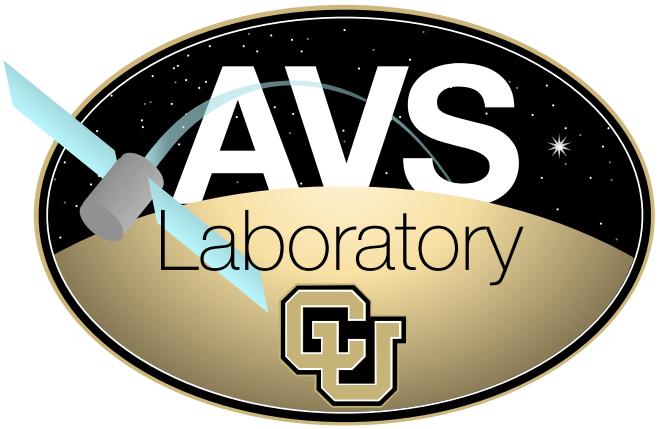

Autonomous Vehicle Simulation (AVS) Laboratory

AVS-Sim Technical Memorandum

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GUIDANCE MODULE FOR HILL FRAME POINTING

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Status: Initial Version
Scope/Contents
Generate the attitude reference to perform a constant pointing towards a Hill frame orbit axis

Rev:	**Change Description**	**By**
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Contents

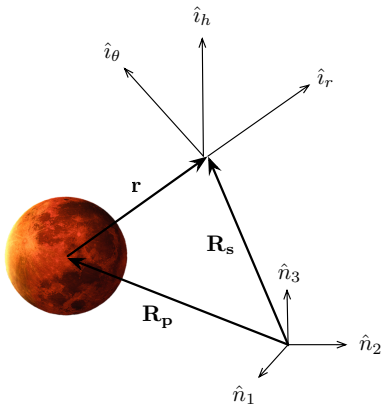

Fig. 1: Illustration of the Hill orbit frame $\mathcal{H}$, and the inertial frame $\mathcal{N}$.

1 Reference Frame Definitions

A general axis is to be aligned with a principal Hill-frame axis and stay pointing fixedly on it. Note that the presented technique does not require the hill orbit frame $\mathcal{H} : \{\hat{\imath}_r, \hat{\imath}_\theta, \hat{\imath}_h\}$ to be the inertial frame in use. Figure 1 illustrates the situation assessed.

2 Angular Velocity Descriptions

Let the general reference frame associated to this pointing attitude be $\mathcal{R}$. The attitude tracking control requires the angular rate $\boldsymbol{\omega}_{R/N}$ and acceleration $\dot{\boldsymbol{\omega}}_{R/N}$. The angular velocity of the Hill frame is given by

$$\boldsymbol{\omega}_{H/N} = \dot{f}\hat{\boldsymbol{\imath}}_h \tag{1}$$

where $\dot{f}$ is the time-varying true anomaly rate applicable for both cirular and elliptic orbits, and $\hat{\boldsymbol{\imath}}_h$ is the orbit's normal direction. Since the pointing towards the orbit axis is constant, the desired reference $\mathcal{R}$ does not move relative to the Hill orbit frame. Thus, the angular velocity of the reference frame happens to be

$$\boldsymbol{\omega}_{R/N} = \boldsymbol{\omega}_{R/H} - \boldsymbol{\omega}_{H/N} = \dot{f}\hat{\boldsymbol{\imath}}_h \tag{2}$$

It is straightforward to compute the acceleration vector of the reference frame

$$\dot{\omega}_{R/N} = \ddot{f}\hat{\boldsymbol{\imath}}_h \tag{3}$$