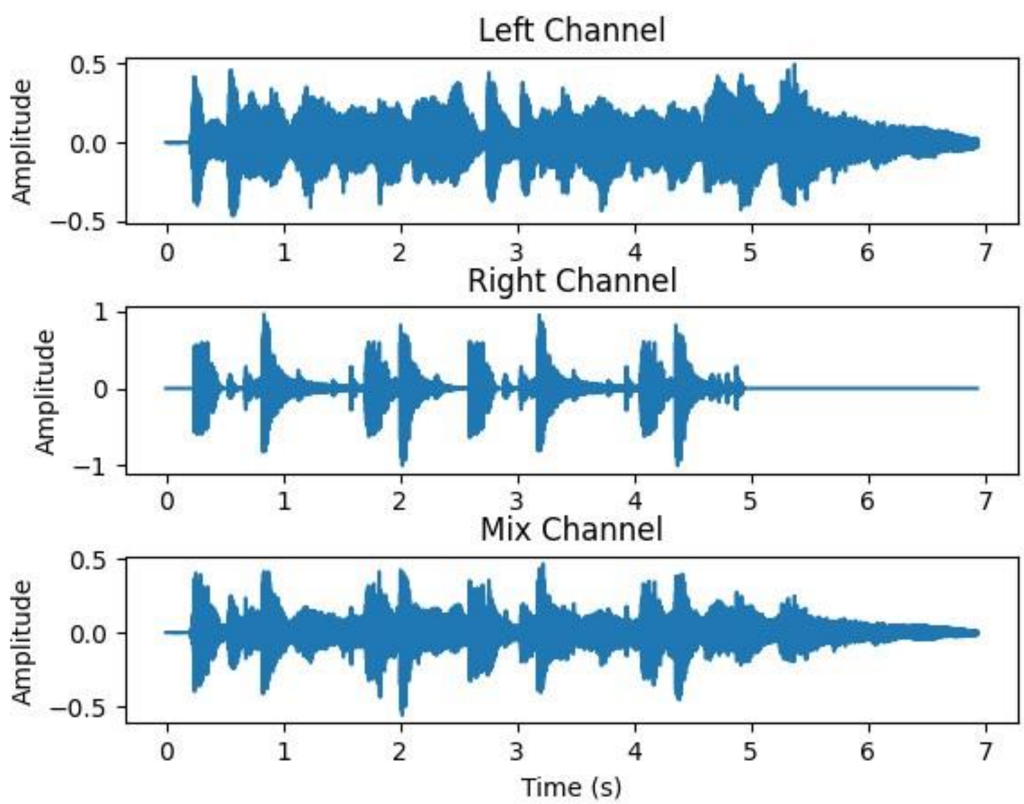
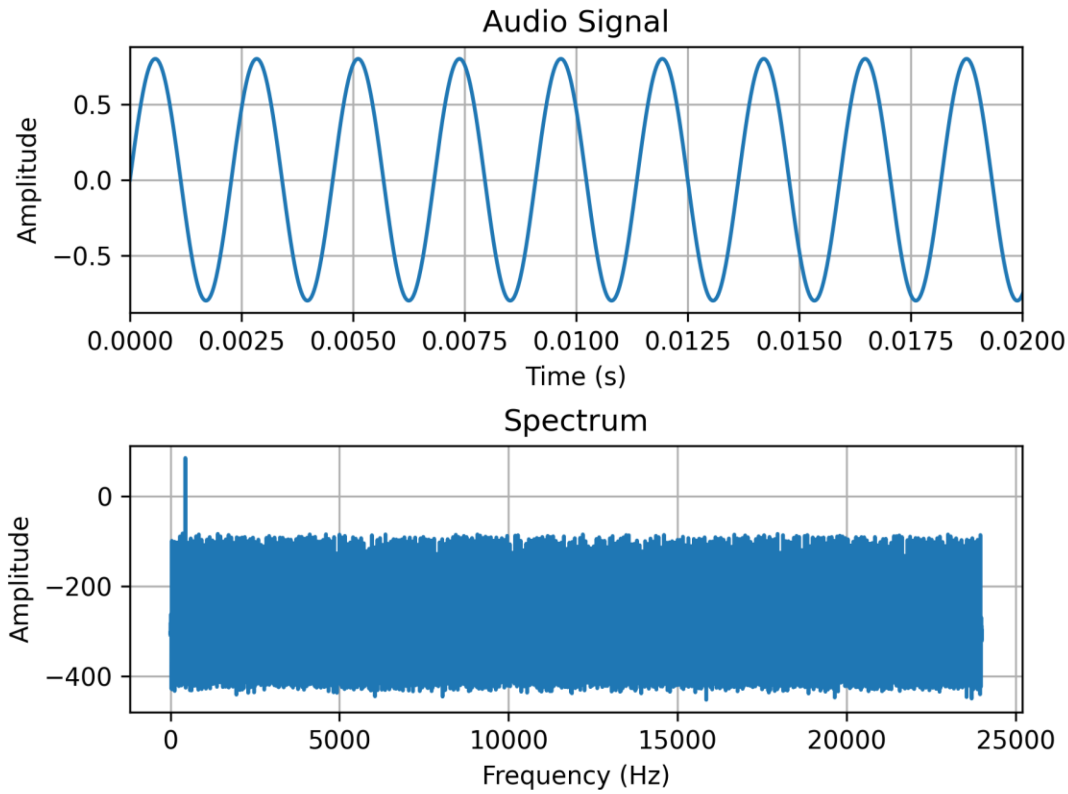
Zadanie 1

```
data, fs = sf.read("SOUND_INTRO/sound1.wav", dtype="float32")

sound_left_channel = data[:, 0]
sound_right_channel = data[:, 1]
sound_mono = np.mean(data, axis=1)

sf.write("sound_L.wav", sound_left_channel, fs)
sf.write("sound_R.wav", sound_right_channel, fs)
sf.write("sound_mix.wav", sound_mono, fs)
```



