Integrated Audio Processor App
User Manual

Contents

1 Introduction

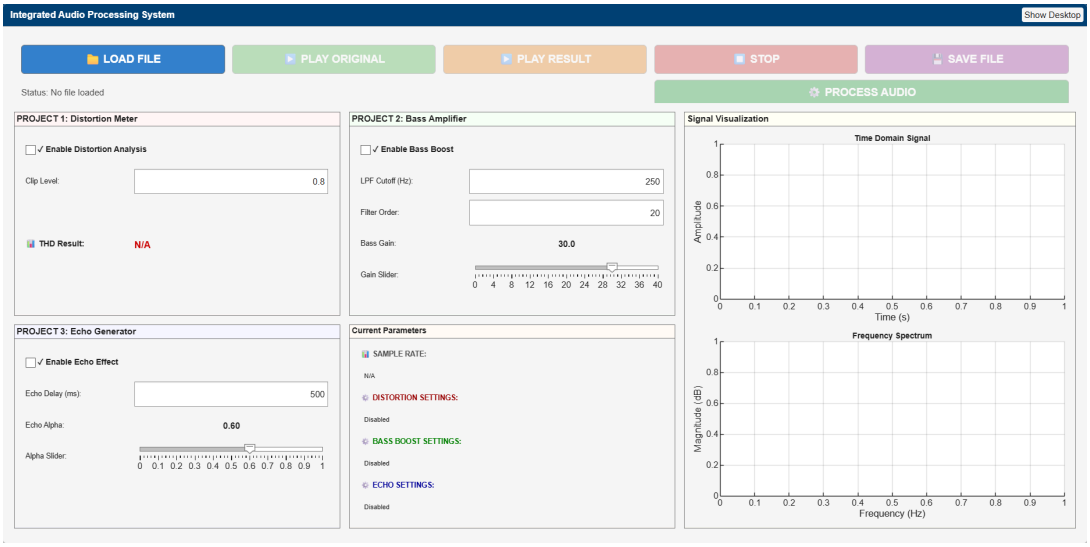
The Integrated Audio Processor is a MATLAB-based application that combines three audio processing projects into a single, unified graphical interface. This manual provides comprehensive instructions for installing, launching, and using all features of the application.

2 Getting Started

2.1 Installation and Launch

To launch the application, open MATLAB and execute the following command in the command window:

