MREN-348: Introduction to Robotics
Winter 2025

MATLAB Assignment #1

1. a) Given a rotation matrix and not considering the special cases, how many possible sets of ZYZ Euler angles can be found?

   b) Write a MATLAB function that receives a rotation matrix as the input, and finds the sets of ZYZ Euler angles (Phi, Nu, Psi). The function should detect and take care of special cases, and display a message when a special case occurs. Use the following format for your code:

```
function Rot2ZYZ(RotMatrix)
.
.
.
Your Code
.
.
.
if (special case)
   display a message describing the case
   display results (in degrees)
else
   display results (in degrees)
end
```

   c) Provide results for the following set of matrices:

```
Rot1 =
    0.6552    0.7550    0.0250
   -0.7526    0.6553   -0.0651
   -0.0655    0.0239    0.9976
Rot2 =
   -0.9816   -0.1908    0.0000
   -0.1908    0.9816    0.0000
   -0.0000    0.0000   -1.0000

Rot3 =
   -0.1219   -0.9925         0
    0.9925   -0.1219         0
         0         0    1.0000
```

2. a) Write a similar function, which converts a rotation matrix to equivalent angle (υ) and axis (**r**). The function should take care of special cases, and display a message when a special case occurs. Use the following format for your code:

```
function Rot2EqAngle(RotMatrix)
.
.
.
Your Code
.
.
.
if (special case)
   display a message describing the case
   display results (degrees)
else
   display results [Nu (in degrees) and R (vector)]
end
```

b) Provide the results for the following set of matrices:

```
Rot4 =
    0.9063         0    0.4226
         0    1.0000         0
   -0.4226         0    0.9063

Rot5 =
   -0.7778    0.4444    0.4444
    0.4444   -0.1111    0.8889
    0.4444    0.8889   -0.1111

Rot6 =
     1     0     0
     0     1     0
     0     0     1
```

3. a) Write a similar function, which converts a rotation matrix to Unit Quaternions Q={η,**ε**}. Use the following format for your code:

```
function Rot2UQuater(RotMatrix)
.
.
.
Your Code
.
.
.
display results [Eta (scalar) and Esp (vector)]
```

Hint: Be careful when using the MATLAB `sign(x)` *function for this question. In particular, what should the value of* `sign(0)` *be? (-1, 0, or 1)*

b) Provide the results for the above rotation matrices Rot4, Rot5, and Rot6.

Submission:

- **Due date:** Thursday January 30th , 2025, 11:59 pm
- **Drop box:** Soft copy to be uploaded to OnQ
- **PDF document should include:**
  - At cover page:
    - University and department name
    - Course number and name
    - Assignment name/number
    - Student name and ID
    - Date
  - Organized answers with:
    - Code output
    - Function code
  - Page numbering