



Student Satellite Project
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Website: www.aero.iitb.ac.in/satlab



README - detumbling.py, quaternion.py

Guidance, Navigation and Controls Subsystem

euler_equation(w)

Code author: Priyanshi Gupta

Created on: DD/MM/YYYY

Last modified: DD/MM/YYYY

Revised by:

Description:

The function calculates the value of derivative of angular velocity using the Euler equation.

Formula & References:

Euler's rotation equations:

$$I \dot{\omega} + \omega \times (I\omega) = M$$

Input parameters:

1. **w** : (Float) - Angular velocity of the satellite. *rad/s*

Output:

Returns the value of the derivative of the angular velocity in terms of the torque acting on the satellite and the satellite's moment of inertia.

quaternion_product (q1, q2)

Code author: Priyanshi Gupta

Created on: DD/MM/YYYY

Last modified: DD/MM/YYYY

Revised by:

Description:

Calculates the quaternion product of two quaternions.

Formula & References:

The quaternion product of two vectors (x, y, z) and (x', y', z') is the product of $q = xi + yj + zk$ and $q' = x'i + y'j + z'k$ as quaternions. The quaternion product qq' works out to be
 $-(xx' + yy' + zz') + (yz' - zy')i + (zx' - xz')j + (xy' - yx')k$

Input parameters:

1. **q1, q2** : (Float) - The 2 quaternions whose product we are calculating.

Output:

Returns the value of the quaternion product of the two quaternions.

quaternion_rotation_matrix(Q)

Code author: Priyanshi Gupta

Created on: DD/MM/YYYY

Last modified: DD/MM/YYYY

Revised by:

Description:

Calculates the rotation matrix of the rotation represented by the given quaternion.

Formula & References: Rotation matrix =

$$\begin{bmatrix} 2(q_0^2 + q_1^2) - 1 & 2(q_1q_2 - q_0q_3) & 2(q_1q_3 + q_0q_2) \\ 2(q_1q_2 + q_0q_3) & 2(q_0^2 + q_2^2) - 1 & 2(q_2q_3 - q_0q_1) \\ 2(q_1q_3 - q_0q_2) & 2(q_2q_3 + q_0q_1) & 2(q_0^2 + q_3^2) - 1 \end{bmatrix}$$

Input parameters:

1. **Q** : (Float) - The quaternion whose rotation matrix we are calculating.

Output:

Returns the value of the rotation matrix of the quaternion.

quaternion_propagation(q,w_current)

Code author: Priyanshi Gupta

Created on: DD/MM/YYYY

Last modified: DD/MM/YYYY

Revised by:

Description:

Calculates the value of the quaternion derivative in terms of the angular velocity and the quaternion.

Formula & References: $\dot{q} = 1/2 \mathbf{w} \otimes \mathbf{q}$

Input parameters:

1. **q** : (Float) - The value of the quaternion at the time for which we are calculating the derivative.
2. **w_current** : (Float) - The value of the angular velocity at the time for which we are calculating the derivative. *rad/s*

Output:

Returns the value of the derivative of the quaternion.

get_quaternion_from_euler(roll, pitch, yaw)

Code author: Priyanshi Gupta

Created on: DD/MM/YYYY

Last modified: DD/MM/YYYY

Revised by:

Description:

Converts an Euler angle to a quaternion.

Input parameters:

1. **roll** : (Float) - The roll (rotation around x-axis) angle in radians. *rad*
2. **pitch** : (Float) - The pitch (rotation around y-axis) angle in radians. *rad*
3. **yaw** : (Float) - The yaw (rotation around z-axis) angle in radians. *rad*

Output:

Returns the orientation in quaternion [w,x,y,z] format