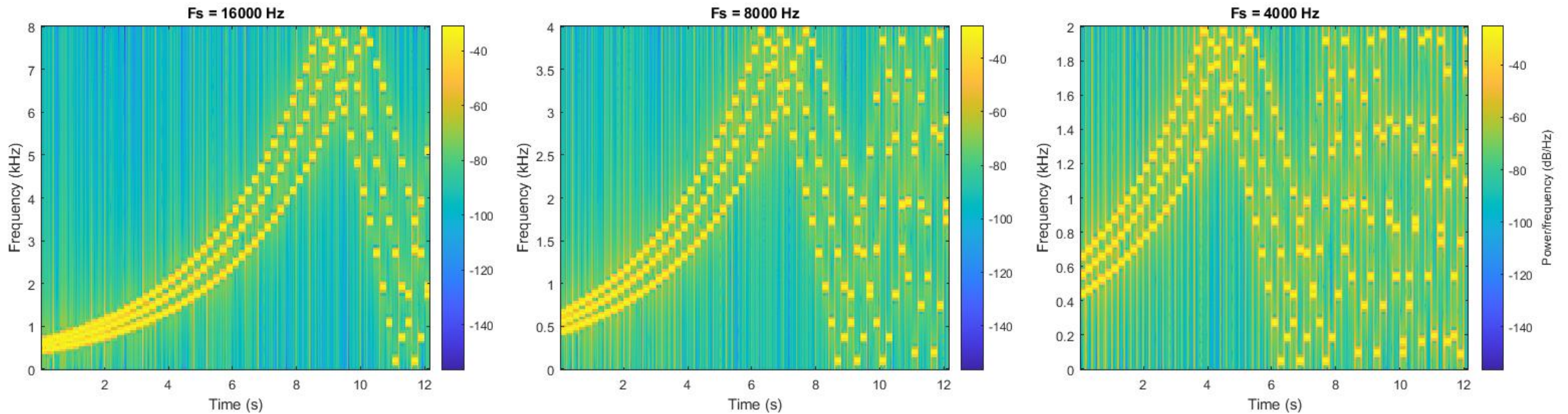
Spektrogram - Aliasing



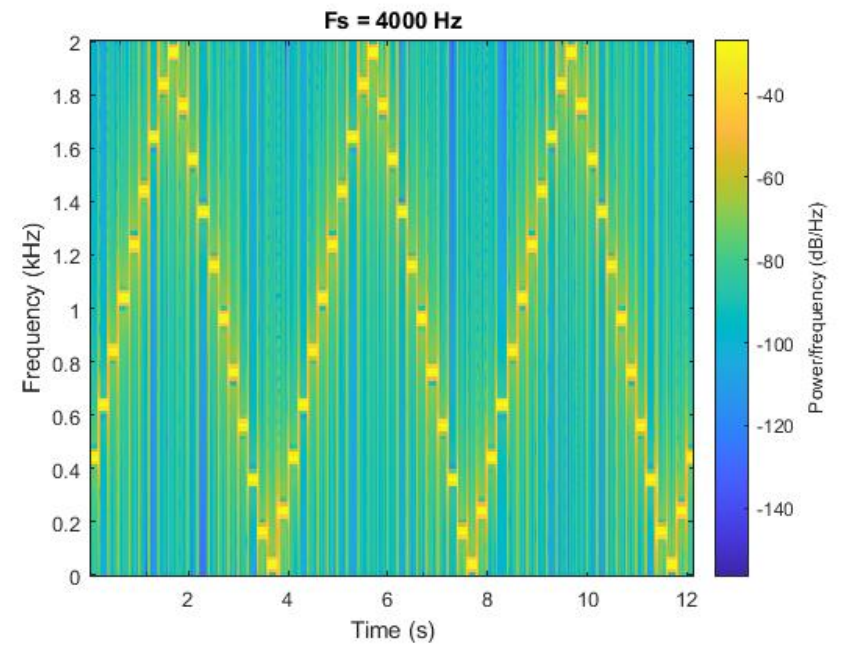
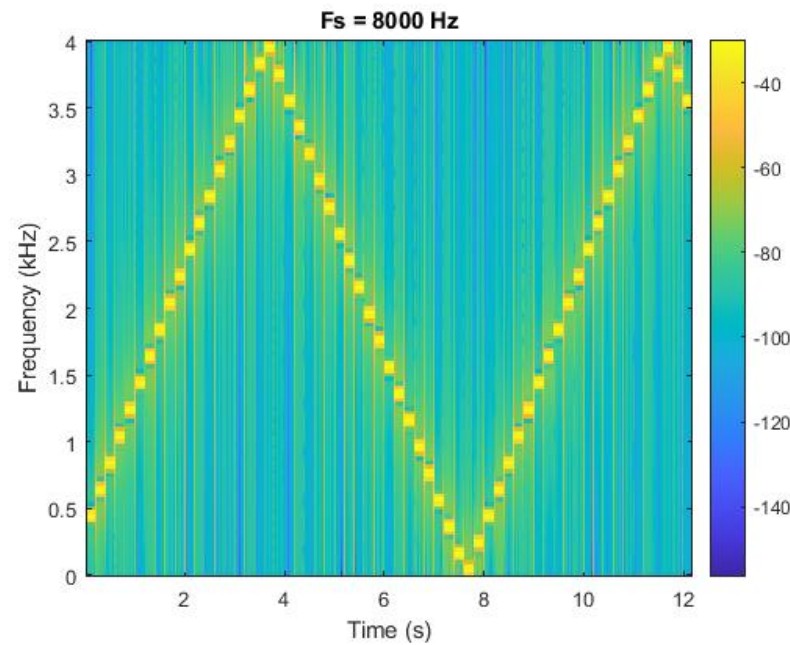
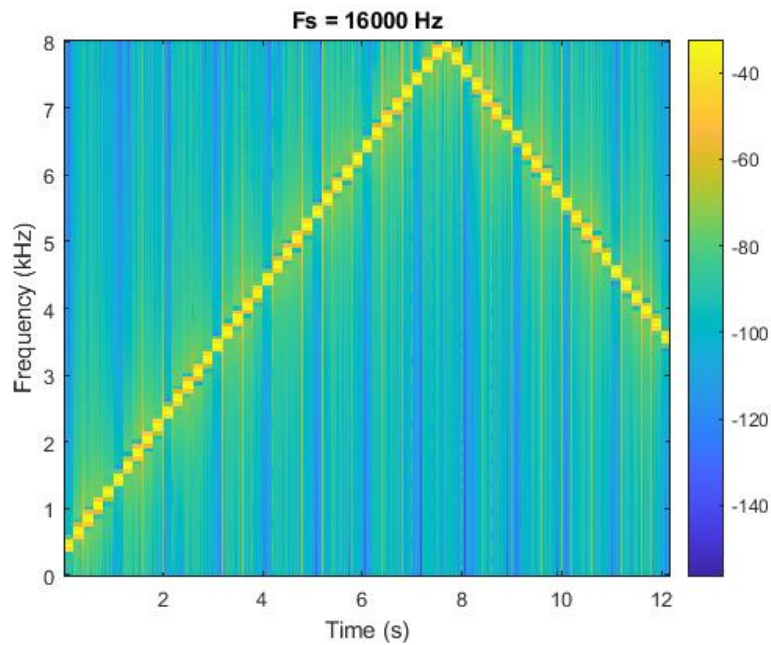
Spektrogram - Aliasing



