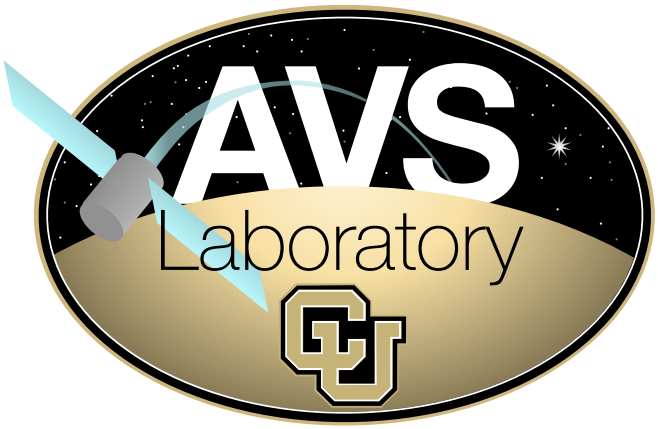

Autonomous Vehicle Simulation (AVS) Laboratory

AVS-Sim Technical Memorandum

Document ID: AVS-SIM-inertial3DSpin

GUIDANCE MODULE TO PERFORM AN INERTIALLY CONSTANT SPIN

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Status: Initial Version
Scope/Contents
Generate the reference attitude trajectory for a general 3D inertial spin with a constant inertial angular velocity vector.

Rev:	**Change Description**	**By**
Draft	initial copy	H. Schaub
v1.1	fixed typo above Eq. (4)	H. Schaub
v1.2	updated the documentation now that the module outputs only the reference frame states	H. Schaub

Contents

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1 Introduction

This technical note discusses the guidance mathematics to perform a constant spin about an inertially fixed axis.

2 Setup

This module requires that the initial inertial attitude $\boldsymbol{\sigma}_{R/N}$ of the reference frame $\mathcal{R}$ relative to the inertial frame $\mathcal{N}$ be set. Further, the inertially constant $\mathcal{R}$ frame angular velocity vector ${}^{\mathcal{N}}\boldsymbol{\omega}_{R/N}$ must be defined in inertial frame components.

3 Reference Frame Propagation

The MRP differential kinematic equations are

$$\dot{\boldsymbol{\sigma}}_{R/N} = \frac{1}{4}[B(\boldsymbol{\sigma}_{R/N})]^{\mathcal{R}}\boldsymbol{\omega}_{R/N} \tag{1}$$

where

$$[B(\boldsymbol{\sigma}_{R/N})] = (1 - \sigma_{R/N}^2)[I_{3\times 3}] + 2[\tilde{\boldsymbol{\sigma}}_{R/N}] + 2\boldsymbol{\sigma}_{R/N}\boldsymbol{\sigma}_{R/N}^T \tag{2}$$

and $\sigma_{R/N} = |\boldsymbol{\sigma}_{R/N}|$.

If there inertially fixed reference angular velocity vector is given in inertial frame components, it must be rotated using the appropriate DCM:

$${}^{\mathcal{R}}\boldsymbol{\omega}_{R/N} = [RN]^{\mathcal{N}}\boldsymbol{\omega}_{R/N} \tag{3}$$

REFERENCES

[1] Hanspeter Schaub and John L. Junkins. *Analytical Mechanics of Space Systems*. AIAA Education Series, Reston, VA, 3rd edition, 2014.