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README - q-Davenport Algorithm

Guidance, Navigation and Controls Subsystem

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es_main_qdp.m

Code Type: MATLAB - Script
Code author: Shashank Singh
Created on: 29/04/2020
Last modified: 08/08/2020
Reviwed by: NOT YET REVIEWED!
Description:
This is the main script, which runs the q-Davenport Algorithm. It also runs the sequential rotation function, in case the q-Davenport fails in the given initial frame.
Formula & References:
Reference: **Chapter 5,** Fundamentals of Spacecraft Attitude Determination and Control Authors: Markley, F. Landis, Crassidis, John L.
Input parameters:
The input arguments to the function are read from the **Input** folder. Here **N** refers to the number of input stars.

1. **es_input.mat** : The contents of which are-
    - **st_op_bi** : ((N, 4) - Matrix) - The body-frame vectors - (X,Y,Z), of the matched stars
    - **st_op_ri** : ((N, 4) - Matrix) - The inertial-frame vectors - (X,Y,Z), of the corresponding matched stars
    - **st_N** : (Integer) - The number of stars matched by Star Matching

Output:
Writes the final estimated quaternion using q-Davenport into **es_q_bi.csv** file in the **Output** folder as well as the **Output** folder(to be used for Sequential Rotation later).

es_qdp.m

Code Type: MATLAB - Function
Code author: Shashank Singh
Created on: 29/04/2020
Last modified: 08/08/2020
Reviwed by: NOT YET REVIEWED!
Description:

This is the main and the only function in the q-Davenport algorithm. This function calculates the **final estimated quaternion**. It also checks if **check_value** is close to zero. If **check_value** is smaller than the threshold value, then $q\_bi = [-1; -1; -1; -1]$ is returned, which indicates the main script that q-Davenport has failed in this frame and then sequential rotation is used.
Formula & References:
Reference: **Chapter 5,** Fundamentals of Spacecraft Attitude Determination and Control Authors: Markley, F. Landis, Crassidis, John L.
Input parameters: Here **N** refers to the number of input stars.

1. **b_m** : ((N, 3) - Matrix) - The body-frame vectors - (X,Y,Z), of the matched stars
2. **m_r** : ((N, 3) - Matrix) - The inertial-frame vectors - (X,Y,Z), of the corresponding matched stars
3. **v_a** : ((N, 1) - Vector) - The weights of the corresponding matched stars

Output:
q_bi : ((4,1) - Vector) - The final estimated quaternion, using q-Davenport algorithm.

es_qdp_seq_rot.m

Code Type: MATLAB - Function
Code author: Shashank Singh
Created on: 08/08/2020
Last modified: –/–/—-
Reviwed by: NOT YET REVIEWED!
Description:
This function calculates the **final estimated quaternion**.This function first finds the preferred frame for sequential rotation and finds the estimated quaternion in the changed frame using q-Davenport. This quaternion is later converted to quaternion in the original initial frame. If **check_value** is again smaller than the threshold value, then a new preferred frame is found and sequential rotation is used in the new frame. This process continues for all the three frames(the three frames are, inertial frame rotated by 180 degrees about x,y,z axes) until the correct quaternion is found.
Formula & References:
Reference: **Chapter 5,** Fundamentals of Spacecraft Attitude Determination and Control Authors: Markley, F. Landis, Crassidis, John L.
Input parameters: Here **N** refers to the number of input stars.

1. **b_m** : ((N, 3) - Matrix) - The body-frame vectors - (X,Y,Z), of the matched stars
2. **m_r** : ((N, 3) - Matrix) - The inertial-frame vectors - (X,Y,Z), of the corresponding matched stars
3. **v_a** : ((N, 1) - Vector) - The weights of the corresponding matched stars
4. **q_bi_prev** : ((4,1) - Vector) - The previous quaternion value

Output:
q_bi : ((4,1) - Vector) - The final estimated quaternion, using q-Davenport after using sequential rotation.