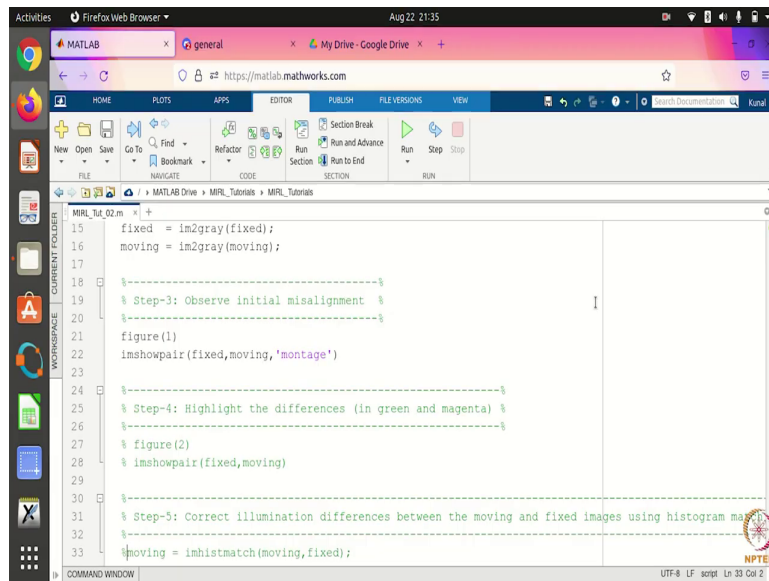


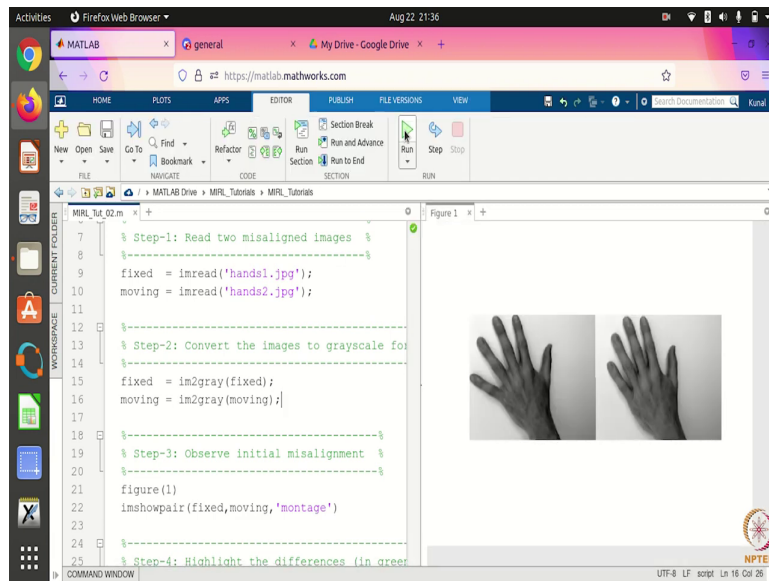
Medical Image Analysis
Professor Ganapathy Krishnamurthi
Biomedical Engineering Design
Indian Institute of Technology, Madras
Lecture 26
Image Registration using MATLAB

(Refer Slide Time: 00:14)



Hello everyone. Welcome to the second tutorial of Medical Image Analysis course. In this course we will show the MATLAB implementation of Thirion's image matching algorithm. Which was inspired by the famous thought experiment by Maxwell, also called Maxwell's Demons. In this example, we will show how to solve an image registration problem in which the same hand have been photographed in different poses. You will notice the misalignment of the images very slowly throughout the image. So, the first step is to read the two images into the workspace.

