Autonomous Vehicle Simulation (AVS) Laboratory, University of Colorado

Basilisk Technical Memorandum

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TESTING EPHEMERIS CONVERSION

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Status: Initial document draft
Scope/Contents
This unit test the ephemeris conversion module by comparing the messages before and after the module has acted on them, and assuring that the desired results are obtained

Rev:	**Change Description**	**By**
Draft	Initial document creation	T. Teil

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1 Introduction

The ephemeris converter module has the purpose of copying the spice sim messages into a flight software interface message.

The spice message, contains the following variables:

- J2000Current: the time of validity for the planet state
- PositionVector : the true position of the planet for the time
- VelocityVector[3]: the tue velocity of the planet for the time
- J20002Pfix: the orientation matrix of planet-fixed relative to inertial
- J20002Pfix_dot: the derivative of the orientation matrix of planet-fixed relative to inertial
- computeOrient: a flag indicating whether the reference should be computed
- PlanetName

Only a the position and velocity vectors are transferred to the ephemeris message, which therefore contains:

- r_BdyZero_N[3]: the position of orbital body
- v_BdyZero_N[3]: the velocity of orbital body
- timeTag: the vehicle Time-tag for state

This test set's up an appropriate simulation by creating a Spice Object, which will write messages containing ephemerides. A ephemeris converter object is also created with the map between the message names. This test guarantees that the data is properly copied.

2 test_test_ephemerisconvert Test Description

This test is located in SimCode/environment/ephemeris_converter/_UnitTest/test_ephemerisconvert.py.

2.1 Validation success criteria

The criteria for a successful testing of this module is driven by the correct copy of the spice messages. This is done simply by comparing the messages before the copy with the outcome of the copied message. The error tolerance is at $\epsilon = 10^{-5}$ which corresponds to 12 significant digits. This gives a healthy margin from machine precision all the while getting all of the physical information from the ephemerides.

3 Test Setup

The spice object was set on the following date: 2015 February 10, 00:00:00.0 TDB, and the planets that were loaded where the Earth, Mars Barycenter, and the Sun.

Successful link test

A boolean variable is added for logging and is verified to have successfully linked the desired messages. This is done by comparing the variables down to $\epsilon = 10^{-10}$, since we are looking for a value of 1.

Successful copy test

For each of the celestial bodies who get a message output, we log the two messages that contain their position and velocities in the inertial frames. For mars the first message is the Spice message is `mars_planet_data` and the second message is the ephemeris converted data `mars_ephemeris_data`. If the norm of their difference (including the time component of the vector), at any time, is greater than our error tolerance $\epsilon = 10^{-5}$, then the test fails.

4 Test Results

4.1 Pass/Fail results

Test	Link Test	Copy Test
Result	Passed	Passed
Tolerance	10^{-10}	10^{-5}

Both components of the test pass. The copy is therefore a properly executed.