Zadanie 2

```python
def plotAudio(Signal, Fs, TimeMargin=[0, 0.02]):
    fig, axs = plt.subplots(2, 1)

    x_time = np.arange(len(Signal)) / Fs
    x_frequency = np.arange(0, Fs / 2, Fs / len(Signal))

    spectrum_halved = fft.fft(Signal)[: len(Signal) // 2]
    spectrum_dB = 20 * np.log10(np.abs(spectrum_halved))

    axs[0].plot(x_time, Signal)
    axs[0].set_title("Audio Signal")
    axs[0].set_xlabel("Time (s)")
    axs[0].set_ylabel("Amplitude")
    axs[0].set_xlim(TimeMargin)
    axs[0].grid()

    axs[1].plot(x_frequency, spectrum_dB)
    axs[1].set_title("Spectrum")
    axs[1].set_xlabel("Frequency (Hz)")
    axs[1].set_ylabel("Amplitude")
    axs[1].grid()

    plt.subplots_adjust(hspace=0.5)

    plt.show()

```



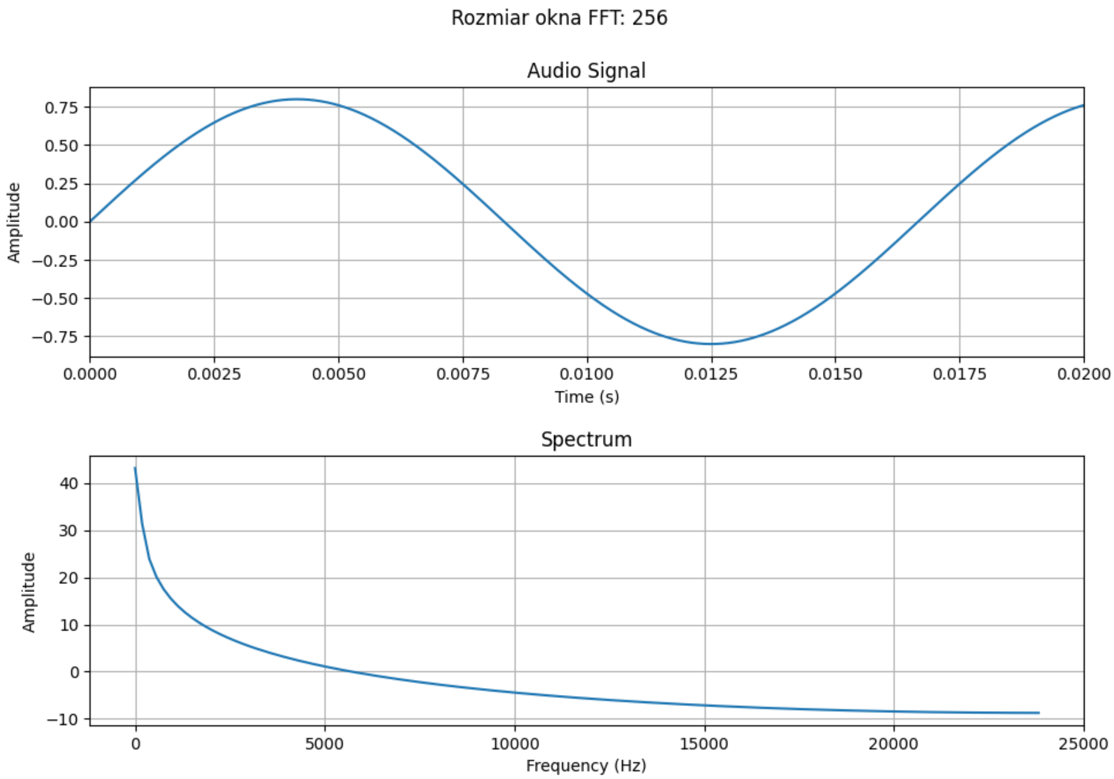
Audio Signal
Amplitude
0.5
0.0
−0.5
0.0000
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
Time (s)
Spectrum
Amplitude
0
−200
−400
0
5000
10000
15000
20000
25000
Frequency (Hz)