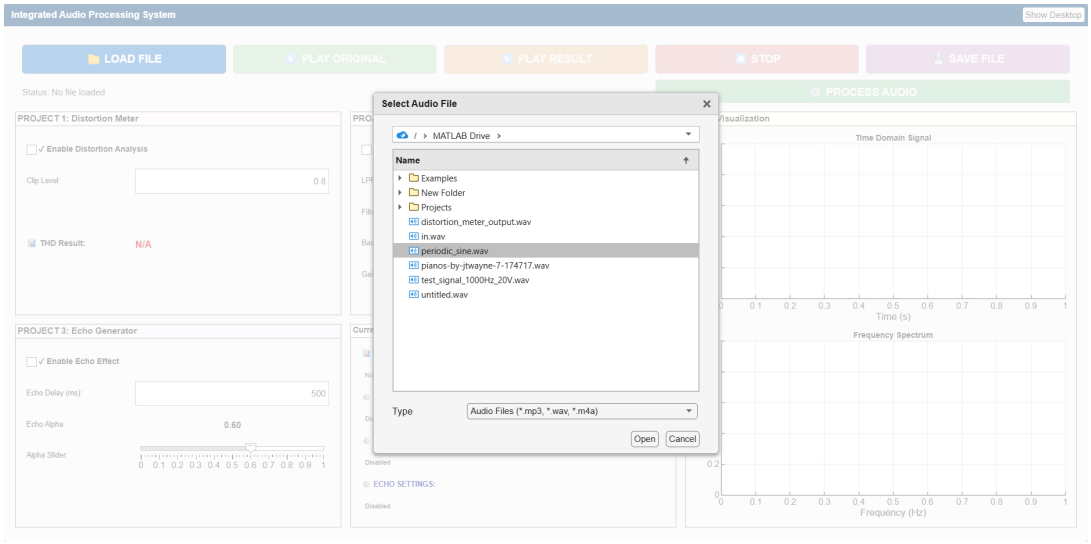
```
IntegratedAudioProcessorGUI()
```



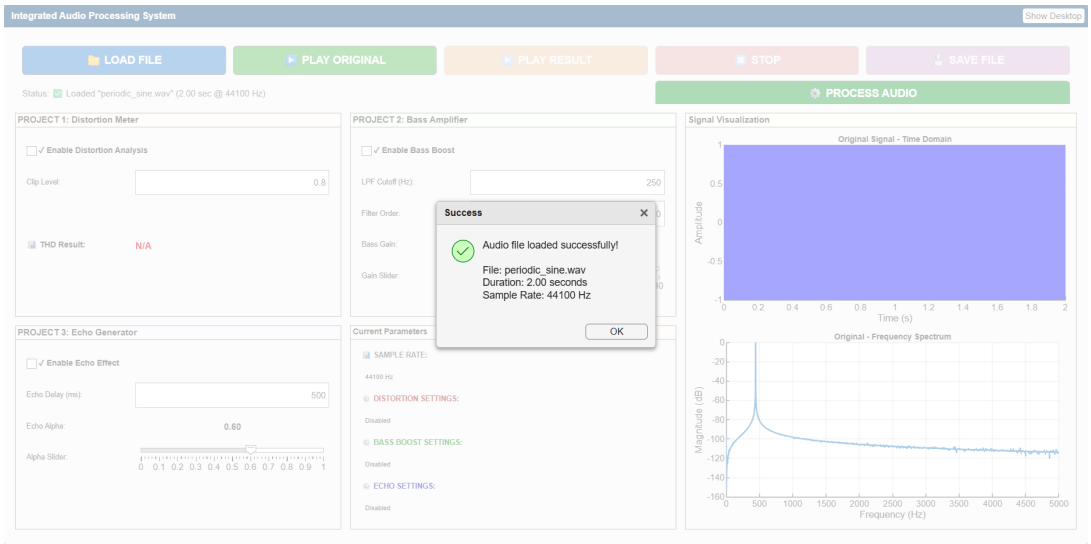
The main window will appear with three project panels on the left and middle, a large visualization panel on the right, and control buttons at the top.

2.2 Loading Audio Files

1. Click the **LOAD FILE** button in the top control panel
2. Browse and select an audio file (supported formats: MP3, WAV, M4A)



3. The application will automatically:
   - Convert stereo files to mono
   - Display the waveform in the time-domain plot
   - Show the frequency spectrum in the lower visualization panel
   - Update the Audio Information section with file details (sample rate, duration, number of samples, peak amplitude)
   - Display the sample rate in the Current Parameters panel



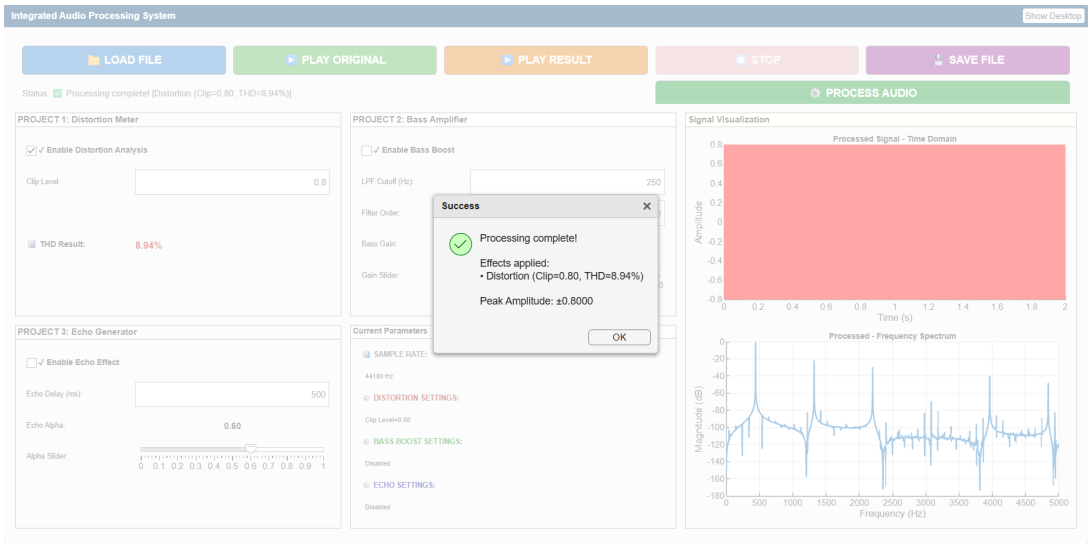
4. A success dialog will confirm the file has been loaded

