ICE503 Homework-10

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Q. 2

(a) Reading the Audio File

The audio file `guitar4.wav` is read using MATLAB's `audioread` function, which extracts the sampled audio data (`x`) and the sampling frequency (`Fs`). This prepares the signal for further processing and determines the resolution in both time and frequency domains.

(b) Creating and Plotting the Hann Window

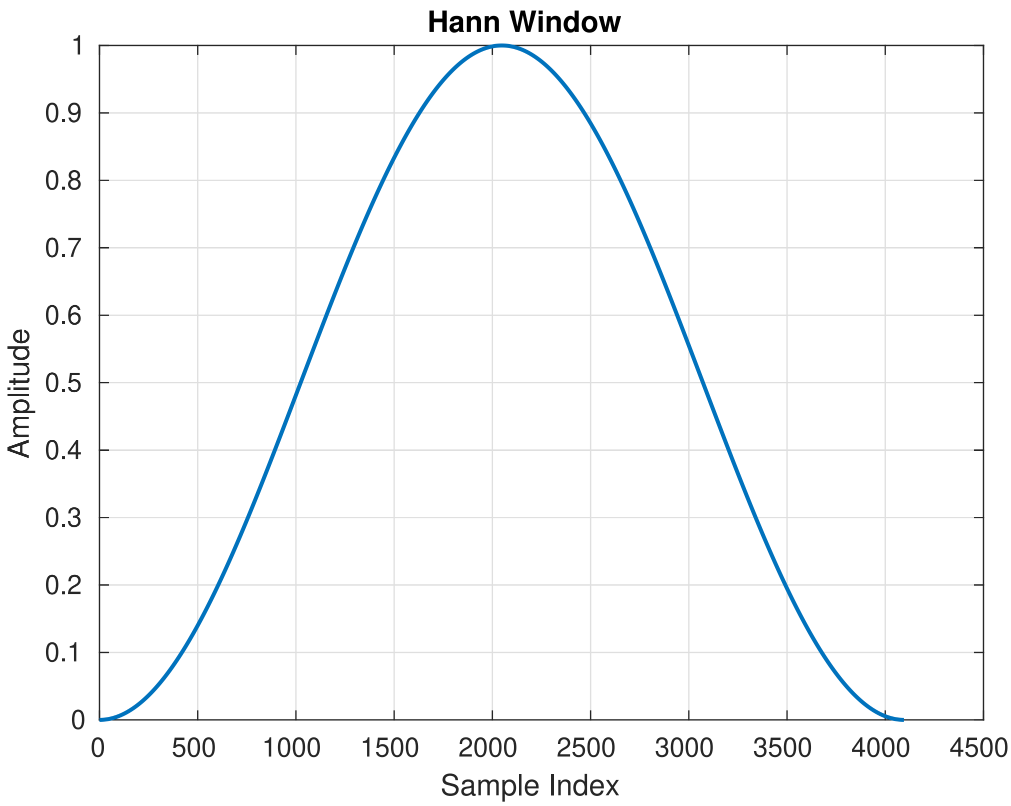

Fig. 1: Hann Window created with length `N`, minimizing spectral leakage for short-time DFT computations.

A Hann window is created with a length (`N`) chosen to achieve a frequency bin bandwidth of approximately 20 Hz. The window tapers the edges of each signal segment, minimizing spectral leakage during DFT computation. The resulting plot is saved as **Fig. 1**.

(c) Computing the Spectrogram

The spectrogram is calculated by dividing the signal into overlapping segments, each multiplied by the Hann window. Short-time DFTs are computed for each segment, and their squared magnitudes are stored to represent the energy distribution of the signal over time and frequency.

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(d) Plotting the Spectrogram

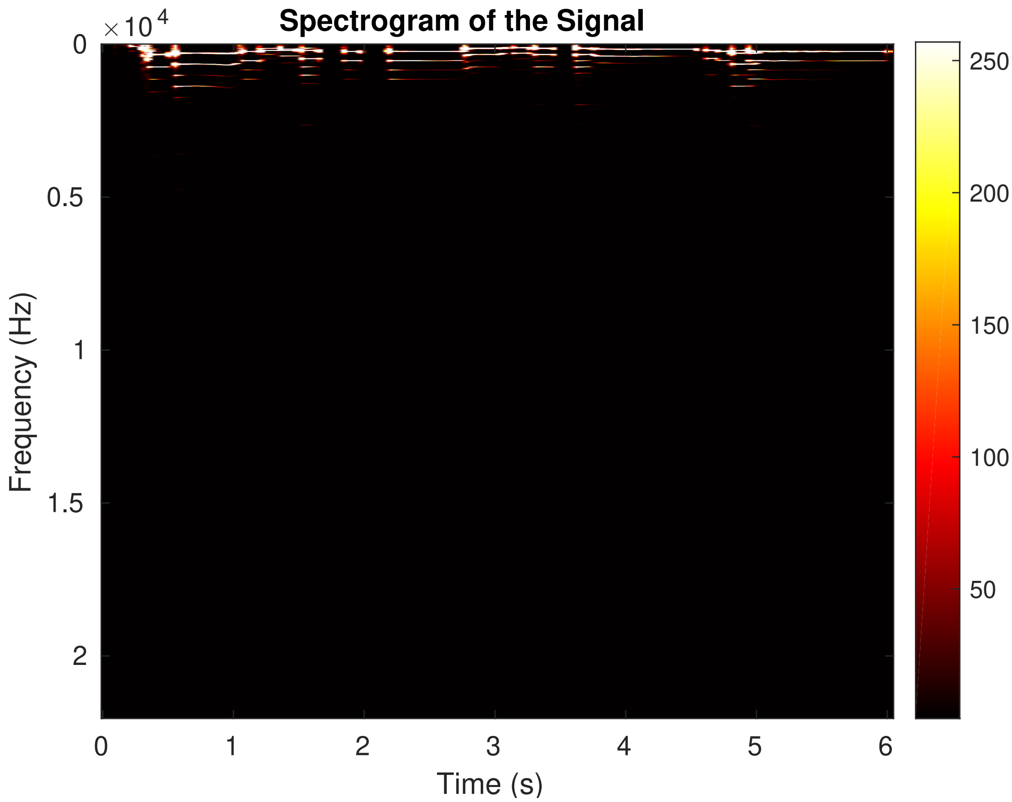

Fig. 2: Spectrogram showing the time-frequency energy distribution of the signal `guitar4.wav`, with a heatmap representation.

The spectrogram is visualized using the `image` function, with time on the x-axis, frequency on the y-axis, and energy intensity represented by a heatmap. A color bar is added to indicate energy levels, and the plot is saved as **Fig. 2**, showing the time-frequency characteristics of the signal.