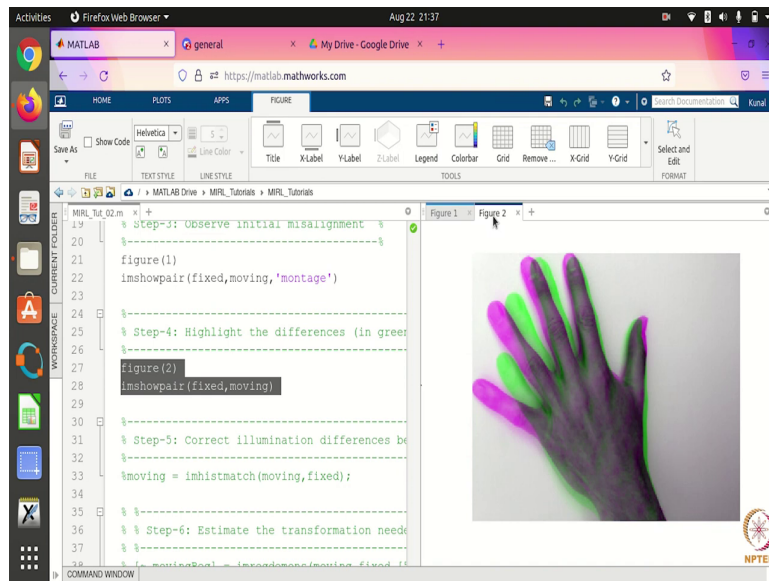
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So, the command for that is “imread”. So, the first image is stored in the variable called “fixed” and the second image is stored in other variable called “moving”. So, these terms come from the paper mainly the Thirion’s paper. So, second step is to convert the image to gray scale for processing so the command for that is “im2gray”. So, this converts the image to grayscale.

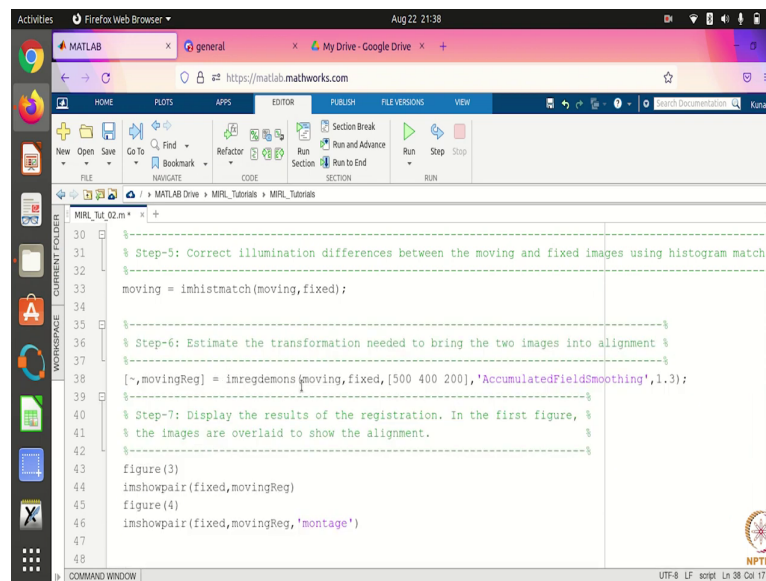
Now if we look at these 2 images fixed and moving so you can see you can observe the initial misalignment between the 2 images. Fingers are in different are not well aligned. They are different. You can see here they are straight here they are not. So, there is some initial misalignment in the figures.

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So, we can overlay the two images. We can overlay the two images to make it easy to see where the images differ. So, for example we run this part of code. So, the differences between the two images are highlighted in green and magenta.