3 Configuring Processing Effects

The application provides three independent audio processing effects that can be used individually or in combination:

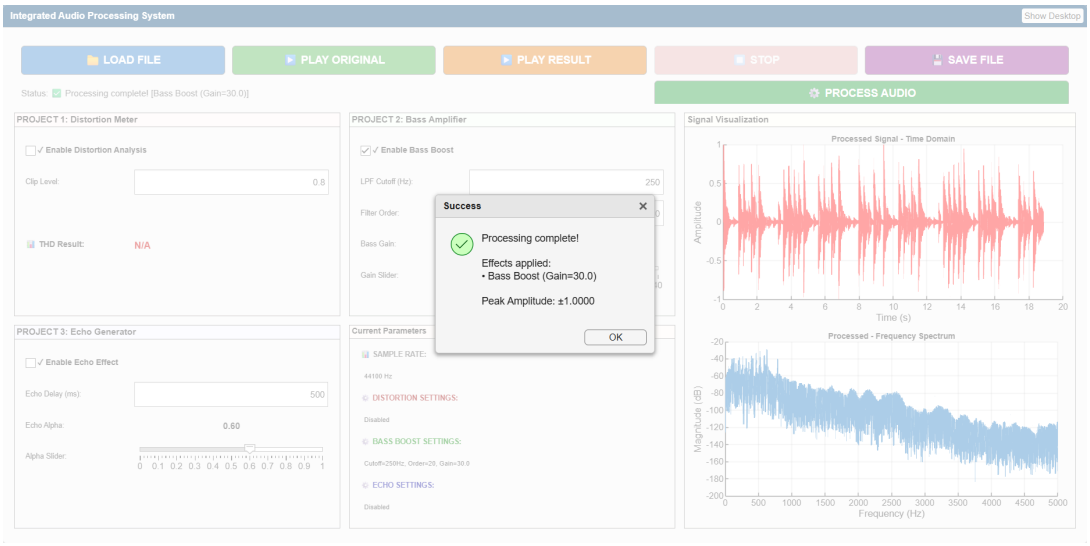
3.1 Project 1: Distortion Meter

- Check **Enable Distortion Analysis** to activate
- Adjust **Clip Level** (range: 0 to 1, default: 0.8)
  - Lower values = more aggressive clipping = higher distortion
  - Higher values = gentler clipping = lower distortion