Zadanie 3

```python
def plotAudio(Signal, fs, fsize, axs, TimeMargin=[0, 0.02]):

    x_time = np.arange(len(Signal)) / fs
    x_frequency = np.arange(0, fs / 2, fs / fsize)
    spectrum_halved = fft.fft(Signal, fsize)[: fsize // 2]
    spectrum_dB = 20 * np.log10(np.abs(spectrum_halved))

    axs[0].plot(x_time, Signal)
    axs[0].set_title("Audio Signal")
    axs[0].set_xlabel("Time (s)")
    axs[0].set_ylabel("Amplitude")
    axs[0].set_xlim(TimeMargin)
    axs[0].grid()

    axs[1].plot(x_frequency, spectrum_dB)
    axs[1].set_title("Spectrum")
    axs[1].set_xlabel("Frequency (Hz)")
    axs[1].set_ylabel("Amplitude")
    axs[1].grid()

    max_amplitude_index = np.argmax(spectrum_dB)
    peak_amplitude = spectrum_dB[max_amplitude_index]
    peak_frequency = x_frequency[max_amplitude_index]

    return peak_frequency, peak_amplitude


def generate_report(files, fsizes, output_file="report.docx"):
    document = Document()
    document.add_heading("Analiza sinusoidalnych sygnałów", 0)

    for file in files:
        document.add_heading(f"Plik {file}", level=2)

        # ----------------------------------------------------------------
        signal, fs = sf.read(file)
        # ----------------------------------------------------------------

        for fsize in fsizes:
            document.add_heading(f"Rozmiar okna FFT: {fsize}", level=3)

            fig, axs = plt.subplots(2, 1, figsize=(10, 7))

            # ----------------------------------------------------------------
            peak_frequency, peak_amplitude = plotAudio(signal, fs, fsize, axs)
            # ----------------------------------------------------------------

            fig.suptitle(f"Rozmiar okna FFT: {fsize}")
            fig.tight_layout(pad=1.5)
            memfile = BytesIO()
            fig.savefig(memfile)

            document.add_picture(memfile, width=Inches(6))

            memfile.close()

            document.add_paragraph(
                f"Największa amplituda: {peak_amplitude:.3f} dB dla częstotliwości {peak_frequency:.3f} Hz"
            )

    document.save(output_file)
    print("Report generated")
```

