**Prof email:** hw@ntu.edu.sg

**Group members:** Minimum 1, maximum 6 members.Create your group in the Groups page. **Each member must submit the SAME report individually!!!**

**1. Find the focal length *f* of your hand phone (in pixels)**

**You may use real person or printed figure, and include one figure of the settings in your report. Make sure you turn the camera’s “zooming/auto-focusing” off. (40 marks)**

Find a wall, or piece of paper, and draw two crosses on it. Find the distance between the two points H (e.g 0.6m). Use your phone to take a picture using a tripod stand from a fixed distance L from the paper. Using the image, find the distance between the two crosses in pixels h. Then, we want to calculate the focal length f (distance from phone to the image, where image is between the actual object and the phone).

To find h (distance between two crosses in pixels on the image), use a software like IrfanView/Photoshop. Then, select the two crosses to find the pixel distance between the two crosses in pixels.

Then, use the formula h/H = f/L to find the focal length f (it should be the only unknown). f = L(h)/H where L and H are in metres and h is in pixels. Typically, f should be in the range of 20-30mm. You cannot read f from the camera specification, that’s cheating = zero marks.

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**2. Take two snaps of an outdoor scene, with 5 to 10 degrees angle difference. You need to keep the angle as ground truth. (0 marks)**

Take a piece of paper and draw two lines, where the angle between them θ = 5-10 degrees (just pick one). Keep the paper fixed on a flat surface. Then align your phone to one of the lines, and simply take a picture of anything. Then, move your phone to align to the other line, and take another picture of the same scene. That’s all. In the end you will have two images taken by the same phone, except with a difference of θ degrees in camera placement.

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Using those two images taken at 10 degrees apart, do the following questions:

**3. Hand pick 8 points or more from one image, and find the matching points on the other image. These points should not be co-planar. You need to turn these points into Nvector, and submit them into the equation for calculation. (10 marks)**

Pick 8 points from each image, turn them into Nvector (normalize) and then find W. Then calculate SVD using matlab.

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**4. Calculate the rotation angle from the matched points using the quaternion approach (pp 14 in [4]), or the SVD(in [3]).** **(40 marks)**

See above, find U and V to get rotation matrix R, then solve for angle.

**5. This is a group project. Find a group of 6 and prepare one report per group. Each member submit the same report through NTUlearn/Assignments before “07-11-2021, Sunday”. Late submission will be degraded by one grade per week. I can help with grouping if you failed to do so.** **(10 marks)**