- After processing, the THD percentage will be displayed below the controls

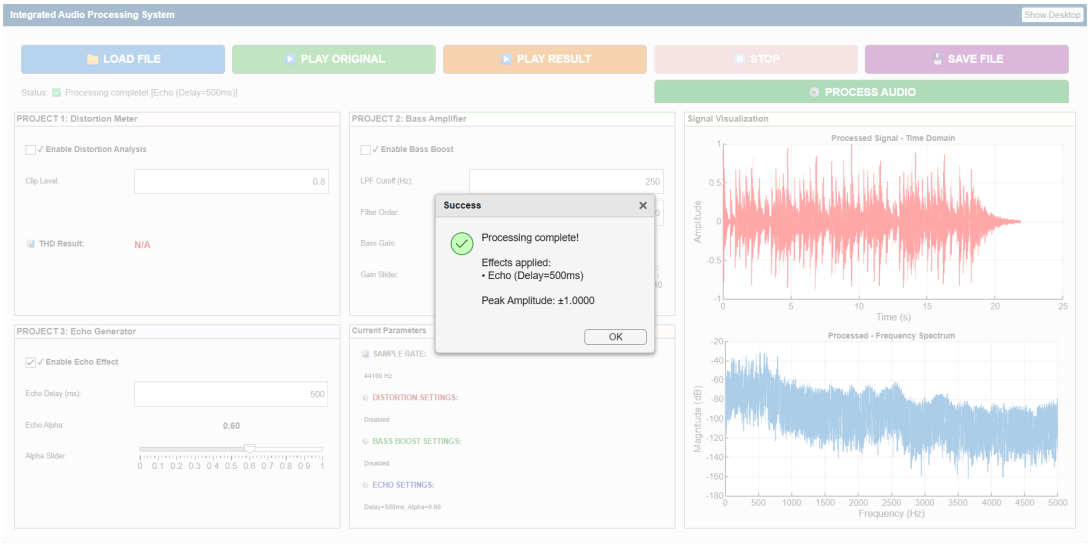
3.2 Project 2: Bass Amplifier



- Check **Enable Bass Boost** to activate
- Set **LPF Cutoff** frequency (range: 20-1000 Hz, default: 250 Hz)
  - Determines which frequencies are considered "bass"
  - Lower values = deeper bass only

  - Higher values = includes more mid-range frequencies
- Adjust **Filter Order** (range: 10-100, default: 20)
  - Higher order = sharper frequency cutoff
- Move the **Bass Gain** slider (range: 0-40, default: 30)
  - Controls the amplification amount of bass frequencies
  - The current value is displayed above the slider

3.3 Project 3: Echo Generator



- Check **Enable Echo Effect** to activate
- Set **Echo Delay** (range: 50-2000 ms, default: 500 ms)
  - Time between original sound and echo repetition
  - Shorter delays = rapid flutter echo
  - Longer delays = distinct repetitions
- Adjust **Echo Alpha** slider (range: 0-1, default: 0.6)
  - Controls echo attenuation/decay rate
  - Higher values = longer-lasting echoes
  - Lower values = quickly fading echoes
- The current alpha value is displayed above the slider

4 Processing Audio

1. After loading an audio file and configuring desired effects:
2. Ensure at least one effect is enabled (checked)
3. Click the **PROCESS AUDIO** button
4. The application will:
    - Apply effects in sequence: Distortion → Bass Boost → Echo
    - Update the time-domain plot with the processed signal (shown in red)
    - Update the frequency spectrum plot
    - Display THD result if distortion analysis was enabled
    - Show the number of output samples and peak amplitude
    - Display which effects were applied in the status bar
5. A dialog box will confirm successful processing and warn if the signal amplitude exceeds ± 1

Note: The Current Parameters panel continuously displays a summary of all active settings including sample rate and enabled effects with their parameters.

5 Playback Controls

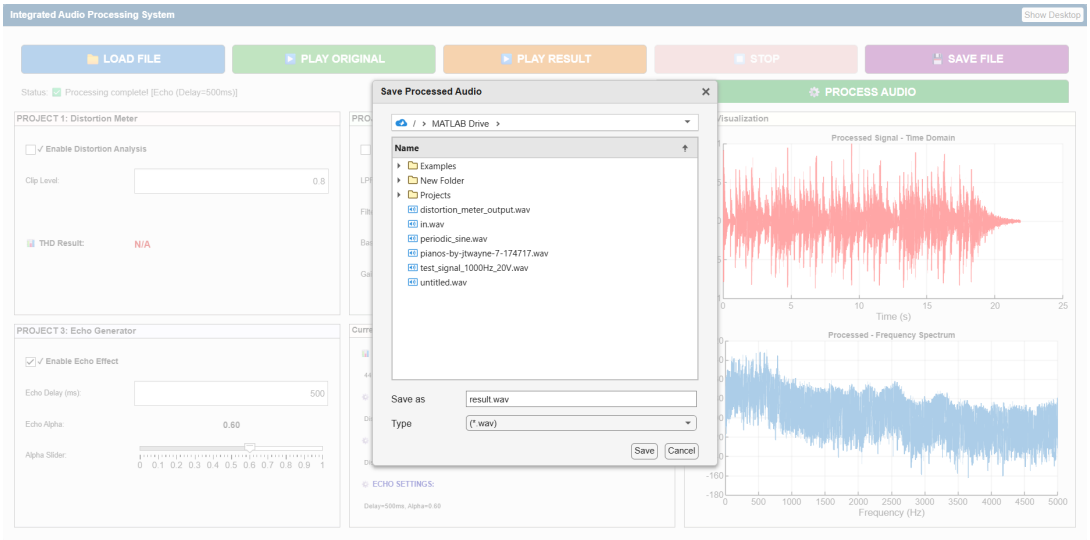
After loading or processing audio:

- **PLAY ORIGINAL** - Plays the loaded input audio file
- **PLAY RESULT** - Plays the processed audio (only available after processing)
- **STOP** - Immediately stops any currently playing audio

Important: If the signal amplitude exceeds ± 1, the application automatically normalizes it for safe playback to prevent speaker damage or distortion. This normalization is only applied during playback; the saved file retains the original processed amplitude.