Spektrogram - Aliasing



Spektrogram - Aliasing



Spektrogram - Matlab

spectrogram (SIG, WINDOW, NOVERLAP, NFFT, Fs, 'yaxis')

SIG - vstupní signál

Fs - vzorkovací frekvence signálu

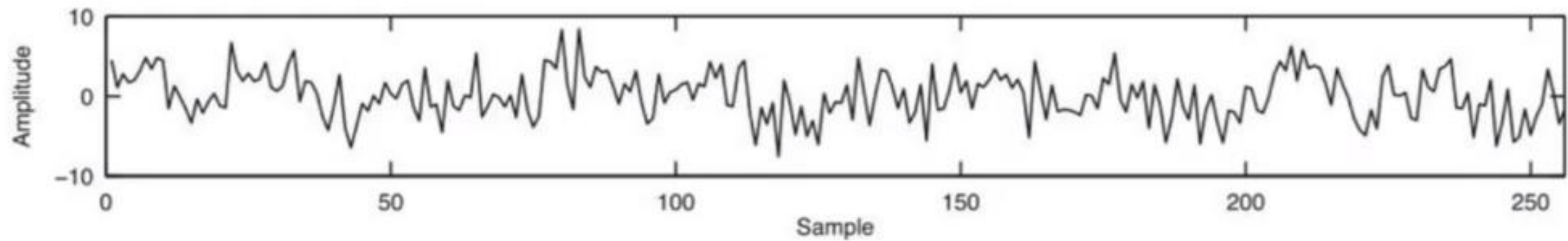
NFFT - počet vzorků pro DFT (FFT), velikost rámce

NOVERLAP - vzájemný překryv jednotlivých rámců

WINDOW - okénkovací funkce (délka se volí stejná jako u NFFT)

