CS543 Assignment 2

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# Part 1 Fourier-based Alignment:

You will provide the following for each of the six low-resolution and three high-resolution images:

* Final aligned output image
* Displacements for color channels
* Inverse Fourier transform output visualization for ***both*** channel alignments ***without*** preprocessing
* Inverse Fourier transform output visualization for ***both*** channel alignments ***with*** any sharpening or filter-based preprocessing you applied to color channels

You will provide the following as further discussion overall:

* Discussion of any preprocessing you used on the color channels to improve alignment and how it changed the outputs
* Measurement of Fourier-based alignment runtime for high-resolution images (you can use the python time module again). How does the runtime of the Fourier-based alignment compare to the basic and multiscale alignment you used in Assignment 1?

## A: Channel Offsets

Replace <C1>, <C2>, <C3> appropriately with B, G, R depending on which you use as the base channel. Provide offsets in the **original image coordinates** (after the image has been divided into three equal parts corresponding to each channel) and be sure to account for any cropping or resizing you performed.

Low-resolution images (using channel <C1> as base channel):

|  |  |  |
| --- | --- | --- |
| Image (base channel) | <C2> (h,w) offset (channel) | <C3> (h,w) offset (channel) |
| 00125v.jpg (B) | (-1, 2) | (-7, 1) |
| 00149v.jpg (B) | (3, 2) | (-6, 1) |
| 00153v.jpg (G) | (4, -3) | (1, 2) |
| 00351v.jpg (B) | (-6, 0) | (-13, 1) |
| 00398v.jpg (B) | (0, 2) | (0, 4) |
| 01112v.jpg (G) | (10, 0) | (3, 1) |

High-resolution images (using channel <C1> as base channel):

|  |  |  |
| --- | --- | --- |
| Image (base channel) | <C2> (h,w) offset (channel) | <C3> (h,w) offset (channel) |
| 01047u.tif (B) | (-104, 9) | (-80, 13) |
| 01657u.tif (B) | (-37, 19) | (-33, 33) |
| 01861a.tif (B) | (-29, 39) | (1, 62) |

## B: Output Visualizations

For each image, insert 5 outputs total (aligned image + 4 inverse Fourier transform visualizations) as described above. When you insert these outputs be sure to clearly label the inverse Fourier transform visualizations (e.g. “G to B alignment without preprocessing”).

### 00125v.jpg

|  |  |  |
| --- | --- | --- |
|  | LoG Preprocessing | No LoG Preprocessing |
| Aligned  Images  (B) | A river with a building in the background  Description automatically generated | A river with a building in the background  Description automatically generated |
| Inverse FT  Align  G to B | A graph of a graph showing the same number of numbers  Description automatically generated with medium confidence | A graph of a number of colors  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B | A graph of a function  Description automatically generated with medium confidence | A graph of a graph of a number of colors  Description automatically generated with medium confidence |

### 00149v.jpg

|  |  |  |
| --- | --- | --- |
|  | LoG Preprocessing | No LoG Preprocessing |
| Aligned  Images  (B) | A painting of people in a room  Description automatically generated | A painting of people in a room  Description automatically generated |
| Inverse FT  Align  G to B | A graph of a graph with a number of numbers  Description automatically generated with medium confidence | A diagram of a graph  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B | A graph of a graph with a green line  Description automatically generated with medium confidence | A diagram of a light  Description automatically generated with medium confidence |

### 00153v.jpg

|  |  |  |
| --- | --- | --- |
|  | LoG Preprocessing | No LoG Preprocessing |
| Aligned  Images  (G) | A person sitting in front of a door  Description automatically generated | A person in a blue robe sitting in front of a door  Description automatically generated |
| Inverse FT  Align  B to G | A graph of a graph with a number of numbers  Description automatically generated with medium confidence | A diagram of a number of light  Description automatically generated with medium confidence |
| Inverse FT  Align  R to G | A graph of a graph of a function  Description automatically generated with medium confidence | A diagram of a light  Description automatically generated with medium confidence |

### 00351v.jpg

|  |  |  |
| --- | --- | --- |
|  | LoG Preprocessing | No LoG Preprocessing |
| Aligned  Images  (B) | A stone building with towers  Description automatically generated | A stone building with towers  Description automatically generated |
| Inverse FT  Align  G to B | A graph of a graph showing the same number of numbers  Description automatically generated with medium confidence | A graph of a number of colors  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B | A graph of a graph showing the same number of numbers  Description automatically generated with medium confidence | A graph of a number of colors  Description automatically generated with medium confidence |

### 00398v.jpg

|  |  |  |
| --- | --- | --- |
|  | LoG Preprocessing | No LoG Preprocessing |
| Aligned  Images  (B) | A train station with a train car  Description automatically generated | A train on the tracks  Description automatically generated |
| Inverse FT  Align  G to B | A graph of a graph showing the same number of numbers  Description automatically generated with medium confidence | A graph of a number of numbers  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B | A graph of a graph showing the same number of lines  Description automatically generated with medium confidence | A diagram of a number of colors  Description automatically generated with medium confidence |

