Practical session on image registration.

1) AIMS

You will solve registration problems of several degrees of difficulty, with real images and using Matlab ready-provided tools or else your own implementations. You are encouraged to be as creative as you can, although some suggestions are provided about suitable methods to use in the blank code sheet. Each work group will start from a different problem, and advance towards the rest through the session.

2) EQUIPMENT AND MATERIAL

- Four pairs of reference-sensed images.
-Matlab and the corresponding technical help advice documentation.

3) EXPERIMENTS.

This is basically an open practical session which strongly depends upon your creative resources to obtain the results. So you will have to decide how to operate to solve the different registration cases, and if to follow the suggestions in the blank code sheet or not.

3.1) *Case 1. Registration for Panorama Image stitching. Very easy*

Register the two images after elucidating the most likely transformation that relates them. Use as starting point first the R, then the G and then the B image planes. Evaluate the quality of the registration by RMSE.

Suggested method: *Phase correlation*

Figure 1. Images for Case 1 (from ref. 3).

Q1) Provide at least two alternative solutions for this registration problem. Discuss if the image used as reference had any influence on the quality of the registration.

3.2) *Case 2. Easy*

Register the two images after trying to elucidate the most likely transformation that relates them. You will also need to implement the registration quality evaluation (suggestion: by RMSE in intensity values).

Suggested method: *Matlab standard automatic intensity-based registration*

Q2) Discuss about other possibilities for quality evaluation, and how easy it would be to implement them and/or find some threshold for considering the registration acceptable.

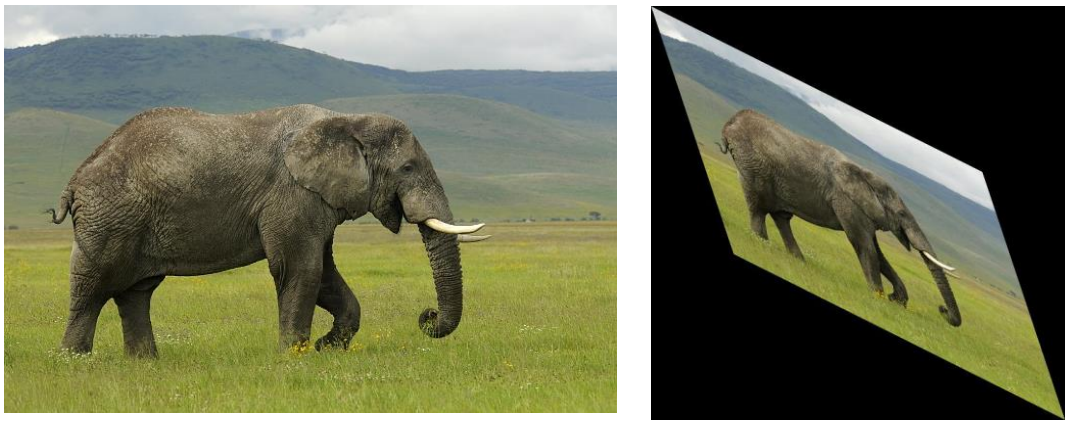

Figure 2. Images for Case 2 (from Google).

3.3) *Case 3. Medium-Hard*

Register the two images after trying to elucidate the most likely transformation that relates them. Evaluate the quality of the registration (suggestion: RMSE or using CP extraction).

Suggested method: *Matlab standard registration using feature extraction and geometric transform estimation*

Q3) Did you obtain a satisfactory outome? If not or not entirely, try to propose different ways to operate to achieve a better result.

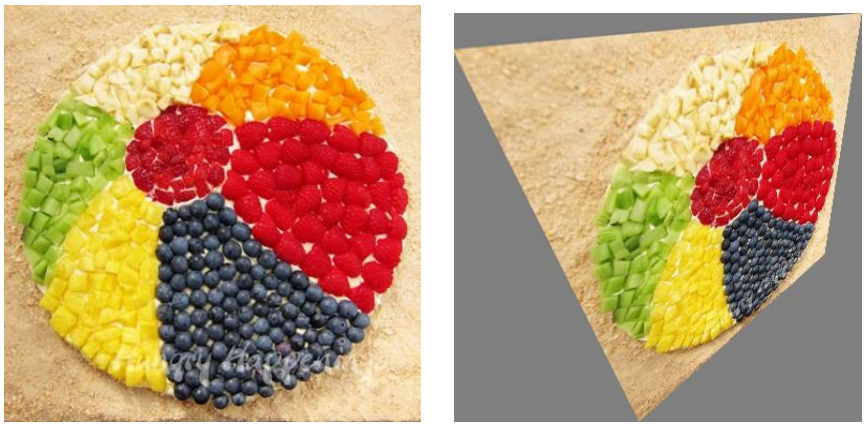

Figure 3. Images for Case 3 (from Google).

3.4) *Case 4. Hard*

The two images resulted from captures of a dual camera with two different filters placed in front of RasberryPi cameras. The first filter was used to cut off the visible portion of the spectrum, and the second to cut off the NIR portion of the spectrum.

Register the two images. Evaluate the quality of the registration by CP location accuracy after registration (since they are multimodal images, it makes no sense to use intensity-based quality evaluation).

Suggested method: *Matlab standard registration using manual CP extraction*

Figure 4. Images for Case 4 (captured as part of an internal project of the ColorImaging Lab).

Q4) Have you solved the problem satisfactorily? Which kind of distortions do you think were present in this problem? Were you able to predict the appropriate transformation just by looking at the two images at a first glance?

4) REFERENCES AND LINKS

1. A. Ardeshir Goshtasby. Image Registration: Principles, Tools and methods. Springer-Verlag, 2012.

2. http://es.mathworks.com/discovery/image-registration.html

3. https://thilinasameera.wordpress.com/2012/03/24/translation-invariant-image-registration-using-phase-correlation-panorama-imaging-on-matlab/

4. http://es.mathworks.com/help/vision/examples/find-image-rotation-and-scale-using-automated-feature-matching.html