RWModel specifications

1. Overview

* This class handles RW (reaction wheel). It is equivalent to one RW, stores angular momentum and attached direction vector, and outputs torque with a first-order lag and dead time according to the command value of angular acceleration. It also outputs the RW speed.
  1. Related source code and files
     1. RWModel.py
     2. InitRWModel.py
     3. Interface function for initialization is described
     4. RW.ini (in folder components)
     5. rw\_ode.py
  2. Usages
* An instance is created and used by the initialization function InitRWModel.
* Calculate and output torque with *calc\_torque* function. Set member variables with various Set functions. Use the *set\_torque* function to input the desired angular acceleration at each loop.

2. Algorithm description

2.1. Torque output

Basically, a torque is output according to the commanded angular acceleration value, but a dead time and a first-order lag are implemented. The output torque is expected to be the product of the commanded angular acceleration value and the moment of inertia of RW. Not to come out. As a specific calculation, an angular velocity target value is set for the first-order lag, and the torque is output in such a manner that P control is applied thereto. This angular velocity target value is such that angular acceleration command value × TimeStep is added each time each acceleration command value is entered. As for the dead time, an array of the size of the dead time / TimeStep is prepared, and it is shifted one by one for each loop so that the current angular velocity target value is entered from the end. This implements a dead time. The member variable lag\_coef\_ is a coefficient of the equation of motion of the RW, and by changing this, it approaches the actual change in the rotation speed of the RW. Currently, two types, ordinary\_lag\_coef and coasting\_lag\_coef, are provided to simulate the behavior of the RW reducing the rotational speed only by friction during normal rotation and during coasting.

3. Result of operation check

3.1 Checking output torque

The simulation was performed under the following conditions.

Table 1. Simulation conditions

|  |  |
| --- | --- |
| Moment of inertia | 100kgm^4 |
| Initial angular velocity | 500rad/s |
| Angular velocity command value | 100rad/s^2 for 1s |
| Time step | 0.01s |
| Dead time | 0.1s |
| First order lag coefficient | 10 |

The results are as follows. The blue tip is the torque that is produced without any dead time or first-order lag, and the red one is the torque that is produced with lag. It can be seen that dead time and first-order delay are implemented.