Real-Time Audio Frequency Spectrum Visualization in Python

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Summary

We present a Python-based tool for real-time visualization of audio frequency spectra. Using PyAudio to capture live microphone input, a Hanning window and FFT compute the magnitude spectrum of each frame. Matplotlib updates the plot dynamically, displaying amplitude versus frequency bins at ~20 Hz. This lightweight, open-source framework allows interactive audio analysis without proprietary software, enabling visualization of tonal components, transients, and noise in real time. Extensions could include converting frequency bins to Hertz, logarithmic scaling, and automated feature detection.

Novelty

While FFT visualization is established, this Python-native, fully open-source implementation provides a minimal yet complete pipeline for real-time audio monitoring and analysis, suitable for education, experimentation, and low-latency applications.