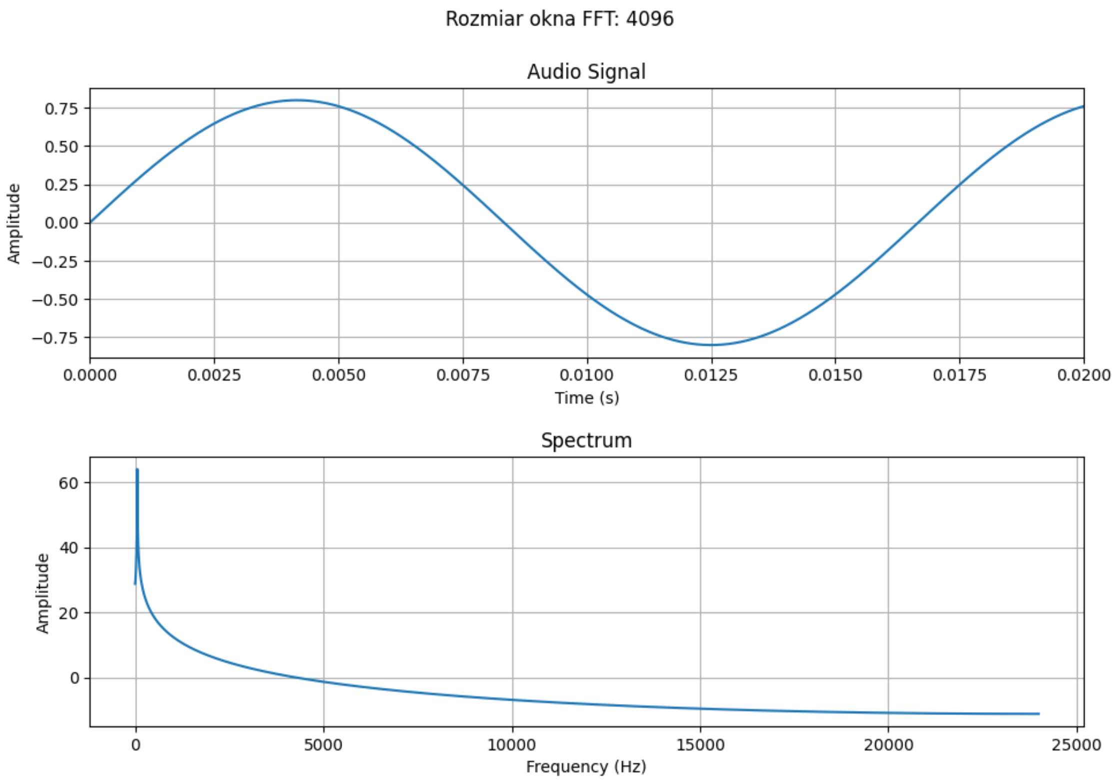
Plik SOUND_SIN/sin_60Hz.wav

Rozmiar okna FFT: 256



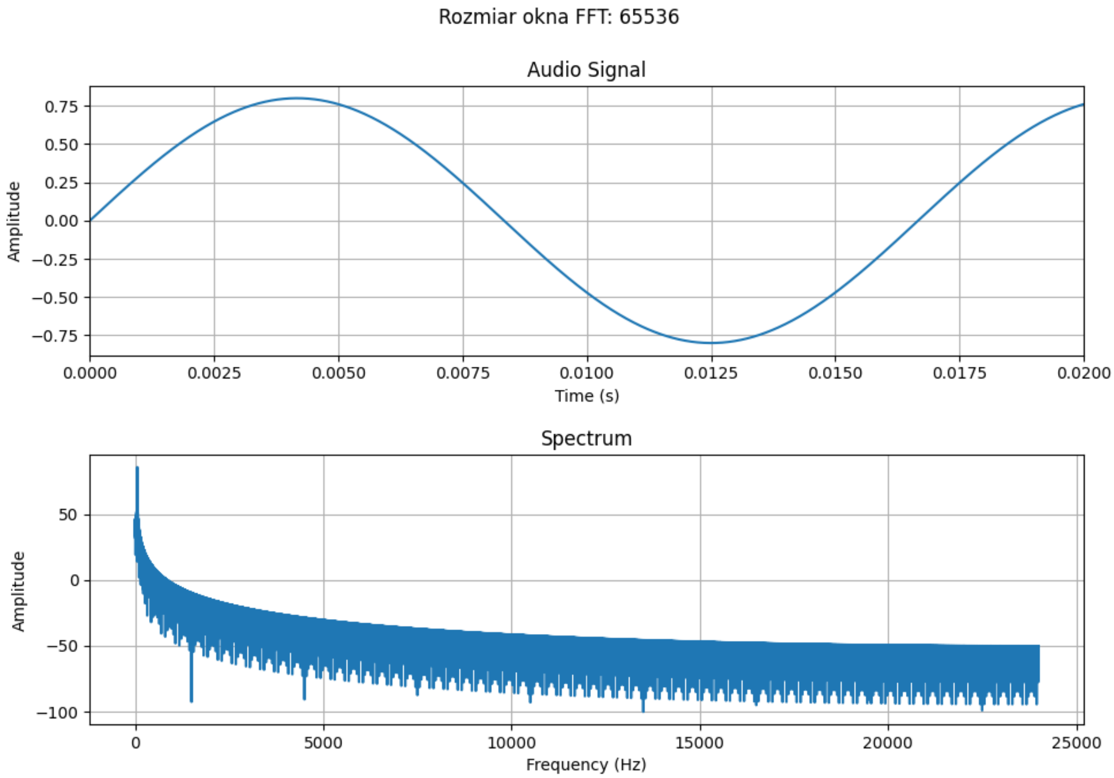
Największa amplituda: 43.219 dB dla częstotliwości 0.000 Hz