### 01112v.jpg

|  |  |  |
| --- | --- | --- |
|  | LoG Preprocessing | No LoG Preprocessing |
| Aligned  Images  (G) | A white building with a dome  Description automatically generated |  |
| Inverse FT  Align  B to G | A graph of a graph showing the same number of numbers  Description automatically generated with medium confidence | A diagram of a light  Description automatically generated with medium confidence |
| Inverse FT  Align  R to G | A graph of a function  Description automatically generated | A blue and green gradients  Description automatically generated with medium confidence |

### 01047u.tif

|  |  |
| --- | --- |
|  | LoG Preprocessing |
| Aligned  Image  (B) | A group of objects on a table  Description automatically generated |
| Inverse FT  Align  G to B | A graph of a number of numbers  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B | A graph of a number of numbers  Description automatically generated with medium confidence |

|  |  |
| --- | --- |
|  | No LoG Preprocessing |
| Aligned  Image  (B) | A group of objects on a table  Description automatically generated |
| Inverse FT  Align  G to B | A diagram of a number of numbers  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B | A diagram of a number of numbers  Description automatically generated with medium confidence |

### 01657u.tif

|  |  |
| --- | --- |
|  | LoG Preprocessing |
| Aligned  Image  (B) | A person sitting on a chair  Description automatically generated |
| Inverse FT  Align  G to B | A graph showing different colors of a log  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B | A graph showing different colors of a log  Description automatically generated with medium confidence |

### 

|  |  |
| --- | --- |
|  | No LoG Preprocessing |
| Aligned  Image  (B) | A person sitting on a chair  Description automatically generated |
| Inverse FT  Align  G to B | A diagram of a light source  Description automatically generated with low confidence |
| Inverse FT  Align  R to B | A diagram of a light source  Description automatically generated with low confidence |

### 01861a.tif

|  |  |
| --- | --- |
|  | LoG Preprocessing |
| Aligned  Image  (B) | A group of people sitting at a table  Description automatically generated |
| Inverse FT  Align  G to B | A graph of a graph showing the same color  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B |  |

|  |  |
| --- | --- |
|  | No LoG Preprocessing |
| Aligned  Image  (B) | A group of people sitting at a table  Description automatically generated |
| Inverse FT  Align  G to B | A diagram of a light  Description automatically generated with medium confidence |
| Inverse FT  Align  R to B | A diagram of a light  Description automatically generated with medium confidence |

## C: Discussion and Runtime Comparison

# Part 2 Scale-Space Blob Detection:

You will provide the results for ***4 different examples chosen by your own***:

● Original image

● Each of the five modified images (shift, rotate, scale)

You will provide the following as further discussion overall:

● Explanation of any "interesting" implementation choices that you made.

### Example 1:

|  |  |
| --- | --- |
| Original Image | A car driving on a road  Description automatically generated |
| Shifted  20%  Left | A car driving on a road  Description automatically generated |
| Shifted  20%  Right | A car driving on a road  Description automatically generated |
| Rotated  90°  CCW | A car on a road  Description automatically generated |
| Rotated  90° CW | A car on the road  Description automatically generated |
| Enlarged by 2 | A car with numbers and circles  Description automatically generated |

### Example 2:

|  |  |
| --- | --- |
| Original Image | A screenshot of a car  Description automatically generated |
| Shifted  20%  Left | A red sports car with circles around it  Description automatically generated |
| Shifted  20%  Right | A screenshot of a car  Description automatically generated |
| Rotated  90°  CCW | A red car in a display  Description automatically generated |
| Rotated  90° CW | A red car with blue dots  Description automatically generated |
| Enlarged by 2 | A red sports car with blue dots  Description automatically generated |

### Example 3:

|  |  |
| --- | --- |
| Original Image | A group of people posing for a photo  Description automatically generated |
| Shifted  20%  Left | A group of people posing for a photo  Description automatically generated |
| Shifted  20%  Right | A group of people posing for a photo  Description automatically generated |
| Rotated  90°  CCW | A group of people posing for a picture  Description automatically generated |
| Rotated  90° CW | A group of people posing for a photo  Description automatically generated |
| Enlarged by 2 | A group of people celebrating  Description automatically generated |

### Example 4:

|  |  |
| --- | --- |
| Original Image |  |
| Shifted  20%  Left | A group of football players posing for a photo  Description automatically generated |
| Shifted  20%  Right | A group of football players posing for a photo  Description automatically generated |
| Rotated  90°  CCW | A group of people posing for a picture  Description automatically generated |
| Rotated  90° CW | A group of people posing for a picture  Description automatically generated |
| Enlarged by 2 | A group of men holding trophies  Description automatically generated |

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## Discussion: