**Overview**

This MATLAB code demonstrates a basic 2D Particle Image Velocimetry (PIV) approach by calculating the displacement field between two sequential images, piv1.jpg and piv2.jpg. PIV is commonly used to measure velocity fields in fluid flows by tracking the movement of particles or markers between frames. Here, we use **normalized cross-correlation** to find how interrogation windows in Image A match with corresponding regions in Image B.

**How It Works**

1. **Image Loading**: The program reads two images, assumed to be successive snapshots of a flow or moving structure.

2. **Preprocessing**: Both images are converted to grayscale to simplify correlation computation.

3. **Defining Parameters**:

• The code sets the size of the interrogation window (e.g., 40 \times 40 pixels).

• A maximum displacement is defined (half the window size in x and y directions), which dictates the search area in the second image.

4. **Creating a Grid**:

• The code iterates over a grid of window centers within the images to ensure the interrogation window stays fully within the image boundaries.

5. **Normalized Cross-Correlation**:

• For each interrogation window in Image A, the code searches for the best match in a corresponding (and larger) region in Image B.

• The best match is determined by the peak in the normalized cross-correlation map.

6. **Extracting Displacements**:

• The position of the peak indicates how far the window has moved between the two images.

• Displacements (dpx and dpy) are recorded for each interrogation window.

7. **Visualization**:

• The code displays the interrogation window in Image A, the corresponding search region in Image B, and the resulting correlation map with the peak marked.

• Finally, it shows a quiver (vector) plot of the displacement field.

8. **Average Displacements**:

• The script computes and displays the average displacement across all interrogation windows.

**Required Files and Setup**

• Two images (piv1.jpg and piv2.jpg) placed in the same working directory as the script.

• MATLAB (or Octave, with minor adjustments) to run the script.

**How to Run**

1. Place piv1.jpg and piv2.jpg in your current MATLAB working directory.

2. Open the script in MATLAB.

3. Run the script (e.g., by pressing **Run** in the MATLAB editor or typing the script’s name in the Command Window).

**Potential Adjustments**

• **Window Size**: You can change wsize = [40,40] to a larger or smaller window depending on the particle density and flow characteristics.

• **Maximum Displacement**: If you expect larger movements between frames, increase x\_disp\_max and y\_disp\_max.

• **Visualization**: Comment out or remove the figure/plot sections if you do not need the step-by-step visualization.

**Troubleshooting**

• If you get indexing errors (e.g., **Index exceeds matrix dimensions**), ensure your chosen window and maximum displacement do not exceed the image boundaries.

• If the code runs but the results do not show significant displacements, check that the images actually differ enough or that the search window is large enough to capture the movement.