Algorithms of F0 detection in vocal voice scale analysis

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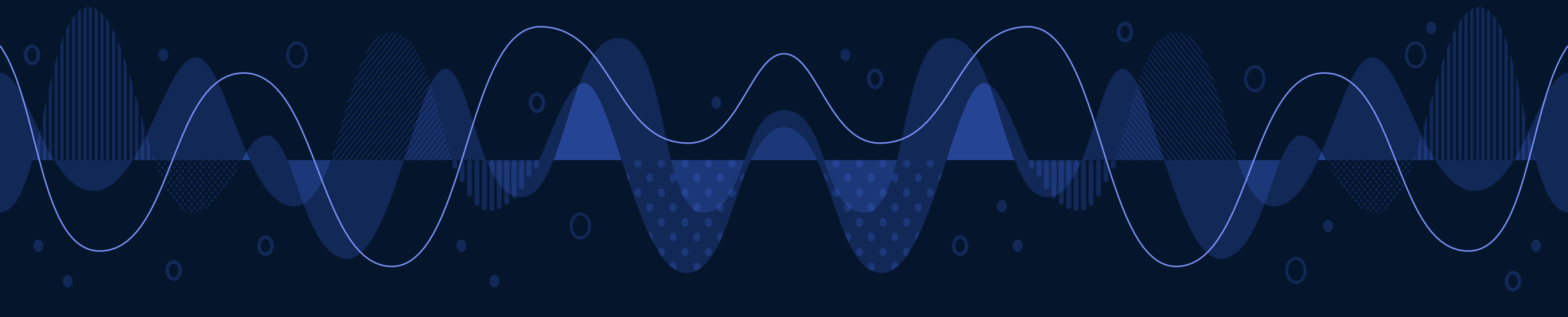
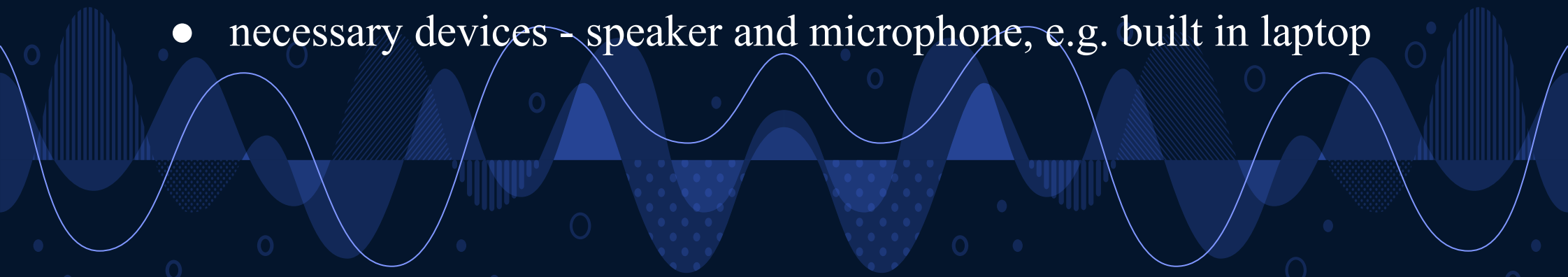