Rozmiar okna FFT: 4096



Największa amplituda: 64.006 dB dla częstotliwości 58.594 Hz

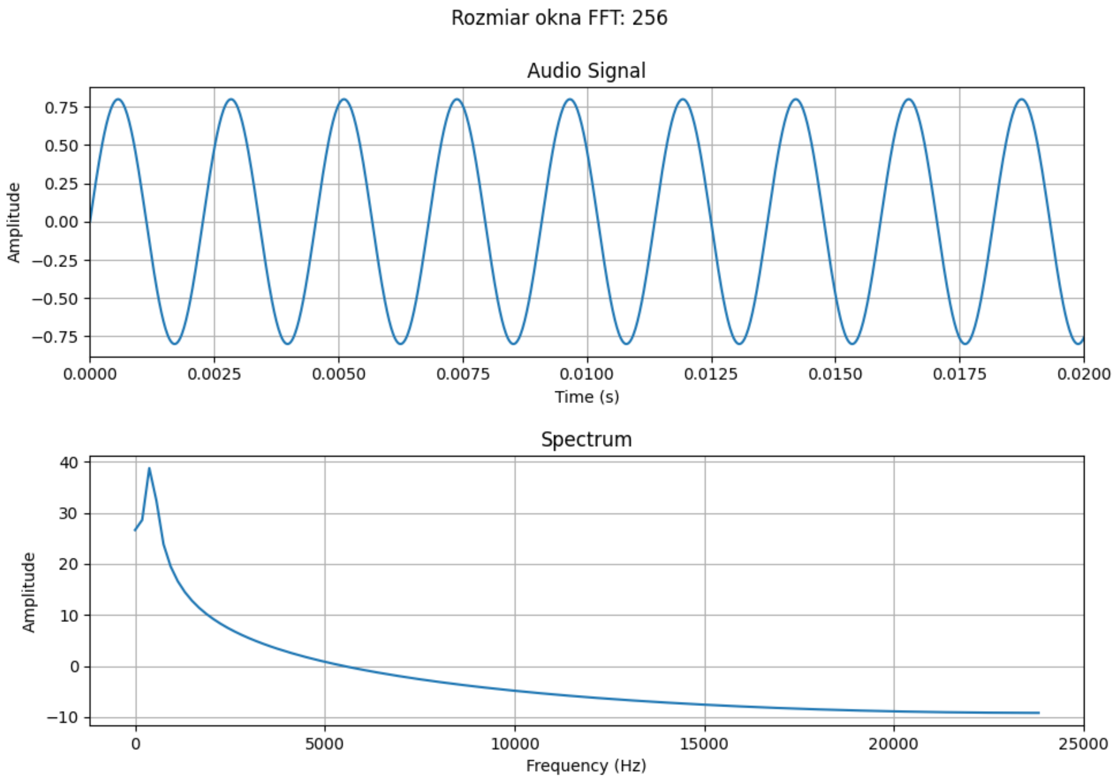
Rozmiar okna FFT: 65536



Największa amplituda: 85.613 dB dla częstotliwości 60.059 Hz

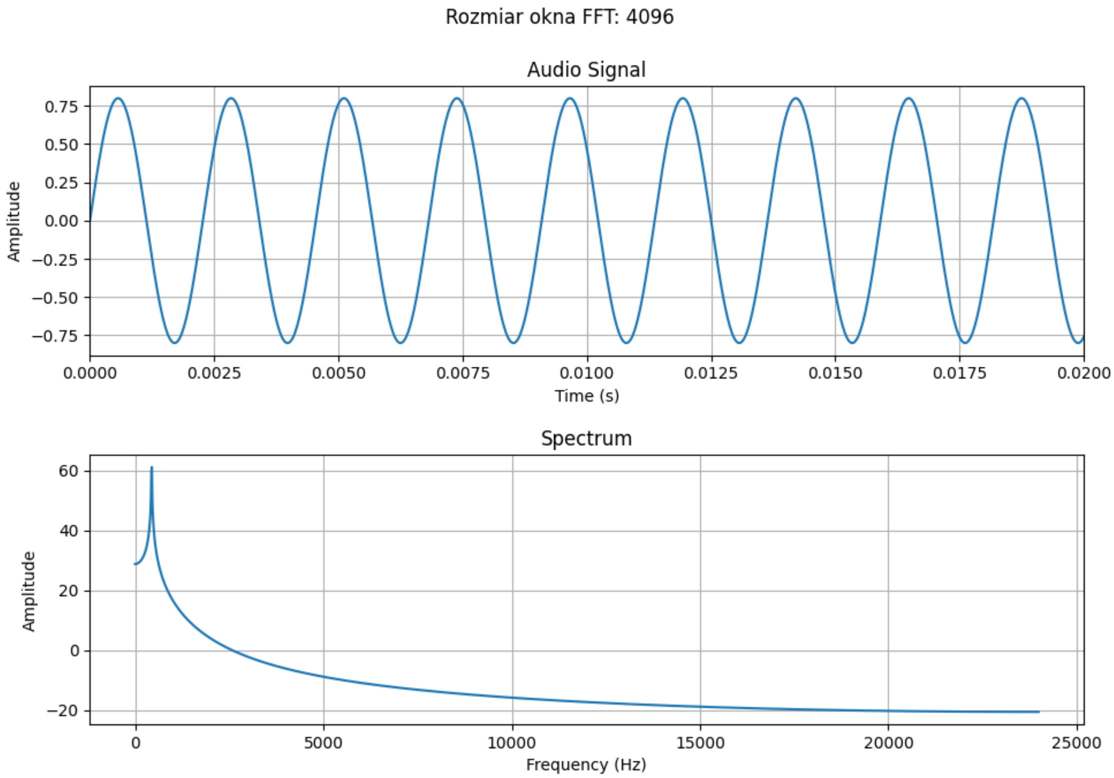
Plik SOUND_SIN/sin_440Hz.wav

Rozmiar okna FFT: 256



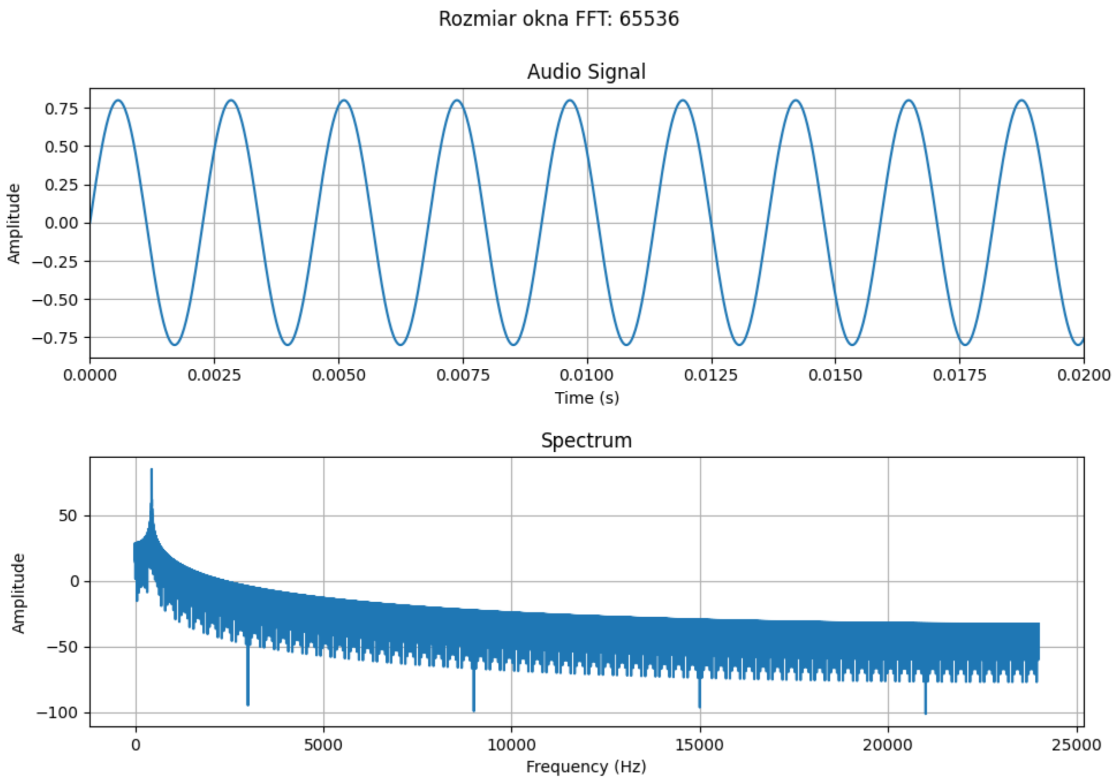
Największa amplituda: 38.789 dB dla częstotliwości 375.000 Hz

