Autonomous Vehicle Simulation (AVS) Laboratory, University of Colorado

Basilisk Technical Memorandum

Document ID: Basilisk-rwVoltageInterface

MODULE TO CONVERT A RW VOLTAGE INPUT INTO A RW MOTOR TORQUE OUTPUT

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Status: First Draft
Scope/Contents
This module provides an analog voltage interface for the cluster of RW devices. An input voltage is converted to a RW motor torque message. This message is what drives the RW dynamics.

Rev:	**Change Description**	**By**
Draft	Initial cut at this documentation	H. Schaub

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1 Description

This module is a simulation environment module which simulates the analog voltage interface of a RW cluster. The input is an array of voltages V_i. The Reaction Wheel (RW) motor torque u_{s_i} is evaluated using a linear mapping

$$u_{s_i} = V_i \gamma \tag{1}$$

where γ is constant value. The output of the module is an array of RW motor torques. The deadband and saturation behavior of the RW speed is modeled inside the RW dynamics model.

2 Module Setup

The interface module is created in python using:

```
testModule = rwVoltageInterface.RWVoltageInterface()
testModule.ModelTag = "rwVoltageInterface"
```

The only parameter that must be set is the voltage to torque conversion gain γ. This is done using

```
testModule.voltage2TorqueGain = 1.32        # [Nm/V] conversion gain
```

3 Unit Test Discussion

A series of unit tests are performed to check the validity of this module's operation. Three base voltages V_0 are test where $V_0 \in (5.0, 7.5, 0.0)$. The input voltages are then setup as

$$\boldsymbol{V} = V_0 \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + \begin{bmatrix} 0.0 \\ 1.0 \\ 1.5 \end{bmatrix} \tag{2}$$

The unit test results are down in the following Tables.

Table 2: RW motoor torque output for Base Voltaget = 5.0V.

time [s]	$u_{s,1}$ (Nm)	Error	$u_{s,2}$ (Nm)	Error	$u_{u,3}$ (Nm)	Error
0	6.6	0	7.92	0	8.58	0
0.5	6.6	0	7.92	0	8.58	0
1	6.6	0	7.92	0	8.58	0

Table 3: RW motoor torque output for Base Voltaget = -7.5V.

time [s]	$u_{s,1}$ (Nm)	Error	$u_{s,2}$ (Nm)	Error	$u_{u,3}$ (Nm)	Error
0	-9.9	0	-8.58	0	-7.92	0
0.5	-9.9	0	-8.58	0	-7.92	0
1	-9.9	0	-8.58	0	-7.92	0

Table 4: RW motoor torque output for Base Voltaget = 0.0V.

time [s]	$u_{s,1}$ (Nm)	Error	$u_{s,2}$ (Nm)	Error	$u_{u,3}$ (Nm)	Error
0	0	0	1.32	0	1.98	0
0.5	0	0	1.32	0	1.98	0
1	0	0	1.32	0	1.98	0