Work objectives and scope

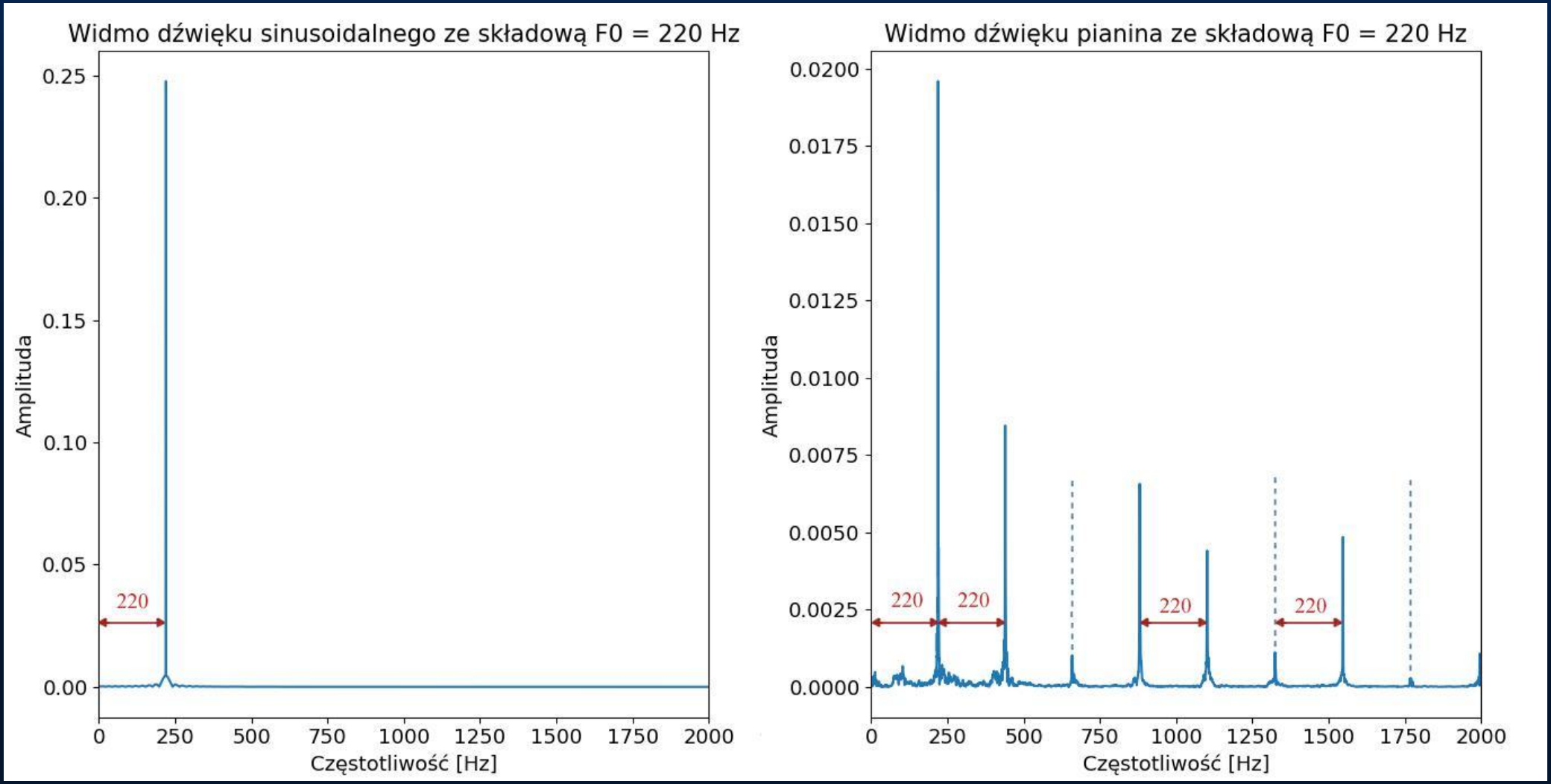
- overview of F0 detection methods
- implementation of selected algorithms

