Student Satellite Project
Indian Institute of Technology, Bombay
Powai, Mumbai - 400076, INDIA

Website: www.aero.iitb.ac.in/satlab

Readme file for TorqueApplied.py

Attitude Determination and Control Subsystem

ctrlTorqueToVoltage()

Author: Ram Milan Verma
Date: 2nd October 2018
This function calculates voltage to be applied to torquer for actuation as per control law. This also accounts for the fact that we can't apply torque parallel to magnetic field of earth.
Input: satellite
Output: vector of voltage to be applied in three torquers at a instant

Using control toque and earth's magnetic field get the magnetic moment to be applied according to the formulae: $\mu_b = \frac{B_b \bigotimes \tau_{c,b}}{\|B_b\|^2}$, Where τ_c is the required control torque and subscript b is for body frame.
Get current as per this formulae: $I = \frac{\mu}{NA}$
Get voltage as per V=IR
References:
Derivation for $\mu_b = \frac{B_b \bigotimes \tau_{c,b}}{\|B_b\|^2}$
Note: Every vector below is expressed in body frame and subscript b is not used every where for convenience.
We have $tau = \mu_c \bigotimes B$
Now on taking cross product of the above expression with **B**, We get
$B \bigotimes \tau = B \bigotimes (\mu_c \bigotimes B) = \|B\|^2 \mu_c - (B \cdot \mu_c) B$
Now since we can not provide component of control torque along the direction of **B**, we can set that component as zero i.e. $B \cdot \mu_c = 0$.
Hence, we get the magnetic moment, $\mu_b = \frac{B_b \bigotimes \tau_{c,b}}{\|B_b\|^2}$

currentToTorque ()

Author: Ram Milan Verma
Date: 2nd October 2018
This function calculates torque applied on the satellite due to passing the current in torquer.
Input: array of vector of currents for each CONTROL_STEP sampled at step size of 'h'(declared in constants_1U.py), satellite
Output: array of torque vector w.r.t time for a complete CONTROL_STEP

Get magnetic moment , $\mu = NIA$
Torque, $\tau = \mu \bigotimes B$

References:

I ()

Author: Ram Milan Verma
Date: 2nd October 2018
This function calculates current in LR circuit when a constant DC voltage is applied.
Input:voltage to applied to torquer as calculated by **ctrlTorqueToVoltage**
Output: multidimensional array of current vector for a complete CONTROL_STEP sampled at fixed interval *h* (A constant mentioned in constants_1U.py). First column is the time instant and next three columns are corresponding currents in the three torquers.

For calculation of currents at a time instant, $I(t) = \frac{V}{R} * (1 - e^{-\frac{t}{\tau}})$
References: standard lr circuit equation