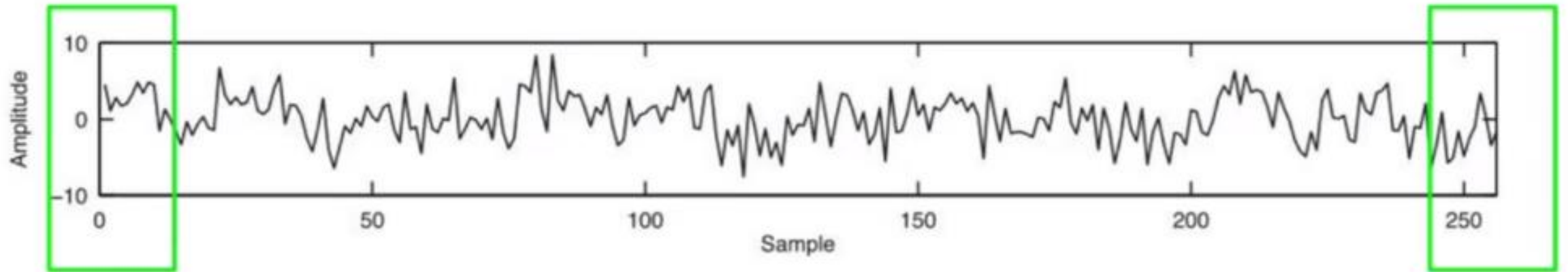
Okénkovací funkce

Rámec signálu



Okénkovací funkce

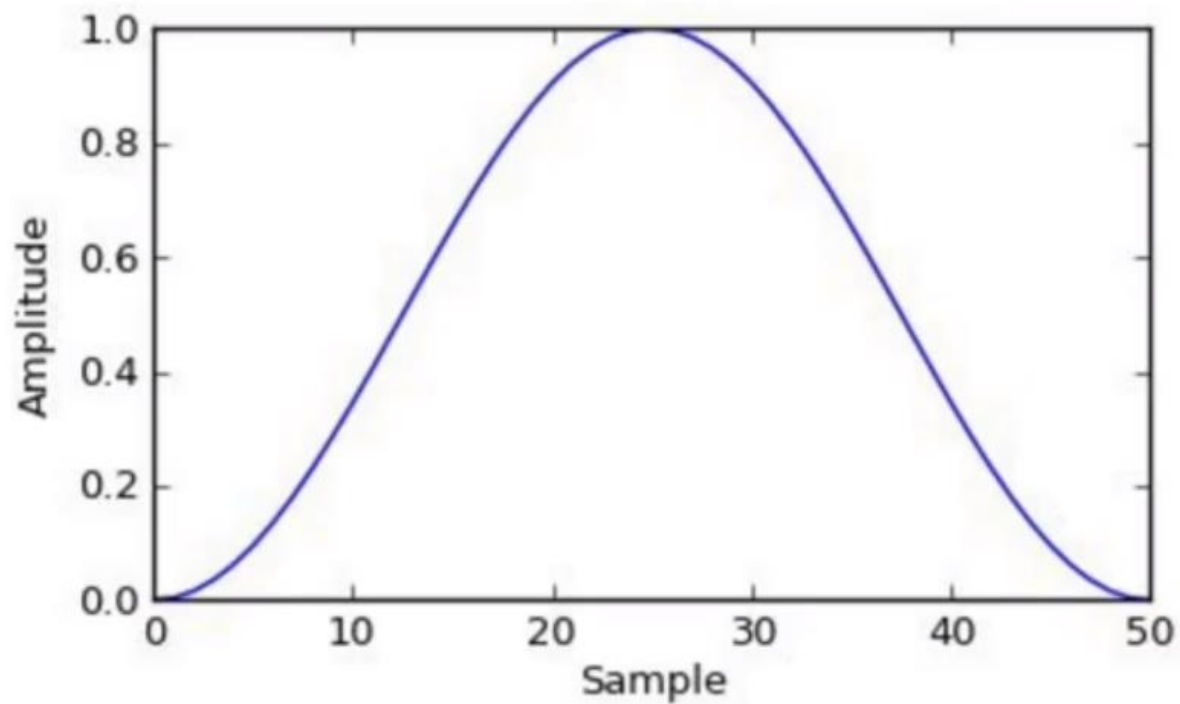
Rámec signálu



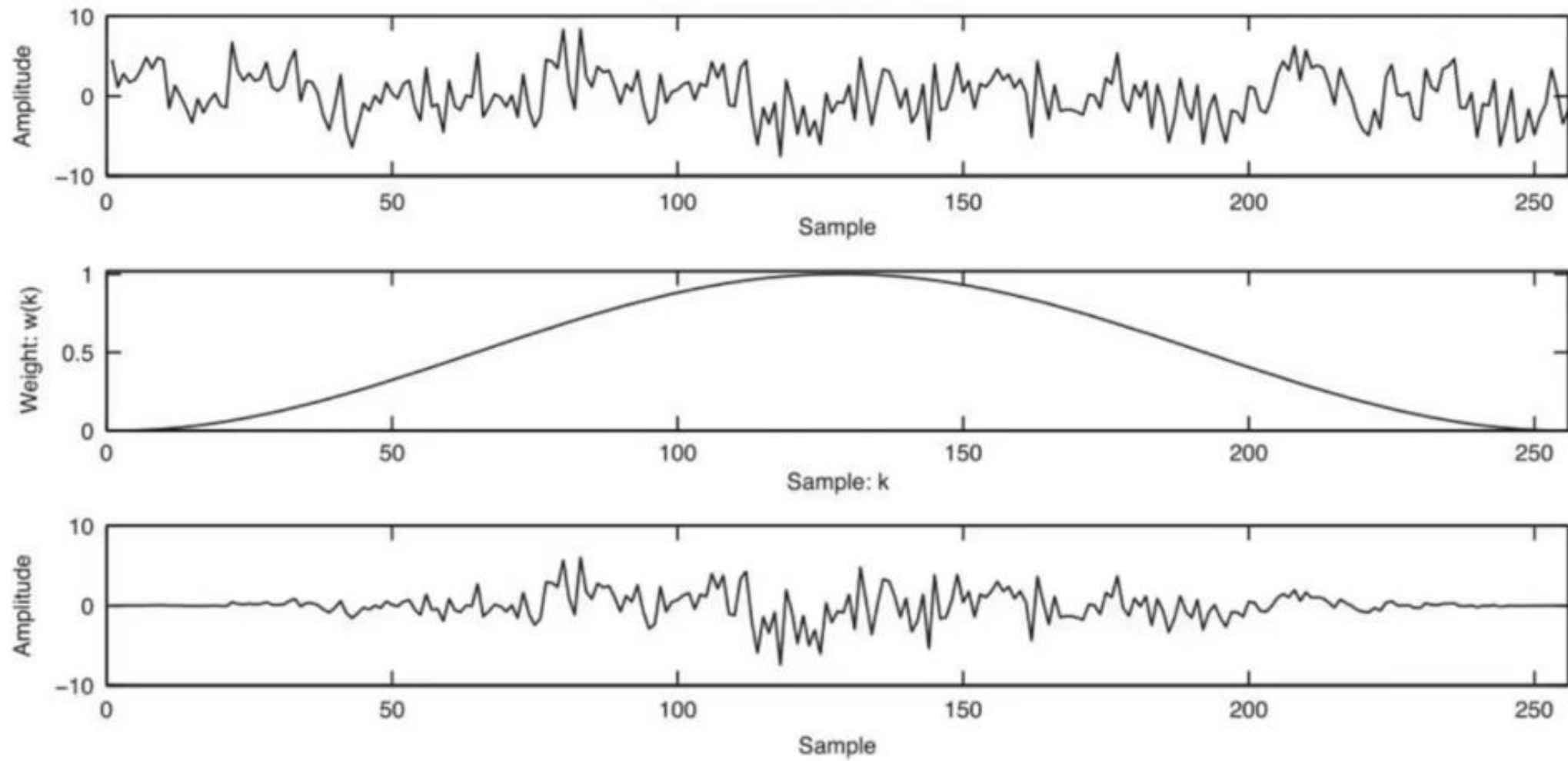
Okénkovací funkce

Hannovo (Hammingovo) okno

$$w[n] = \frac{1}{2} \left(1 - \cos \left(\frac{2\pi n}{N} \right) \right); 0 \leq n \leq N$$