Project requirements

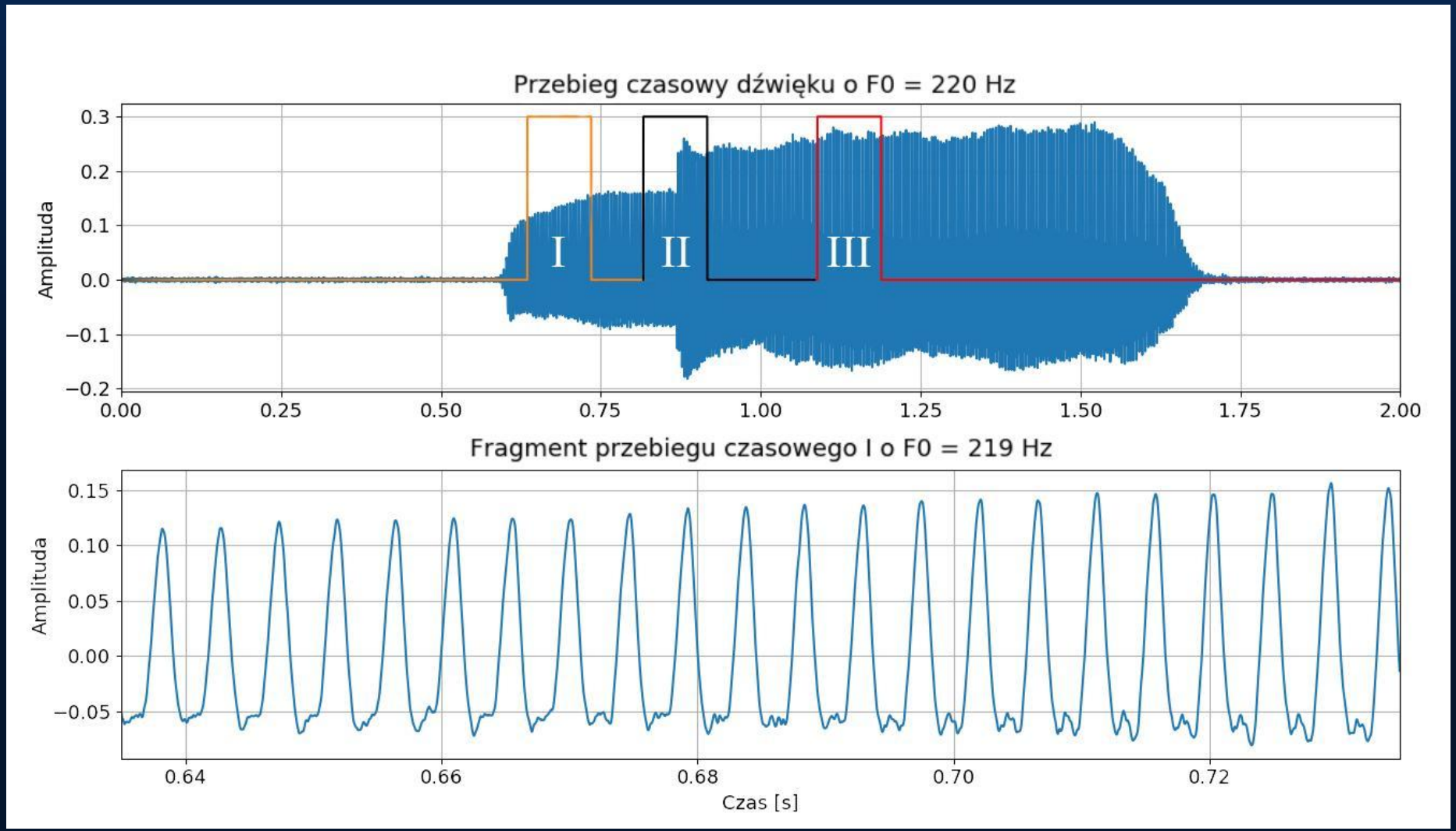
- input - recording of a few seconds of sound
- output - information about its F0
- programming language - Python
- necessary devices - speaker and microphone, e.g. built in laptop



