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README - Tracking Mode Algorithm : Preprocessing

Guidance, Navigation and Controls Subsystem

sm_constants_TM.m

Code Type: MATLAB - Script

Code author: Pranjal Gupta

Created on: 10/08/2020

Last modified: 27/09/2020

Reviewed by: NOT YET REVIEWED!

Description: This script generated all the constants required for the Tracking Mode Algorithm and the Star Neighbourhood Table. It saves the Star Neighbourhood Table, the guide star and preprocessed star catalogues and the values of the constants. The constants are as follows:

1. **sm_TM_SNT_R:** (Float) The radius used for generating the Star Neighbourhood Table. Units in *deg*.
2. **sm_TM_RBM_R:** (Float) The radius used for the Radius Based Matching Algorithm. Units in *deg*.
3. **sm_TM_CP_F:** (Float) Focal length of the star sensor. Units in *cm*.
4. **sm_TM_FOV_x:** (Float) Length of the sensor Field-of-View. Units in *cm*.
5. **sm_TM_FOV_y:** (Float) Breadth of the sensor Field-of-View. Units in *cm*.
6. **sm_TM_Nth:** (Int) Minimum number of stars required for satisfying the accuracy requirement of attitude. *unitless*

Formula & References:

Input parameters:

The input arguments to the function must be written here. The format would

1. **write_csv :** (Boolean) - If true, saves the Star Neighbourhood Table as a CSV file.

Output:

1. Writes constants in `./Star_Matching/Tracking_Mode/Preprocessing/Output/sm_constants_TM.mat` directory. The `.mat` file contains the following variables:
 - (a) `sm_consts_TM:sm_TM_SNT_R, sm_TM_RBM_R, sm_TM_CP_F, sm_TM_FOV_x, sm_TM_FOV_y, sm_TM_Nth`
 - (b) `sm_TM_SNT`: contains the Star Neighbourhood Table

(c) `sm_catalogues` : stores the Guide Star Catalogue (`sm_GD_SC`) and the Preprocessed Star Catalogue (`sm_PP_SC`)

2. Writes the Star Neighbourhood Table in `./Star_Matching/Tracking_Mode/Preprocessing/Output/sm_Star_Neighbourhood_Table_TM.csv` directory.

sm_TM_SNT_main.m

Code Type: MATLAB - Script

Code author: Pranjal Gupta

Created on: 10/08/2020

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Description: This script generates and saves the Star Neighbourhood Table required by the Tracking Mode Algorithm. The first column of the table stores the SSP IDs from the Guide Star Catalogue, and the remaining columns store the SSP IDs of the stars in the neighbourhood of the star in the first column. Since the number of neighbours for every star may not be the same, the stars with less number of neighbours than the maximum number are padded with zeros in the end, to ensure a uniform size of the table.

NOTE : This script should only be run through `sm_constants_TM.m` ! The script will throw an error if run independently.

Formula & References:

Input parameters:

Output:

1. Writes the Star Neighbourhood Table in `./Star_Matching/Tracking_Mode/Preprocessing/Output/sm_Star_Neighbourhood_Table_TM.csv` directory.

sm_TM_gnrt_SNT.m

Code Type: MATLAB - Function

Code author: Pranjal Gupta

Created on: 10/08/2020

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Description: This function generates the Star Neighbourhood Matrix given a Radius value (in either degrees or unitless (implies that the value is cosine of an angle)).

Formula & References: Reference : Recursive Mode Star Identification Algorithms - M.A Samaan, D.Mortari, J.L Junkins (2005). *Star Neighbourhood Table*.

Input parameters:

1. `sm_consts_TM`: (binary .mat file) - This binary MATLAB file contains all the constants required in the Tracking Mode algorithm (the current function requires the SNT Radius, Guide star catalogue and Preprocessed Star catalogue).
2. `is_degree` : (Boolean) - If true, implies that the unit of Radius value is degree.

Output:

1. `sm_TM_SNT` : ((5060, N) - Matrix) - The Star Neighbourhood Matrix. Here N refers to the maximum number of neighbours detected around a particular Guide star.

sm_TM_SNT_neighbours.m

Code Type: MATLAB - Function

Code author: Pranjal Gupta

Created on: 10/08/2020

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Reviewed by: NOT YET REVIEWED!

Description: For a given Guide star, this function finds other Guide stars in the neighbourhood of the given star by searching within a specified radius value (sm_TM_SNT_R) around it.

Formula & References:

Input parameters:

1. **sm_star_ID** : (Integer) - The SSP_ID of the star around which neighbours are found.
2. **sm_consts_TM**: (binary .mat file) - This binary MATLAB file contains all the constants required in the Tracking Mode algorithm (the current function requires the SNT Radius and the Preprocessed Star catalogue).
3. **is_degree** : (Boolean) - If true, implies that the unit of Radius value is degree.

Output:

1. **sm_TM_SNT_vec** : ((1, N) - Vector) - The Star Neighbourhood Row vector corresponding to the given star sm_star_ID.

sm_TM_SNT_padding.m

Code Type: MATLAB - Function

Code author: Pranjal Gupta

Created on: 10/08/2020

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Reviewed by: NOT YET REVIEWED!

Description: This function concatenates a given Star Neighbourhood Row vector with the (incomplete) Star Neighbourhood Matrix and adds zero padding to either the Star Neighbourhood Row vector or the Star Neighbourhood Matrix if required, to generate the (complete) Star Neighbourhood Matrix. If the length of sm_TM_SNT_vec is more than the number of columns in sm_TM_SNT, then sm_TM_SNT is padded, otherwise sm_TM_SNT_vec is padded.

Formula & References:

Input parameters:

1. **sm_TM_SNT_vec** : ((1,N) - Vector) - The Star Neighbourhood Row vector corresponding to a single star and a given radius.
2. **sm_TM_SNT** : ((M,N) - Matrix) - The (incomplete) Star Neighbourhood Matrix

Output:

1. **sm_TM_SNT** : ((5060, N) - Matrix) - The (complete) Star Neighbourhood Matrix