Autonomous Vehicle Simulation (AVS) Laboratory, University of Colorado

Basilisk Technical Memorandum

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MODULE TO AGGREGATE A SERIES OF NAVIGATION MESSAGES INTO A SINGLE MESSAGE

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Status: Released
Scope/Contents
The goal of this module is to read in a series of navigation messages and then construct a blended output navigation message. Both attitude and navigation messages are supported at the same time. The number of attitude and translational messages to be merged can be different. The module is configured to select particular parts from each message.

Rev	Change Description	By	Date
1.0	Initial Document	H. Schaub	2019-02-21

Contents

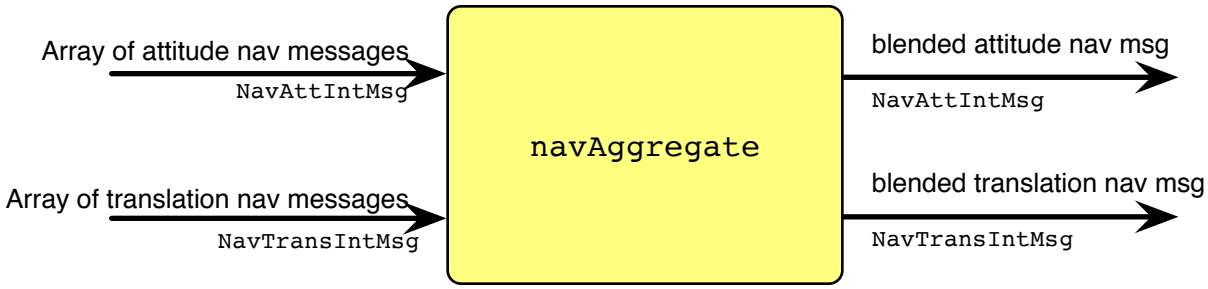

Fig. 1: Illustration of the `navAggregate()` input and output messages.

1 Module Description

The purpose of this simple aggregate module is to read in a series of navigation messages, and combine their values into a single output message. The module is able to blend both attitude and translation navigation messages.

The number of input messages is defined through either `attMsgCount` or `transMsgCount`. If either of these values is zero, then the corresponding output navigation message is populated with zero components.

To select which input message value to use, the module index value must be set for that particular parameter. All these variables end with `Idx`. Their default values are 0, indicating that by default the values of the first navigation message are used. By changing the `Idx` value the user selects which message content to use for that variable. This can be set individually for each navigation message variable. If the `Idx` value is larger than the number of input messages, then the corresponding variable is set to zero values. This allows the output message to zero out particular variables. In all cases the `Idx` index must be less than input navigation message counter `attMsgCount` or `transMsgCount` respectively.

2 Module Functions

- **Read in Navigation messages**: This module reads in a list of attitude and navigation messages. The remaining message slots are zeroed.
- **Assemble blended output navigation messages**: The input navigation message content can be selectively blended to create a single attitude and translation navigation message.

3 Module Assumptions and Limitations

This module doesn't have any assumptions.

4 Test Description and Success Criteria

The unit test sets up a range of module input conditions ranging from using no message, 1 message, 2 messages, and even using index for an empty message. All permutations between setting these conditions between the attitude and translation navigation messages are tested.

5 Test Parameters

The attitude navigation messages are setup using the states shown in Tables **??** and **??**. If no attitude navigation message is specified, then the attitude navigation output should be a zero message. If an index is chosen that is larger than 3, then the corresponding message variable should be zeroed as well.

Table 2: Attitude Navigation Message #1 and Error tolerance for each test.

Output Value Tested	Value	Tolerated Error
timeTag	11.11	1e-12
sigma_BN	[0.1, 0.01, -0.1]	1e-12
omega_BN_B	[1.0, 1.0, -1.0]	1e-12
vehSunPntBdy	[-0.1, 0.1, 0.1]	1e-12

Table 3: Attitude Navigation Message #2 and Error tolerance for each test.

Output Value Tested	Value	Tolerated Error
timeTag	22.22	1e-12
sigma_BN	[0.2, 0.02, -0.2]	1e-12
omega_BN_B	[2.0, 2.0, -2.0]	1e-12
vehSunPntBdy	[-0.2, 0.2, 0.2]	1e-12

Tables **??** and **??** show the translational input navigation message states.

Table 4: Translational Navigation Message #1 and Error tolerance for each test.

Output Value Tested	Value	Tolerated Error
timeTag	11.1	1e-12
r_BN_N	[1000.0, 100.0, -1000.0]	1e-12
v_BN_N	[1.0, 1.0, -1.0]	1e-12
vehAccumDV	[-10.1, 10.1, 10.1]	1e-12

6 Test Results

The permuations of the unit test configurations are listed in Table **??**. All the tests should pass. If the variable index parameter is beyond the number of message that variable is zeroed. If an index is set to N/A, this indicates that this index is not set in python to test the default behavior.

Table 6: Test results

attMsgCount	Attitude Variable Idx	transMsgCount	Translation Variable Idx	**Pass/Fail**
0	N/A	0	N/A	PASSED
1	N/A	1	N/A	PASSED
0	N/A	1	N/A	PASSED
1	N/A	0	N/A	PASSED
2	1	2	1	PASSED
1	N/A	2	1	PASSED
0	N/A	2	1	PASSED
2	1	1	N/A	PASSED
2	1	0	N/A	PASSED
2	2	2	2	PASSED
2	2	2	1	PASSED
2	2	1	N/A	PASSED
2	2	0	N/A	PASSED
2	1	2	2	PASSED
1	N/A	2	2	PASSED
0	N/A	2	2	PASSED

Table 5: Translational Navigation Message #2 and Error tolerance for each test.

Output Value Tested	Value	Tolerated Error
timeTag	22.2	1e-12
r_BN_N	[2000.0, 200.0, -2000.0]	1e-12
v_BN_N	[2.0, 2.0, -2.0]	1e-12
vehAccumDV	[-20.2, 20.2, 20.2]	1e-12

7 User Guide

7.1 Required Module Parameters

- outputAttName — Name of the blended attitude output navigation message
- outputTransName — Name of the blended translation output navigation message

7.2 Optional Module Parameters

- attMsgs — Array of AggregateAttInput navigation message structures which have the input message name specified in inputNavName
- transMsgs — Array of AggregateTransInput navigation message structures which have the input message name specified in inputNavName
- attMsgCount — number of attitude input navigation messages to read in, must not exceed 10. If this value is left at zero, then no messages are read in and the output navigation message is zeroed. Default value is zero.
- transMsgCount — number of translation input navigation messages to read in, must not exceed 10. If this value is left at zero (default value), then no messages are read in and the output navigation message is zeroed. Default value is zero.
- attTimeIdx — the message index to use for this value. The first message has an index of zero. Default value is zero.
- attIdx — the message index to use for this value. The first message has an index of zero. Default value is zero.
- rateIdx — the message index to use for this value. The first message has an index of zero. Default value is zero.
- sunIdx — the message index to use for this value. The first message has an index of zero. Default value is zero.
- transTimeIdx — the message index to use for this value. The first message has an index of zero. Default value is zero.
- posIdx — the message index to use for this value. The first message has an index of zero. Default value is zero.
- velIdx — the message index to use for this value. The first message has an index of zero. Default value is zero.
- dvIdx — the message index to use for this value. The first message has an index of zero. Default value is zero.