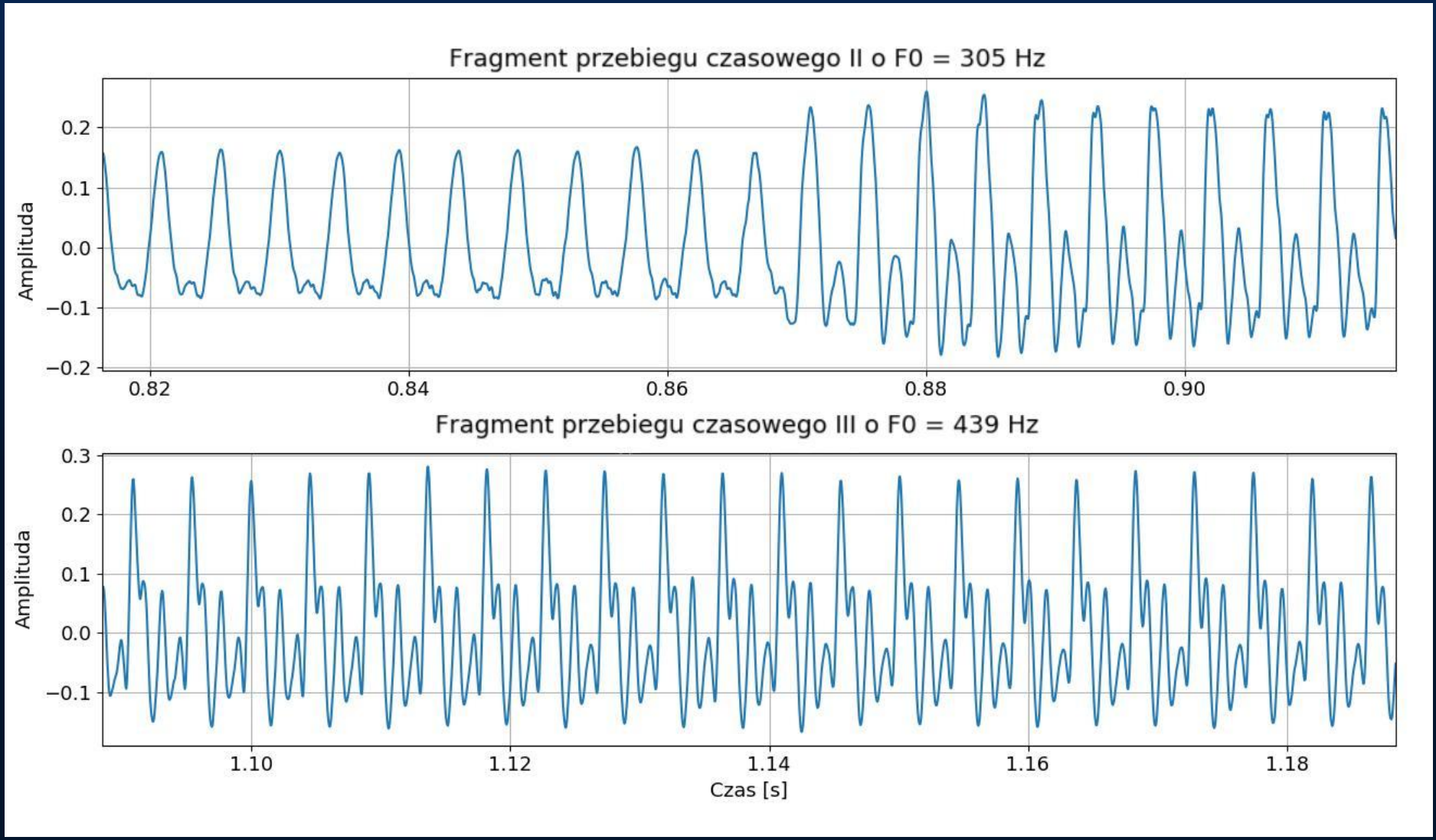
Value of basic frequency (F0)