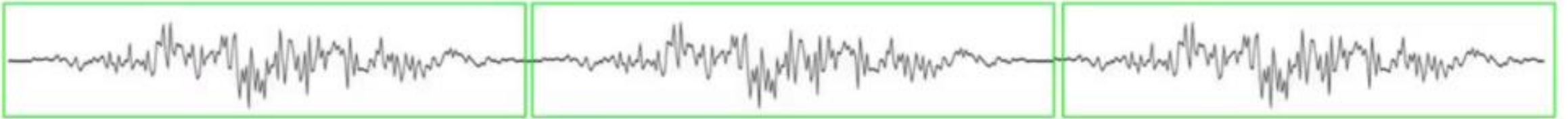


Okénkovací funkce



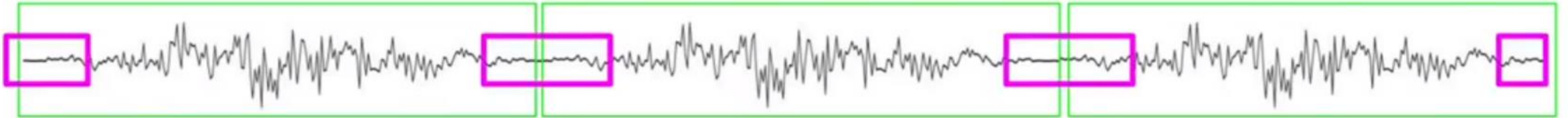
Okénkovací funkce - Overlap

Ztráta informací



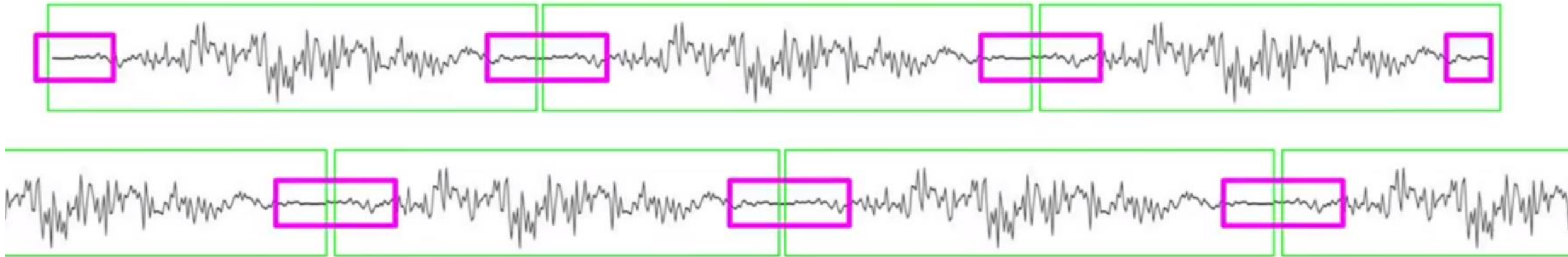
Okénkovací funkce - Overlap

Ztráta informací



Okénkovací funkce - Overlap

Ztráta informací - Překrytí



Zero-crossing rate

Počet průchodů nulou

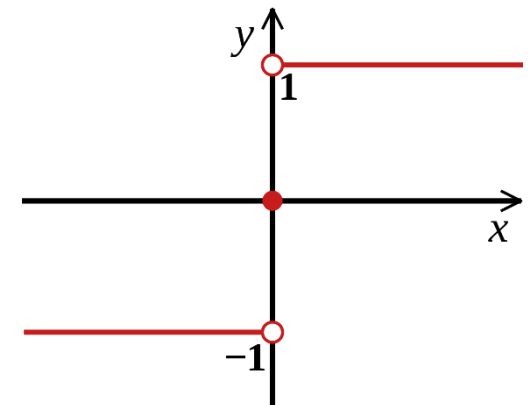
$$ZCR(x) = \frac{1}{2(N-1)} \sum_{n=2}^N |\text{sign}(x[n]) - \text{sign}(x[n-1])|$$

Zero-crossing rate

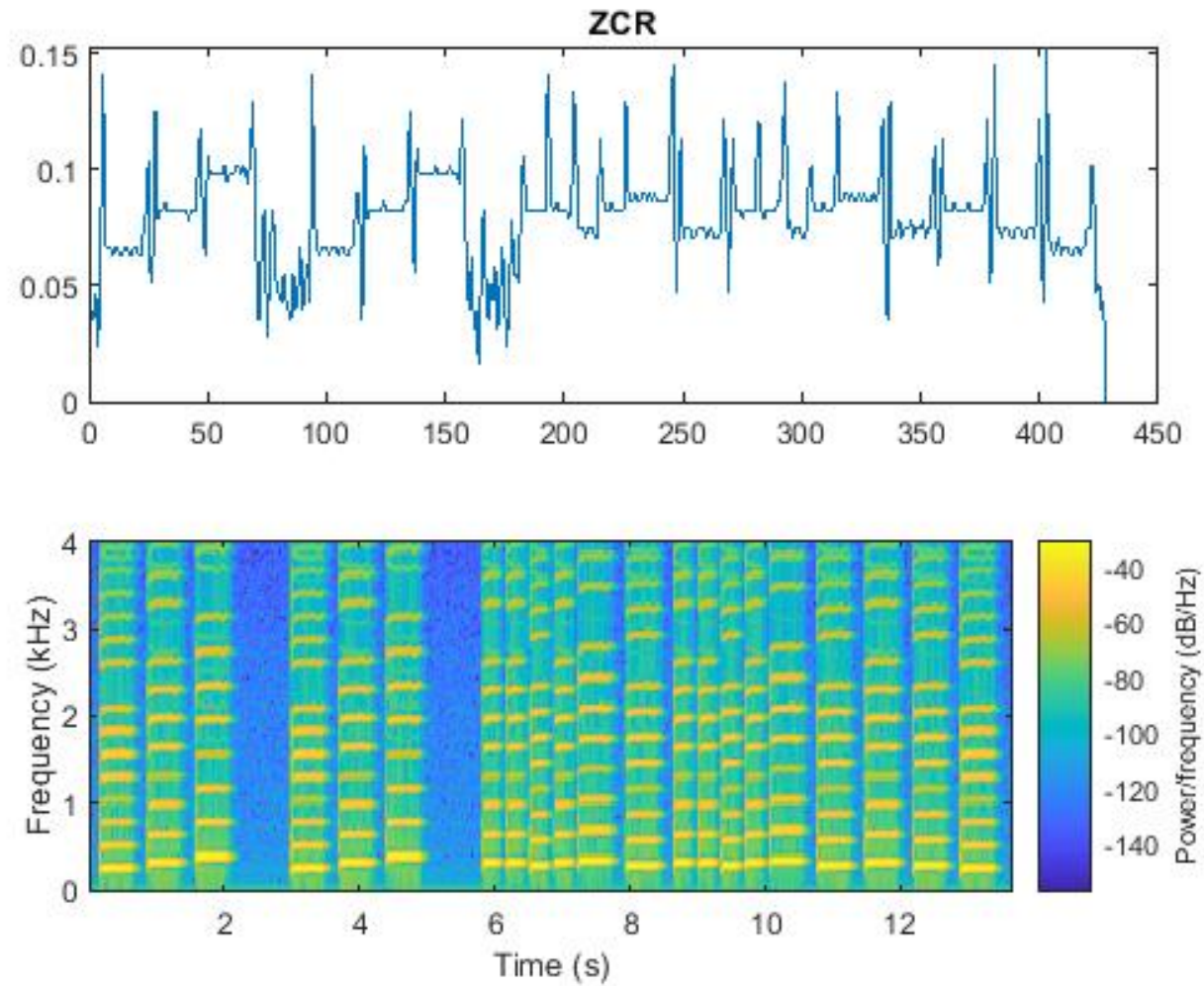
Počet průchodů nulou

$$ZCR(x) = \frac{1}{2(N-1)} \sum_{n=2}^N |\text{sign}(x[n]) - \text{sign}(x[n-1])|$$

