Robotics Engineering Graduate Program

Problem Set for Preparation

Solution 1: Solution code included.

Solution 2: Solution code included.

Solution 3: Solution code included.

Solution 4: A square matrix with real elements is considered orthogonal if its *Transpose* is equal to the *Inverse* of the matrix. Another method of representing it is if the result of multiplication of the matrix with its *Transpose* is an Identity matrix of the same order.

If, 𝐴𝑇 = 𝐴−1 condition  is satisfied, then

𝐴 × 𝐴𝑇 = I

Solution 5: A square matrix with real elements is considered singular if & only if its determinant is 0, i.e., it does not have an *Inverse*. The determinant is an important mathematical concept to solve and analyze linear equations.

Solution 6: An eigenvector of a square matrix *A* is a non-zero vector *v* such that multiplication by *A* alters only the scale of v:

*Av = λv*

The scalar *λ* is known as the eigenvalue corresponding to this eigenvector.

The eigenvector represents a vector which on linear transformation, does not change its span but only its scale by the eigenvalue. An eigenvector with a eigenvalue = 1, for a 3D shape, can also represent its axis of rotation.

Solution 7:

*Taking integral on both sides,*

*Given,*

*Thus,*

Solution 8:

*Taking integral on both sides,*

*Given,*

*Thus,*

Solution 9:

9a.

9b.

+ c

9c.