Mixing Analysis Program

Objective

This program was developed to support students in evaluating the mixing efficiency of fluids in experimental systems such as stirred tanks or mixing vessels. It uses real **experimental video footage** to analyze the dispersion of color, which reflects the degree and speed of fluid mixing.

Key Features

1. **Video File Selection**

- Users can select .mp4 or .avi files of their fluid mixing experiments from their local machine.
- Example: A video of color being added to a tank and stirred using different rotor types.

2. **Parameter Input**

- Number of initial frames used for background training (NumTrainingFrames) to detect regions of change (50 frames is recommended as a default).
- Type of rotor used (Rotor Type).
- Stirring speed (Speed).
- Output filename for the analyzed video.

3. **Mixing Analysis**

- Uses background subtraction and morphological filtering techniques to detect regions where mixing occurs.
- Calculates mixing efficiency and mixed area for each video frame.
- Detects color changes by comparing each frame to the initial reference frame.

4. **Real-Time Display**

- The left panel shows the original video.
- The right panel displays the video with the **"Expanded Mixing Zone"** highlighted in turquoise.

5. **Graphical Analysis**

- Generates plots showing the progression of the mixed area and total color change over time.
- Useful for comparing different rotor types or stirring speeds.

6. **Result Export**

- The processed video is saved as a new file for review or inclusion in student lab reports.

Application in the Laboratory

- Students can apply the program to their experimental videos.
- Results can be compared across rotor types such as paddle, turbine, or anchor.
- The impact of stirring speed on color dispersion can be evaluated.
- Results can be linked to theoretical concepts such as Reynolds number, turbulent vs. laminar mixing, and scale of segregation.