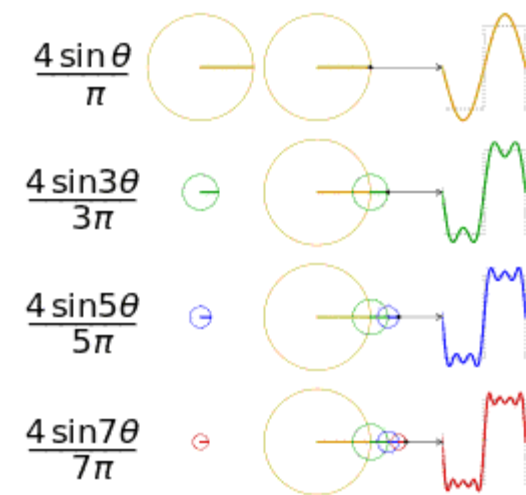
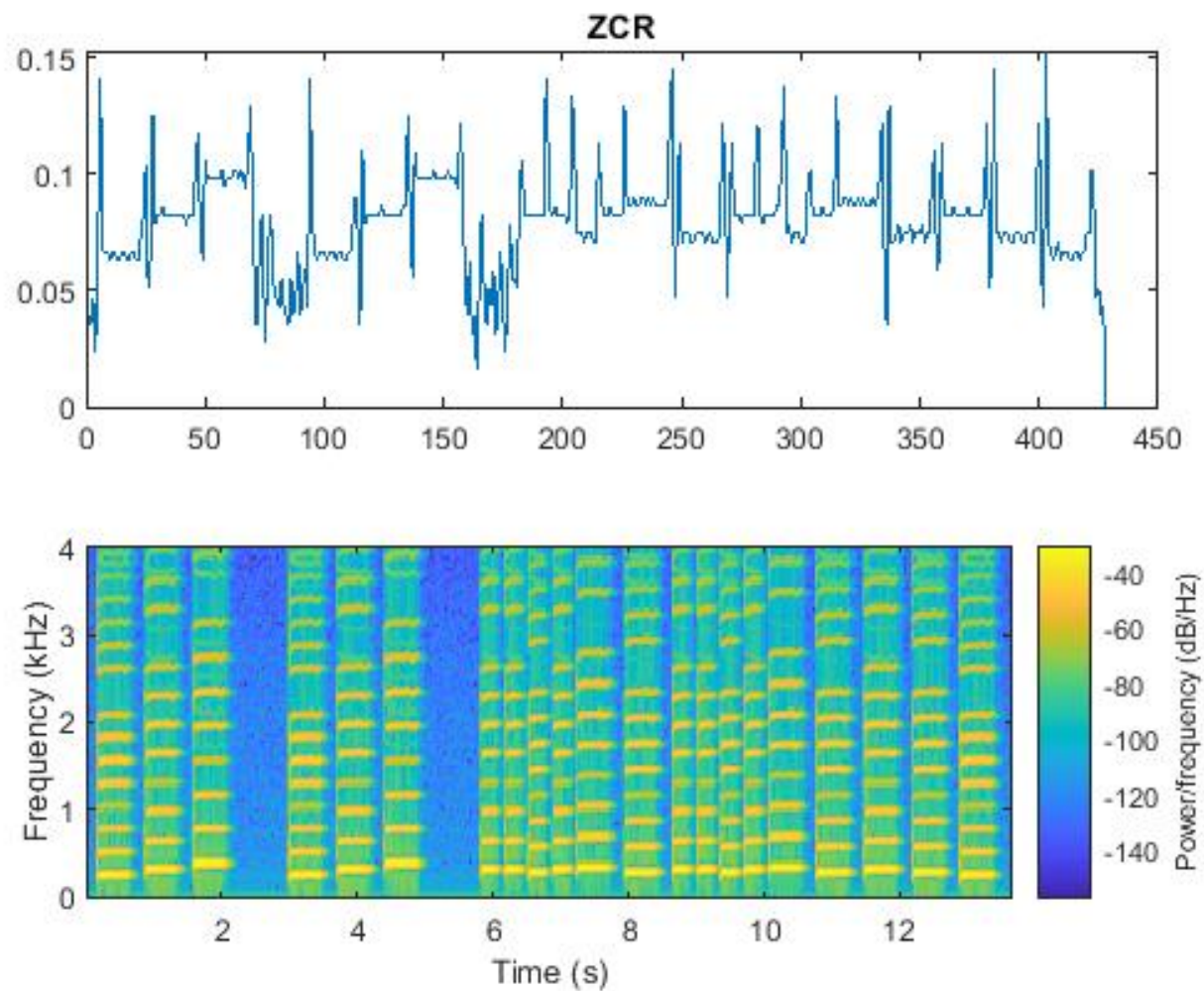
$$\text{sign}(x) = \begin{cases} -1, & x < 0 \\ 0, & x = 0 \\ 1, & x > 0 \end{cases}$$