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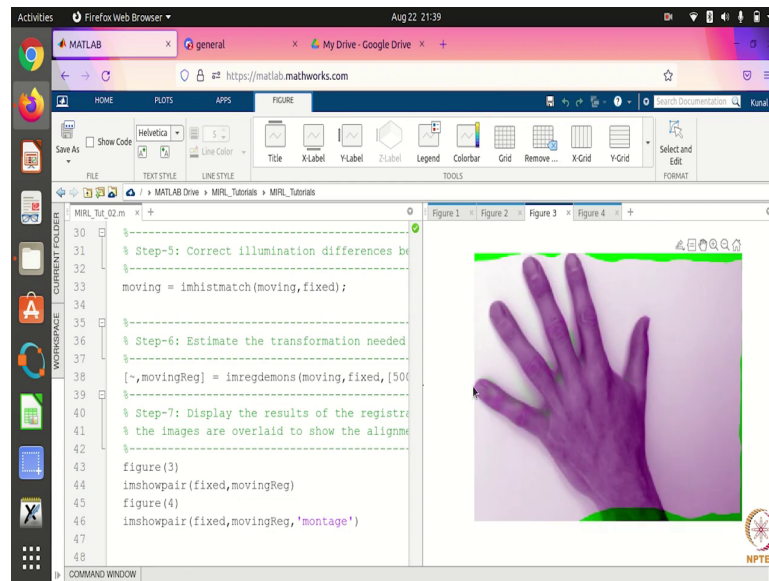
```
30 %
31 % Step-5: Correct illumination differences between the moving and fixed images using histogram match
32 %
33 moving = imhistmatch(moving, fixed);
34 %
35 % Step-6: Estimate the transformation needed to bring the two images into alignment %
36 %
37 %
38 [~, movingReg] = imregdemons(moving, fixed, [500 400 200], 'AccumulatedFieldSmoothing', 1.3);
39 %
40 % Step-7: Display the results of the registration. In the first figure, %
41 % the images are overlaid to show the alignment. %
42 %
43 figure(3)
44 imshowpair(fixed, movingReg)
45 figure(4)
46 imshowpair(fixed, movingReg, 'montage')
47
48
```

So, the next step. The next step is to correct the illumination differences between the moving and fixed images using histogram matching. So, for histogram matching you can refer to the lecture by the professor. This is the common pre-processing step, so here we do histogram matching. In MATLAB you can use this inbuilt function “imhistmatch” for histogram matching.

So, the next step is to estimate the transformation needed to bring the two images into alignment. So, for that the command the command used in MATLAB is imregdemons. So, this is a inbuilt function in the MATLAB image processing tool box which implements the this Demon's algorithms. So, what it does is it estimates the displacement field “D” that aligns the image to be registered (that image to be registered is a moving image, the right-hand side) and it aligns the image to be registered with a reference image. And the reference image is the fixed image which is in the left-hand side.

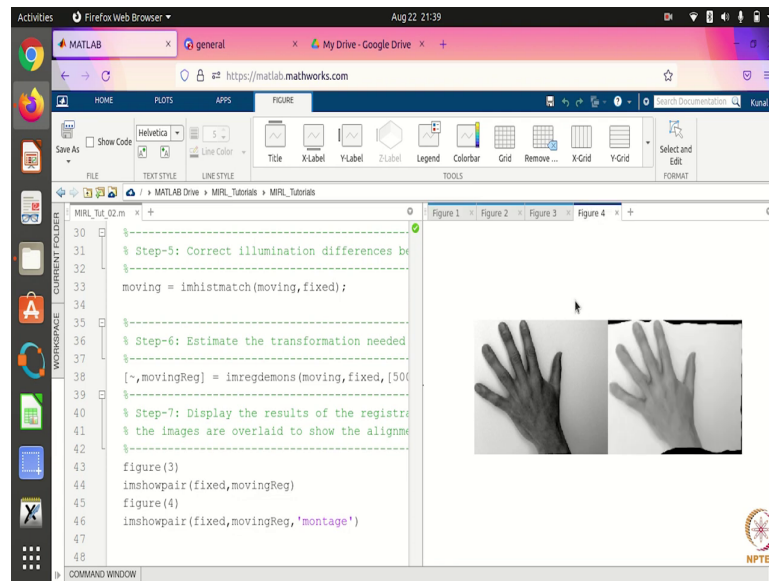
So, the displacement vectors at each pixel location map locations from the fixed image grid to the corresponding location in the moving image. In this figure, sorry in this example the number of iterations are fixed to be 500 and the parameter related to weight computation is taken to be 1.3. So, please refer to the lecture and the paper for the details. So, when we run this algorithm, we get the following results.

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So, when we display the results of the registration, we can see that the images are overlaid to show the alignment and as we can see the moving image has diffused very nicely to the fixed image and the alignment is pretty good. So, initially we started with this type of with this type of moving image which was not very well aligned with the fixed image.

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But after applying this algorithm we see that the alignment of the fingers is very nice and the two images are now very well aligned. So, that is all for the second tutorial. Thanks.