Rozmiar okna FFT: 4096



Największa amplituda: 61.073 dB dla częstotliwości 445.312 Hz

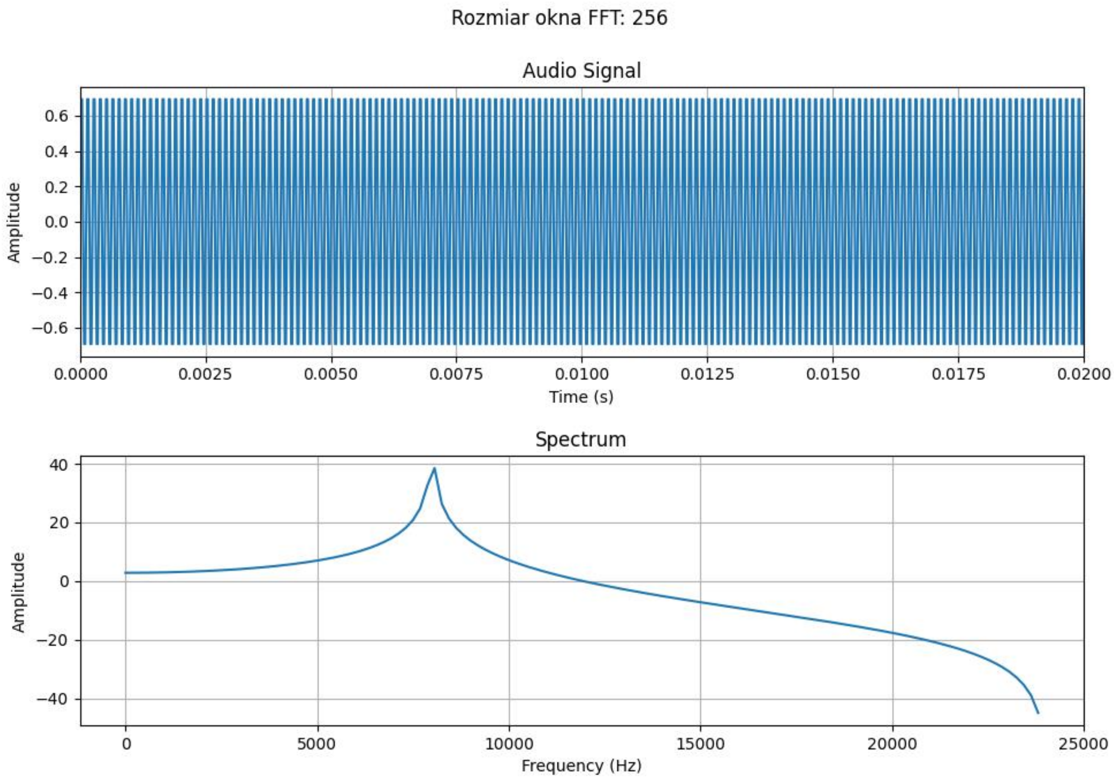
Rozmiar okna FFT: 65536



Największa amplituda: 85.167 dB dla częstotliwości 440.186 Hz

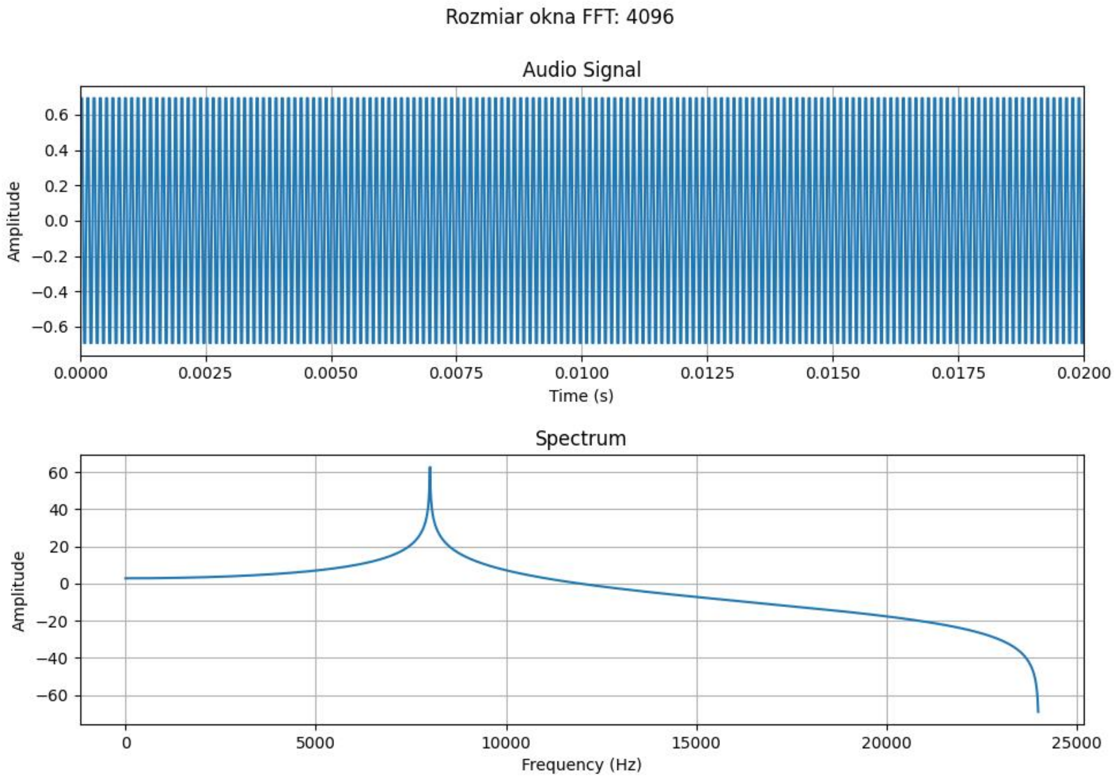
Plik SOUND_SIN/sin_8000Hz.wav

