Projekt 3: Symulacja (wizualizacja w czasie/częstotliwości) impulsu zaburzenia elektromagnetycznego na podstawie zależności matematycznej opisującej zjawisko

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1. **Project Assumptions**

The aim of the project is to prepare tools that enable the graphical presentation of parameterized signals (sinusoidal and a signal composed of two sinusoidal signals, including a fading sinusoid) and described with appropriate mathematical formulas, in the time domain and in the frequency domain (after performing the Fourier transform)

1. **Stage 1**

In stage 1 the calculations had to be made and the characteristics of the sinusoidal signal in the time and frequency domains were presented in the form of graphs. The frequency of the sinusoidal signal was selected based on the index number = 257698 (Hz)

With sampling frequency = 10 MHz

A diagram of a sine wave

Description automatically generated with low confidence

Next step, for comparison, I calculate frequency: 257698 \* 2  
A diagram of a sine wave

Description automatically generated with low confidence

1. Stage 2

Perform calculations and present in the form of graphs the characteristics in the time and frequency domain of the signal described by the following relationship (formula):

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Perform an analysis for several variants of parameter selection: times t1 and t2, phase φ and the slope of the sine wave extinction characteristic n

Amplitude A= 1

Scaling factor: K =1

Frequency: 257698 Hz

Sampling frequency: 10MHz

Phi values in range (0 to 1.57)

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1. **Conclusion**

In Stage 1, we performed simulations and visualizations of different types of signals in the time and frequency domains. We analyzed the characteristics of a sinusoidal signal and a composition of two sinusoidal signals. By varying parameters such as frequency, amplitude, and phase, we observed how these changes affected the waveforms and power spectra. The use of the Fourier transform allowed us to examine the frequency components present in the signals. Through this analysis, we gained insights into the relationship between time and frequency representations of signals and how different parameters impact the signal characteristics.

In Stage 2, we extended our analysis to a more complex signal described by the equation w(t) = A \* K \* (((t/t1)^n)/(1+((t/t1)^n)))) \* exp(-t/t2) \* cos(2 \* pi \* f \* t + phi). We investigated the effects of varying parameters such as time constants (t1, t2), phase (phi), and the slope of the decaying sinusoid (n). By exploring different combinations of these parameters, we observed changes in the waveform and power spectrum of the signal.

Through the time domain analysis, we examined the variations in the shape, amplitude, and duration of the signal. The frequency domain analysis allowed us to observe the frequency components present in the signal and how changes in the parameters affected the spectral characteristics.

By analyzing different parameter variations, we gained insights into the behavior and characteristics of the signal. We observed how changes in time constants influenced the shape and decay of the signal, how phase alterations affected the phase offset of the waveform, and how the slope of the decaying sinusoid impacted the decay rate. These variations provided a comprehensive understanding of how different parameters influenced the signal in both the time and frequency domains.

Overall, the analysis conducted in Stage 2 enhanced our understanding of the relationship between the parameters of the signal equation and the resulting signal characteristics. It demonstrated the importance of parameter selection in shaping and defining the properties of signals.