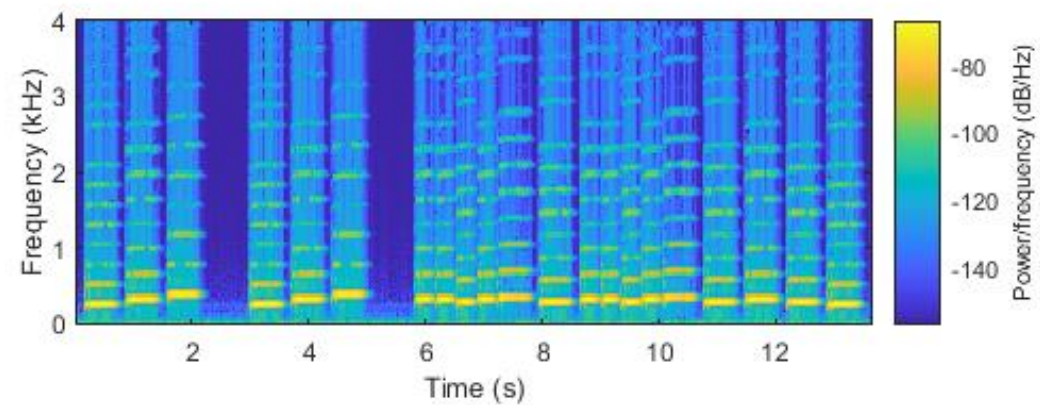
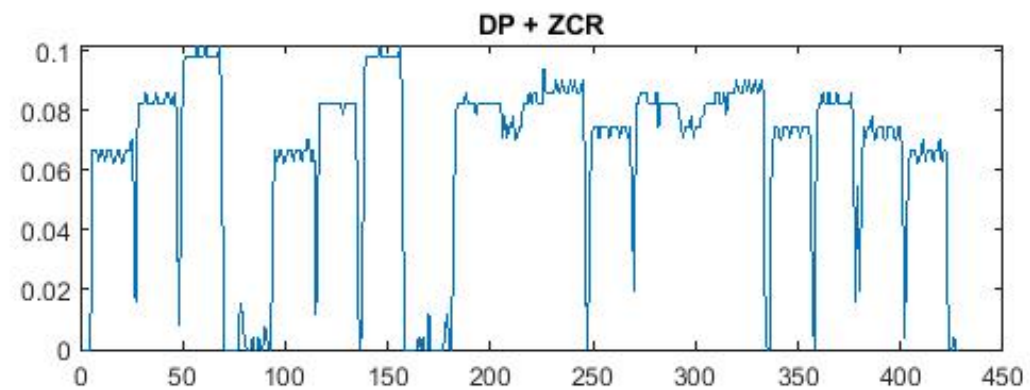
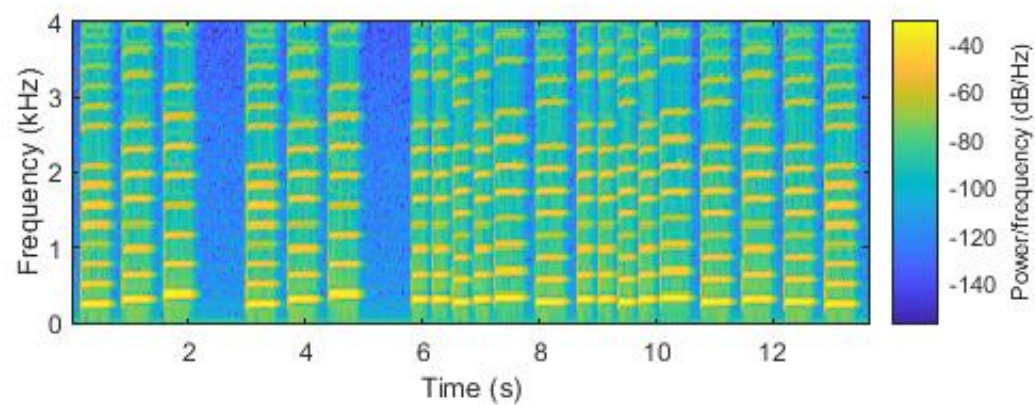
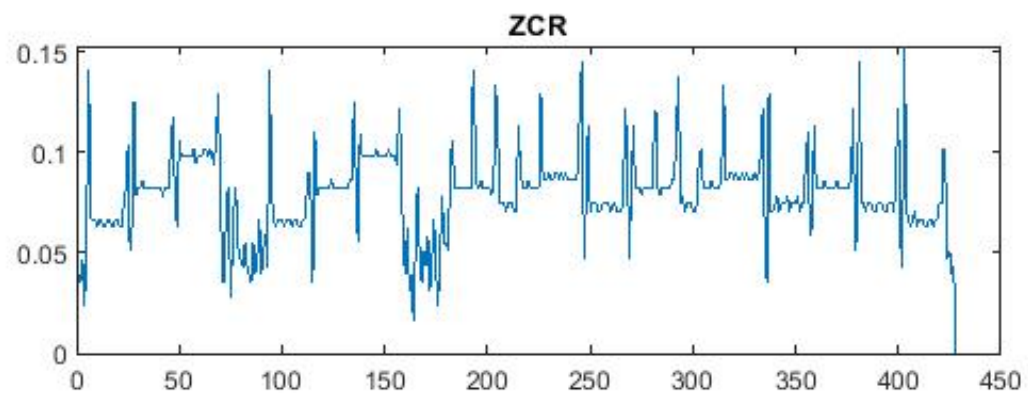
Zero-crossing rate



