
# Autonomous Vehicle Simulation (AVS) Laboratory, University of Colorado

## Basilisk Technical Memorandum

**Document ID: Basilisk-thrMomentumManagement**

### REACTION WHEEL ANGULAR MOMENTUM DUMPING MANAGEMENT MODULE



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| Prepared by | H. Schaub |



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| **Status:** Initial Document draft |
| **Scope/Contents** |
| This module reads in the Reaction Wheel (RW) speeds, determines the net RW momentum, and then determines the amount of angular momentum that must be dumped. A separate thruster firing logic module called `thrMomentumDumping` will later on compute the thruster on cycling. |

| **Rev**: | **Change Description** | **By** |
|---|---|---|
| Draft | Initial document creation | H. Schaub |

# Contents

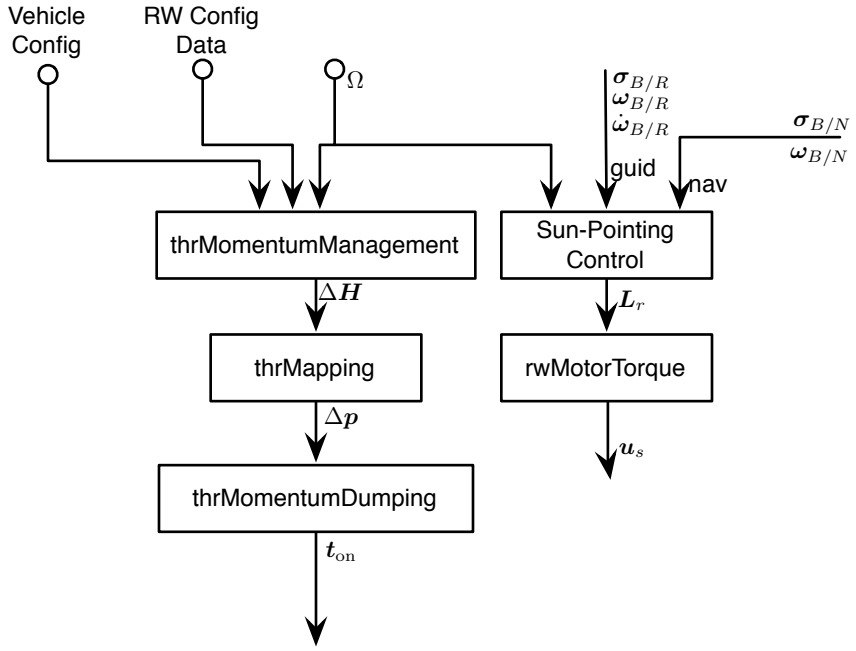


**Fig. 1:** Overview of the Modules Used to Perform Reaction Wheel Angular Momentum Dumping.

## 1 Introduction

To manage the Reaction Wheel (RW) angular momentum build-up over time, a thruster-based momentum dumping strategy is used. Figure **??** illustrates how the momentum dumping will occur simultaneously with an inertial pointing control solution. Assume the spacecraft contains $N_{\text{RW}}$ RWs, and $M_{\text{thr}}$ thrusters. The net RW angular momentum is given by

$$\boldsymbol{h}_s = \sum_{i=1}^{N_{\text{RW}}} \hat{\boldsymbol{g}}_{s_i} \Omega_i \tag{1}$$

where $\hat{\boldsymbol{g}}_{s_i}$ is the RW spin axis, and $\Omega_i$ is the RW speed rate about this axis. Because the inertial attitude of the spacecraft is assumed to be held nominally steady,

$$\dot{\boldsymbol{h}}_s = \frac{{}^{\mathcal{B}}\mathrm{d}\boldsymbol{h}_s}{\mathrm{d}t} + \boldsymbol{\omega}_{B/N} \times \boldsymbol{h}_s \approx \frac{{}^{\mathcal{B}}\mathrm{d}\boldsymbol{h}_s}{\mathrm{d}t} \tag{2}$$

## 2 `thrMomentumManagement` Module Description

Figure **??** illustrates the function of the RW angular momentum dumping management module. Let $h_{s,\text{min}}$ be lower bound that the RW momentum dumping strategy should achieve. The desired net change in inertial angular momentum is thus determined through

$${}^{\mathcal{B}}\Delta \boldsymbol{H} = {}^{\mathcal{B}}\boldsymbol{h}_s \frac{|\boldsymbol{h}_s| - h_{s,\text{min}}}{|\boldsymbol{h}_s|} \tag{3}$$

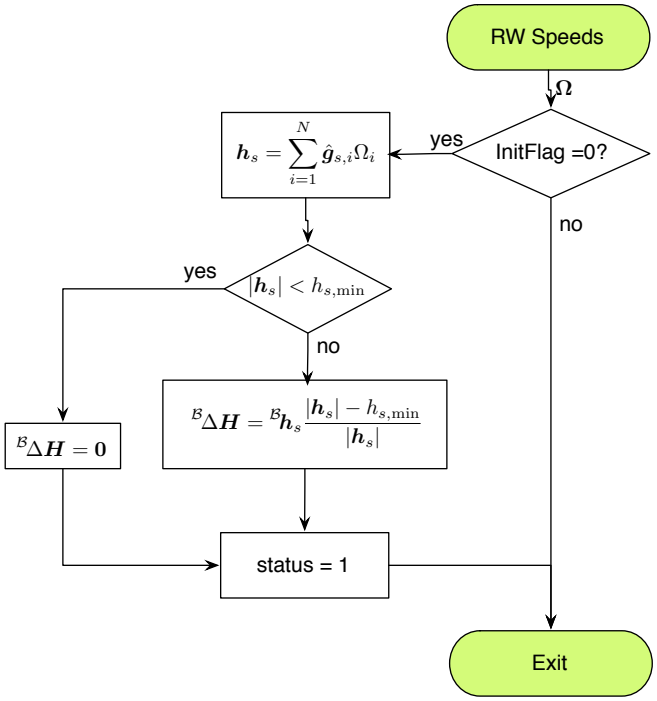


**Fig. 2:** Overview of the Reaction Wheel Angular Momentum Management Module.

This strategy requires a thruster firing solution which creates this desired ${}^{\mathcal{B}}\Delta\boldsymbol{H}$ over the duration of the momentum dumping. The goal of the RW momentum management module is to simply compute if a ${}^{\mathcal{B}}\Delta\boldsymbol{H}$ is required, or set it equal to zero if the RW momentum is too small. Not that this module will only compute ${}^{\mathcal{B}}\Delta\boldsymbol{H}$ once. Either it is zero or non-zero. To reuse this momentum management module, the reset() function must be called.

# 3 Module Parameters

## 3.1 `hs_min` Parameter

This parameter dictates the desired lower ceiling of the RW cluster angular momentum. It must be set prior to calling the routine.