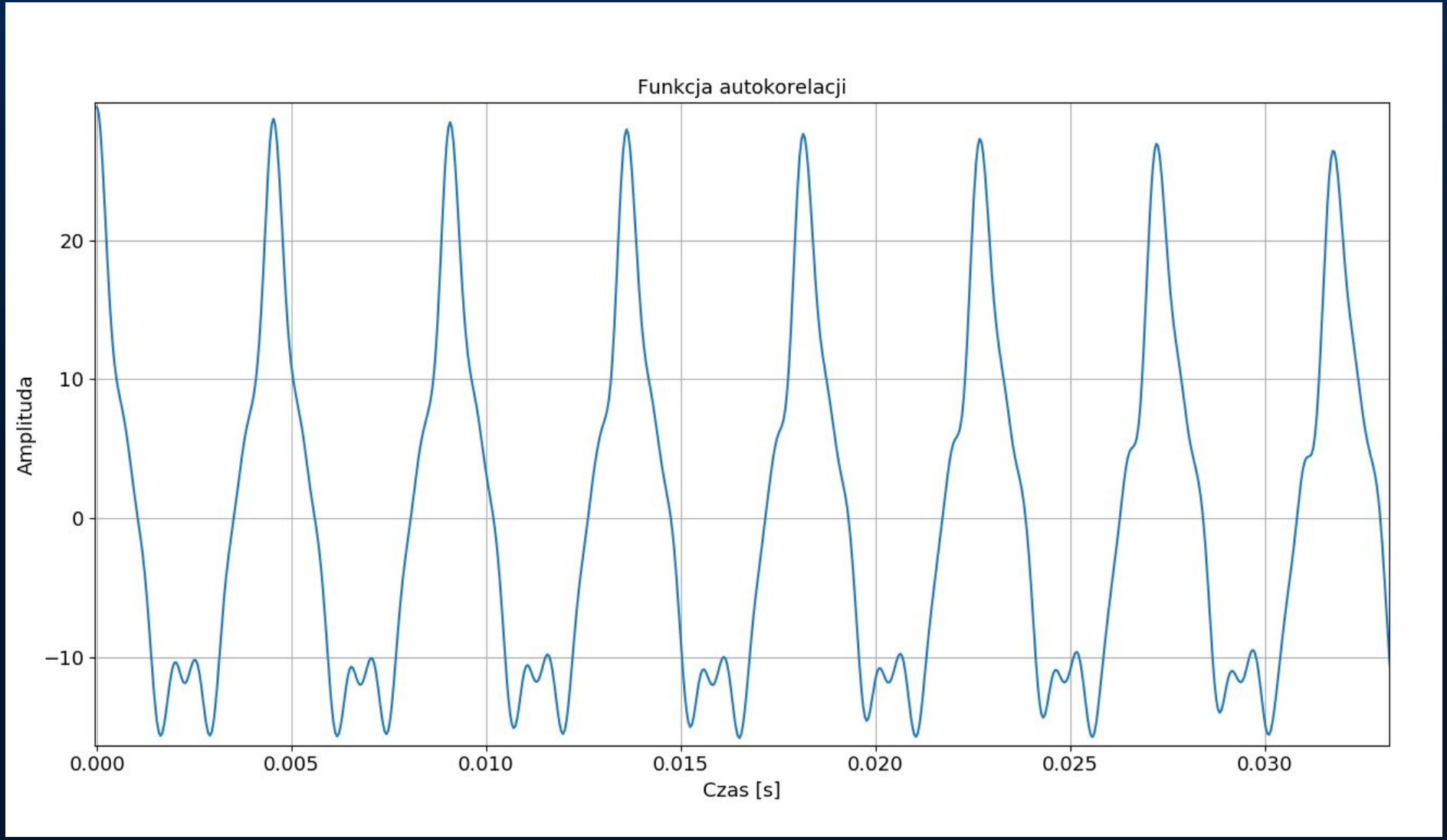
Algorithms operating in the time domain - Zero crossing analysis