Rozmiar okna FFT: 256



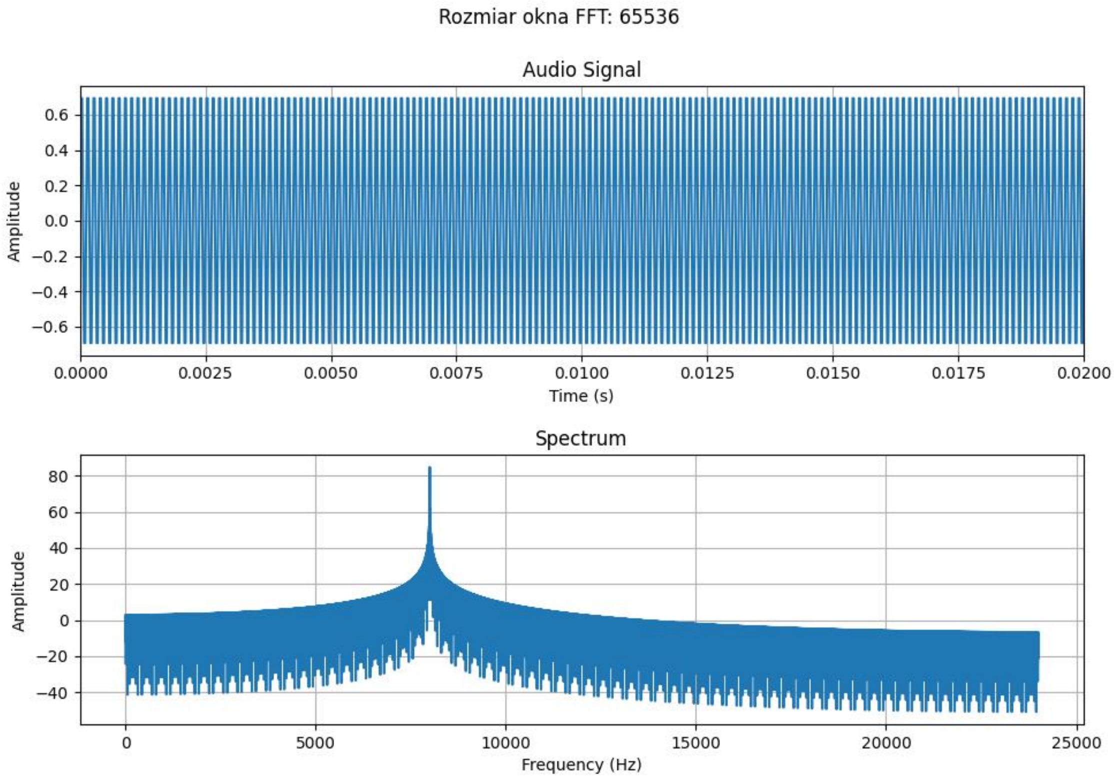
Największa amplituda: 38.515 dB dla częstotliwości 8062.500 Hz

Rozmiar okna FFT: 4096



Największa amplituda: 62.636 dB dla częstotliwości 8003.906 Hz

Rozmiar okna FFT: 65536



Największa amplituda: 84.797 dB dla częstotliwości 8000.244 Hz