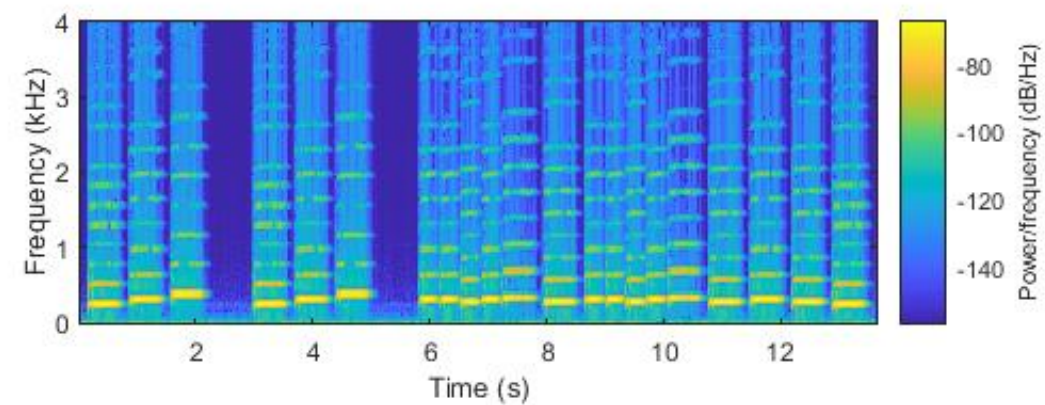
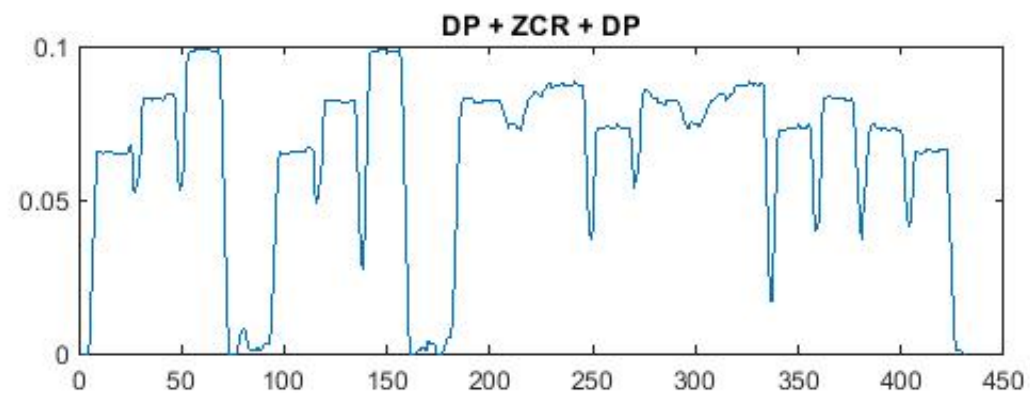
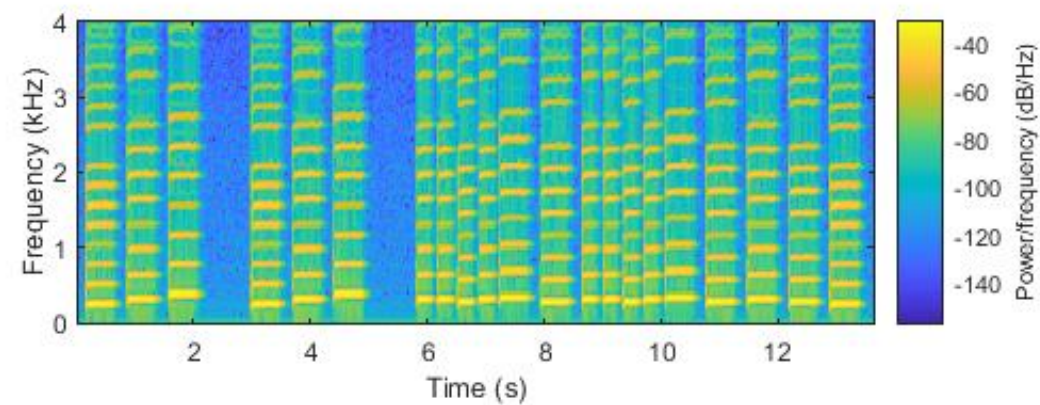
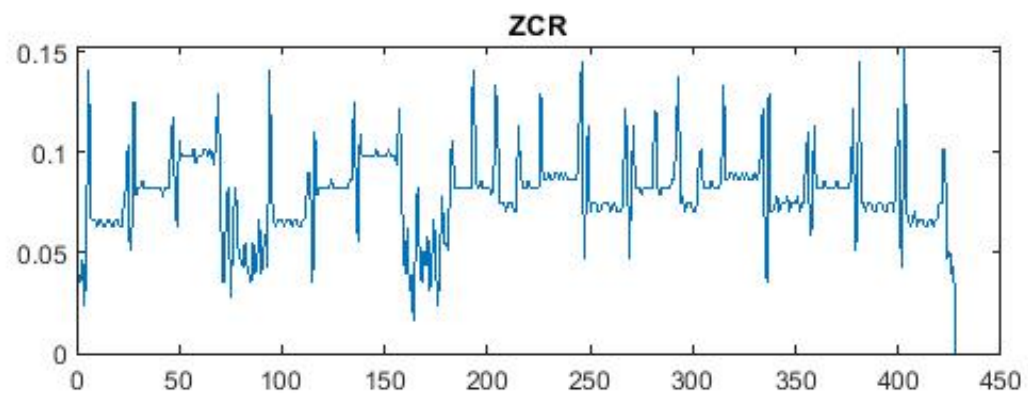
Zero-crossing rate



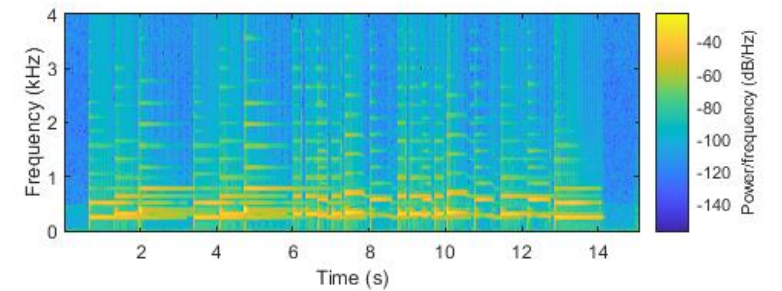
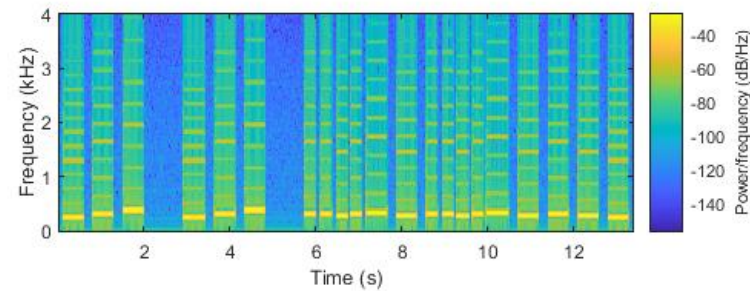
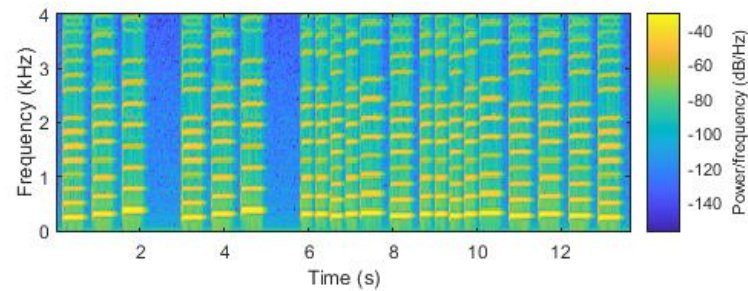
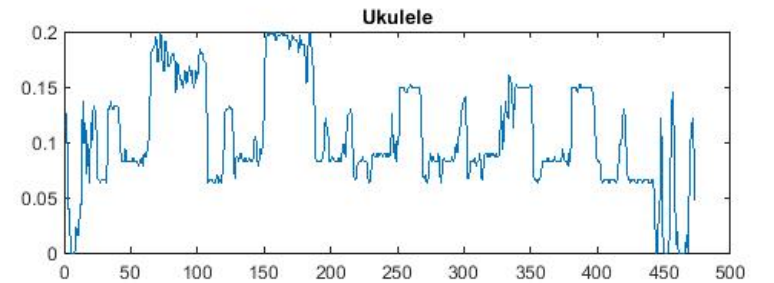
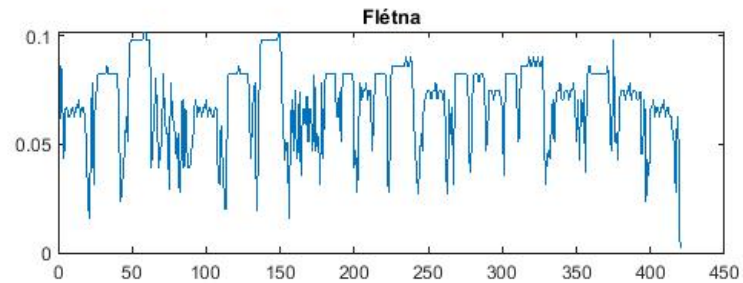
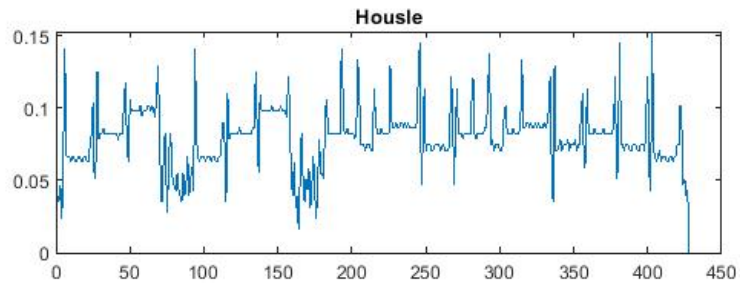
Zero-crossing rate