6 Saving Processed Audio

1. After processing audio, click the **SAVE FILE** button
2. Choose a destination folder and enter a filename
3. The processed audio will be saved as a WAV file
4. A confirmation dialog will appear upon successful save



7 Typical Usage Workflows

7.1 Measuring Distortion:

1. Load an audio file
2. Enable only Distortion Analysis
3. Set desired clip level
4. Click Process Audio
5. Read THD percentage from Project 1 panel

7.2 Enhancing Bass:

1. Load an audio file
2. Enable only Bass Boost
3. Adjust cutoff frequency and gain to taste
4. Click Process Audio
5. Use Play Original and Play Result to compare
6. Save if satisfied with results

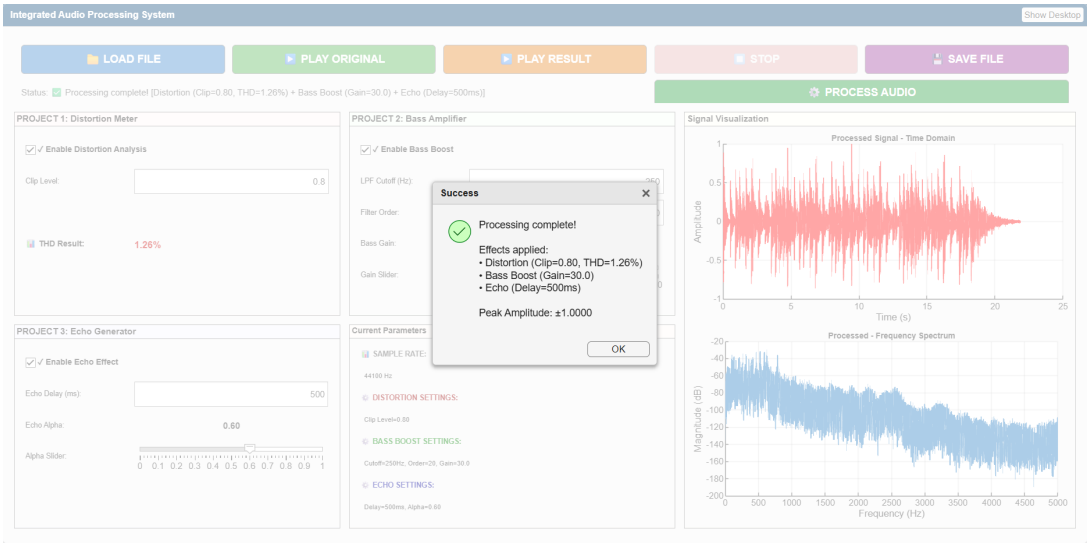
7.3 Adding Echo Effect:

1. Load an audio file
2. Enable only Echo Effect
3. Set delay time and attenuation
4. Click Process Audio

5. Listen to the result
6. Adjust parameters and re-process if needed

7.4 Combined Processing:

1. Load an audio file
2. Enable multiple effects (e.g., Bass Boost + Echo)
3. Configure all enabled effects
4. Click Process Audio
5. Effects are applied sequentially
6. Review and save results



8 Troubleshooting

- **Warning: Signal amplitude exceeds ±1**
  - This occurs when processing results in amplitudes greater than 1 or less than -1
  - The signal is automatically normalized during playback
  - The saved file contains the unnormalized version for analysis purposes
  - To avoid this, reduce gain values or clip levels
- **No audio output during playback**
  - Check system volume settings
  - Ensure audio hardware is connected
  - Try clicking Stop and then Play again
- **Process Audio button is disabled**

  - Make sure an audio file is loaded first
  - Ensure at least one effect is enabled (checkbox checked)

- **File loading errors**
  - Verify the file format is supported (MP3, WAV, M4A)
  - Check that the file is not corrupted
  - Ensure MATLAB has read permissions for the file location