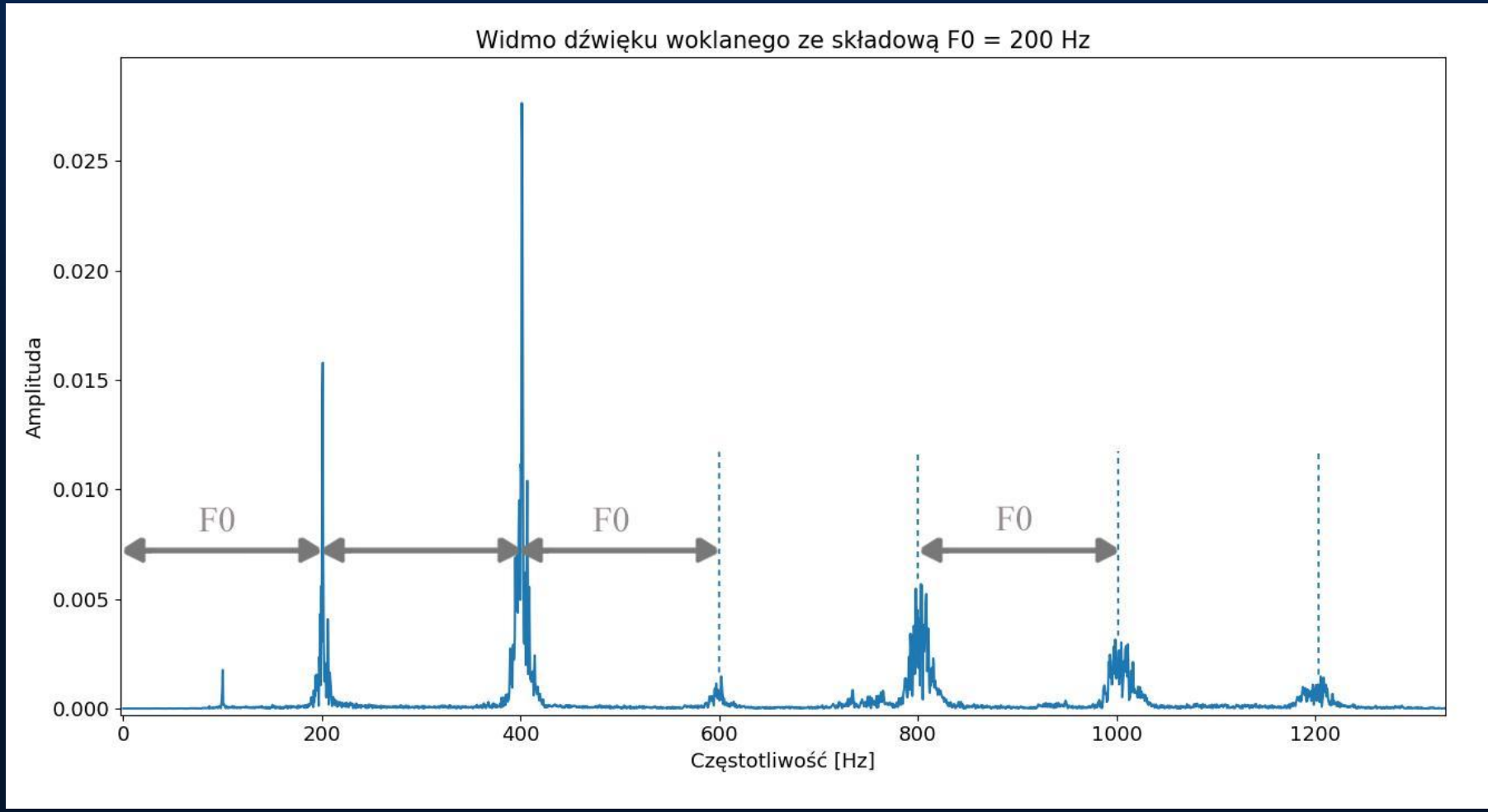
Zero crossing analysis



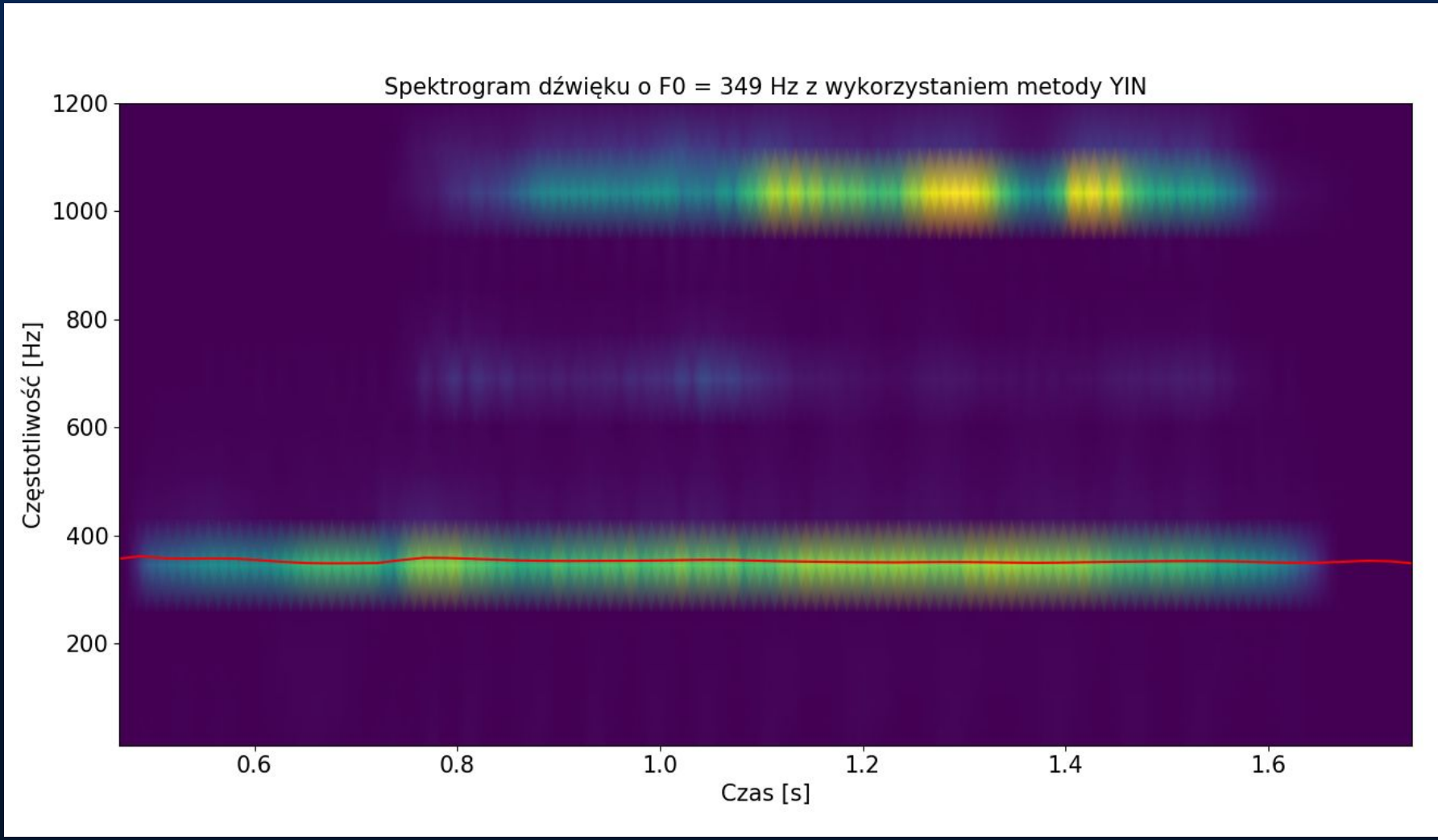
Autocorrelation function analysis



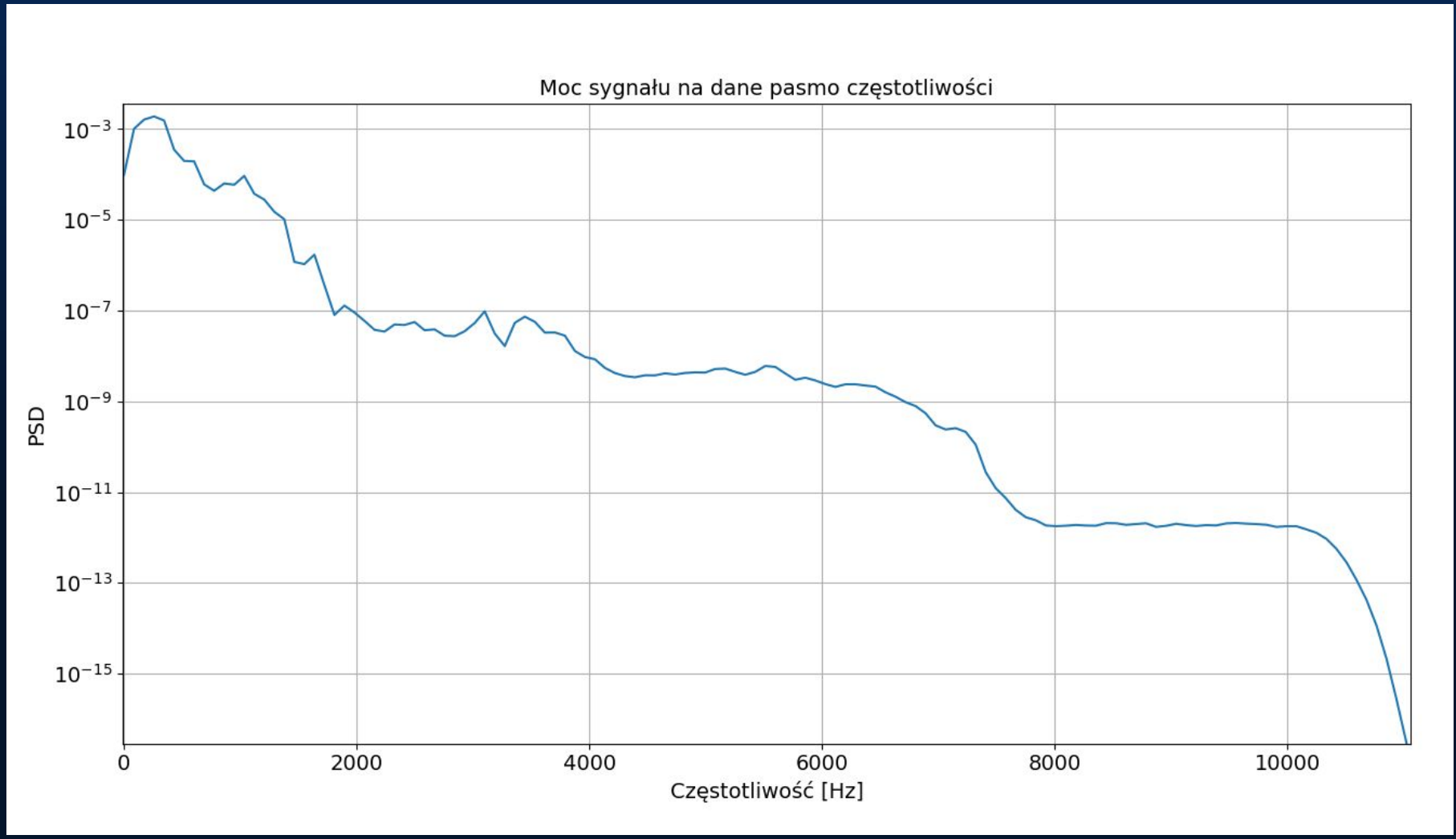
Algorithm based on spectral analysis



YIN


Spektrogram dźwięku o F0 = 349 Hz z wykorzystaniem metody YIN
1200
1000
800
600
400
200
Częstotliwość [Hz]
0.6
0.8
1.0
1.2
1.4
1.6
Czas [s]

Power per bandwidth (PSD)



The results produced by the presented algorithms

Signal type	Expected value [Hz]	Zero crossing analysis (entire recording) [Hz]	Zero crossing analysis (part of recording) [Hz]	Autocorrelation function [Hz]	YIN [Hz]	Spectral analysis [Hz]	PSD [Hz]
Sine	**220**	279	220	220	220	220	258
Piano	**220**	423	502	220,6	220	219,95	258
Vocal voice	**220**	830	468	220,54	220	221,49	258
Vocal voice	**146**	455,94	153	147,89	147	148,1	258
Vocal voice	**200**	1526,27	397	200,61	202	201,81	430
Vocal voice	**349**	848	352	351,48	354	354,36	340

Literature

1. Cheveigne A., Kawahara H., *YIN, a fundamental frequency estimator for speech and music*, Acoustical Society of America, 2002
2. Librosa, *domentation*, https://librosa.org/, access: 05.2021
3. SciPy, *domentation,* https://docs.scipy.org/doc/, access: 05.2021
4. Szwoch E., *Cyfrowe przetwarzanie sygnałów w języku Python*, Gdańsk, 2017 - 2018, URL: https://sound.eti.pg.gda.pl/~greg/dsp/, dostęp: 05.2021