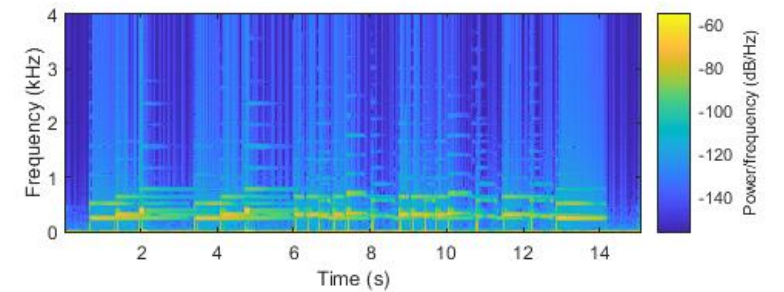
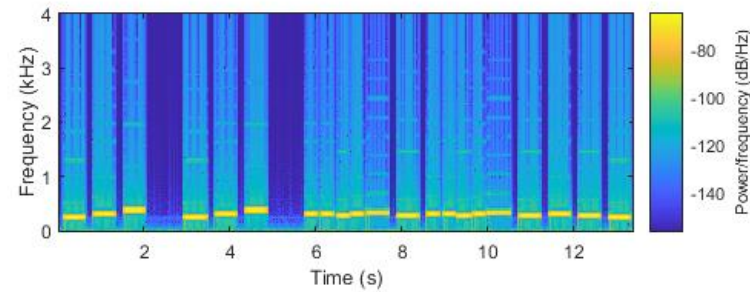
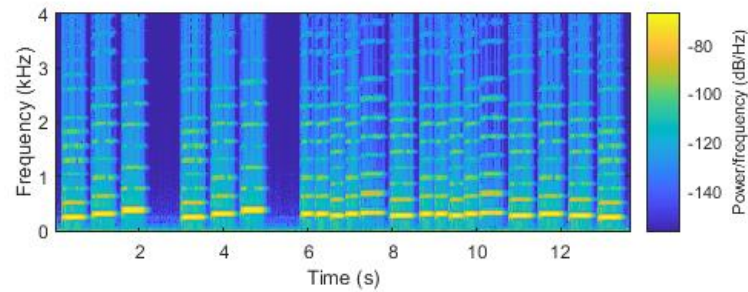
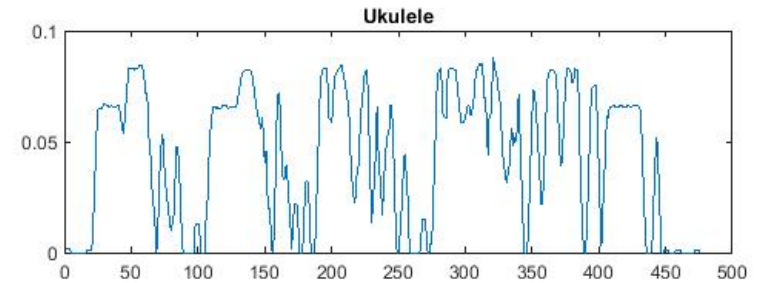
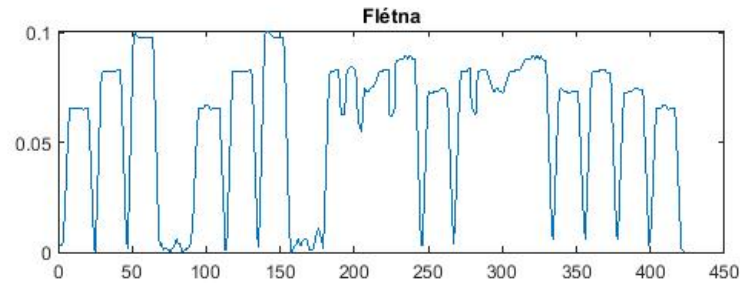
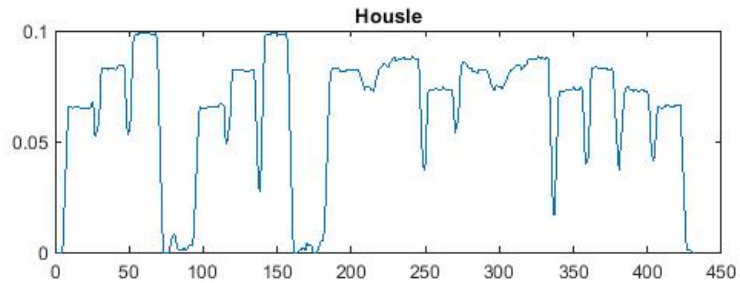
Zero-crossing rate



Zero-crossing rate



Zero-crossing rate



Úloha k odevzdání

Načtěte soubor „ovcaci-housle.wav“.

Spočítejte hodnoty ZCR s okénkem velikosti 256 vzorků a překryvem 128 vzorků (1. frame – 1-256, 2. frame 129-384, 3. frame 257-512, ...).

Vykreslete původní signál, průběh ZCR a spektrogram (vygenerujte si Hannovo okno).
Vyzkoušejte si i ostatní soubory.

Pozor, Matlab indexuje od 1, suma projde 255 iterací!!!

