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README - 4-Star Matching Algorithm: Preprocessing
Guidance, Navigation and Controls Subsystem

st_constants_4SM.m

Code Type: MATLAB - Script
Code author: KT Prajwal Prathiksh
Created on: 26/04/2020
Last modified: 28/05/2020
Reviewed by: NOT YET REVIEWED!
Description:
This script generates all the constants required for 4-Star Matching Algorithm as well as the Reference Star Catalogue. It also saves the values of the constants and catalogue.
The constants are as follows:

1. **Focal_Length** : (Float) The focal length of the optics system. Units in *mm*
2. **st_M_EPS** : (Float) The machine epsilon of the platform where the algorithm will be executed
3. **st_n_GC** : (Integer) The number of stars (= number of rows) in the Guide Star Catalogue
4. **st_n_RC** : (Integer) The number of star-pairs (= number of rows) in the Reference Star Catalogue
5. **st_DELTA** : (Float) The δ constant that determines the tolerance of the size window when searching for an angular distance value in the Reference Star Catalogue
6. **st_M** : (Float) The slope of the Z-vector line
7. **st_Q** : (Float) The y-intercept of the Z-vector line
8. **es_N_EST** : (Integer) The minimum number of pairs of body-frame (b_i and inertial-frame r_i vectors required by *Estimation block* to provide the attitude within the accuracy requirements
9. **st_ITER_MAX_4SM** : (Integer) The max number of iterations of 4-Star Matching that will be allowed to execute irregardless of whether all the stars match or not - owing to the time constraint on the *Star-Matching block*

Formula & References: –
Input parameters:

1. **write_csv** : (Boolean) If true, saves the Reference Star Catalogue as a csv file

Output:

1. Writes constants in `./Star_Matching/4_Star_Matching/Preprocessing/Output/st_constants_4SM.mat` directory
2. Writes Reference Star Catalogue in `./Star_Matching/4_Star_Matching/Preprocessing/Output/st_Reference_Star_Catalogue_4SM.csv` directory

st_RF_SC_4SM.m

Code Type: MATLAB - Script
Code author: KT Prajwal Prathiksh
Created on: 26/04/2020
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Description:
This script generates the Reference Star Catalogue as required by 4-Star Matching Algorithm, which has the following columns:

1. **SSP_ID_1** - The SSP-ID of i^{th} star
2. **SSP_ID_2** - The SSP-ID of j^{th} star
3. **K_Vec** - The K-Vector value determined uniquely using the dot product of the Cartesian unit vector corresponding to the i^{th} and j^{th} star $(i \neq j, \forall\, i, j)$

Note: This script should be run only by **st_constants_4SM.m**! The script will throw an error if run by itself!
Formula & References: –
Input parameters: –
Output:

1. Writes Reference Star Catalogue in `./Star_Matching/4_Star_Matching/Preprocessing/Output/st_Reference_Star_Catalogue_4SM.csv` directory

st_gnrt_K_Vec.m

Code Type: MATLAB - Function
Code author: KT Prajwal Prathiksh
Created on: 26/04/2020
Last modified: –/–/—-
Reviewed by: NOT YET REVIEWED!
Description:
This function generates the K-Vector for a given array.
Formula & References:
Reference: The original k-vector searching technique - Mortari, D. Neta, Beny. (2000). *k-Vector Range Searching Technique.* 105.
Input parameters:

1. **c_y** : ((N, 1) - Matrix) - The array for which K-vector has to be generated

2. **st_M_EPS** : (Float) - The machine epsilon of the platform where the algorithm will be executed

3. **is_sorted** : (boolean) - If true, implies the array is sorted

Output:

1. **K_Vec** : ((N, 1) - Matrix) - The K-vector of the given array

2. **st_M** : (Float) - The slope of the Z-vector line

3. **st_Q** : (Float) - The y-intercept of the Z-vector line

4. **I_Vec** : ((N, 1) - Matrix) - The integer vector associated with sorting