This assignment is to be carried out individually in Matlab and you have to deliver the code, with results and calculations in a single PDF file. You have to show the results in class.

Nombre y apellidos: _____

Exercises

1. Consider a rotation about the X axis of 1.1 radians, followed by a rotation about the Y axis of -0.5 radians, followed by a rotation about the Z axis by 0.1 radians (this order of rotations is called the "XYZ fixed angles" convention).

   (1.1) Give the 3×3 rotation matrix corresponding to the rotations above.

   (1.2) Since the rotation matrix is "orthonormal" matrix (i.e., a square matrix whose rows and columns are orthogonal unit vectors), its inverse is equal to its transpose. Show this.

   (1.3) Give the 3x3 rotation matrix where the same rotations described in part (a) are done in the opposite order; i.e., first a rotation about the Z axis of by 0.1 radians, followed by a rotation about the Y axis of -0.5 radians, followed by a rotation about the X axis by 1.1 radians (this convention is called "ZYX fixed angles"). The matrix should be different.

2. A camera observes the following 7 points, defined in WORLD coordinates (meters):

```
  6.8158   7.8493   9.9579   8.8219   9.5890  10.8082  13.2690
-35.1954 -36.1723 -25.2799 -38.3767 -28.8402 -48.8146 -58.0988
 43.0640  43.7815  40.1151  46.6153  42.2858  56.1475  59.1422
```

   The pose of the camera with respect to the world is given by the following:

   - Translation of camera origin with respect to the world is $(10, -25, 40)^T$ in meters.
   - Orientation of the camera with respect to the world is given by the angles provided in problem 1.

   (2.1) Compute the homogeneous transformation matrix that represents the pose of the camera with respect to the world, ${}^{W}_{C}\mathbf{H}$, assuming that the convention being used is "XYZ fixed angles".

   (2.2) Compute the homogeneous transformation matrix that represents the pose of the world with respect to the camera, ${}^{C}_{W}\mathbf{H}$.

   (2.3) Assume that the size of the image is 256 columns (width) by 170 rows (height), with the optical center at the image center. The effective focal length is 400 pixels. Write the intrinsic camera calibration matrix $\mathbf{K}$.

   (2.4) Create a blank (zeros) image, and project the 7 points to the image. Write white dots into the image at those points.

   (2.5) Using Matlab's `line` function, draw lines between the points on the image. Namely draw a line from point 1 to point 2, another line from point 2 to point 3, and so forth. Show the resulting image (hint: it should be a familiar object).