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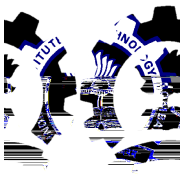

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# README - sm.m

Guidance, Navigation and Controls Subsystem

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## sm_TM_main.m()

**Code author:** Pranjal Gupta
**Created on:** 18/01/2021
**Last modified:** 18/01/2021
**Reviwed by:** NOT YET REVIEWED
**Description:**
This is the main script of the Tracking Mode algorithm, which calls the three blocks (Centroid Prediction (CP), Radius Based Matching (RBM) and the Star Neighbourhood Table (SNT)) in accordance with the main flowchart for the algorithm.
**Formula & References:**
**Input parameters:**
The input arguments to the function must be written here. The format would

1. **fe_output** : ((N,2) - Matrix) - The output matrix from Feature Extraction containing the centroids obtained from the image at an instant.
2. **sm_output_curr** : ((M,3) - Matrix) - The Star Matching output at the $K^{th}$ iteration, containing the (x,y) coordinates in the first two columns and the Star ID in the third column.
3. **sm_output_prev** : ((O,3) - Matrix) - The Star Matching output at the $(K-1)^{th}$ iteration, containing the (x,y) coordinates in the first two columns and the Star ID in the third column.
4. **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 Focal Length, FOV width, RBM Radius, CP radius and $N_{th}$).
5. **sm_TM_SNT** : ((5060, N) - Matrix) - The Star Neighbourhood Table
6. **sm_catalogues** : (binary .mat file) - Contains the Guide star catalogue and the Preprocessed Star Catalogue

**Output:**

1. **sm_output** : ((K,4) - Matrix) - The final output of the Star Matching block (operating in Tracking Mode). Contains the Star IDs and the corresponding star unit vector from the Guide Star Catalogue.

## sm_TM_CP_main()

**Code author:** Pranjal Gupta
**Created on:** 15/10/2020
**Last modified:** 15/10/2020
**Reviwed by:** NOT YET REVIEWED
**Description:**
This script deploys centroid prediction (and angular velocity estimation) at the $(K+1)^{th}$ frame given the common centroids among the $(K-1)^{th}$ and $(K)^{th}$ frames.
**Formula & References:**
Refer Mark Knutson's thesis containg the matrix calculations for centroid prediction.
**Input parameters:**

1. **sm_TM_CP_prevmat** : ((N,2) - Matrix) - The common centroids from the Feature extraction output at the $(K-1)^{th}$ iteration, containing the (x,y) coordinates of the centroids.
2. **sm_TM_CP_prevmat** : ((N,2) - Matrix) - The common centroids from the Feature extraction output at the $(K)^{th}$ iteration, containing the (x,y) coordinates of the centroids.
3. **sm_TM_CP_F** : (double) - The focal length of the star sensor (Units - cm)

**Output:**

1. **sm_TM_CP_predmat** : ((N,2) - Matrix) - The predicted centroids at the $(K+1)^{th}$ frame.

## sm_TM_RBM_main()

**Code author:** Pranjal Gupta
**Created on:** 24/09/2020
**Last modified:** 24/09/2020
**Reviwed by:** NOT YET REVIEWED
**Description:**
This script deploys Radius Based Matching to match the true centroids (obtained from feature extraction) to the predicted centroids (obtained from the CP block).
**Formula & References:**
**Input parameters:**

1. **sm_TM_RBM_predmat** : ((N,2) - Matrix) - The predicted centroids at the $(K+1)^{th}$ frame.
2. **sm_TM_RBM_truemat** : ((M,2) - Matrix) - The true centroids at the $(K+1)^{th}$ frame obtained from feature extraction.
3. **sm_TM_RBM_R** : (double) - The radius value to be used for carrying out Radius based matching between predicted and true centroids (Units - cm)
4. **is_dx** : (boolean) - if True : predicted and true centroids are sorted according to their x-coordinates
5. **sort_before_match** : (boolean) - if True : Implement sorting before matching optimisation algorithm (to carry out faster RBM)

**Output:**

1. **sm_TM_RBM_matchmat** : ((L,4) - Matrix) - The matrix of matched true and predicted centroids

## sm_TM_CP_jacobian()

**Code author:** Pranjal Gupta
**Created on:** 15/10/2020
**Last modified:** 15/10/2020
**Reviwed by:** NOT YET REVIEWED
**Description:**
Constructs the Jacobian Matrix given a set of centroids and star sensor's focal length
**Formula & References:**
**Input parameters:**

1. **n_centroid** : (int) - Number of common centroids among the $(K)^{th}$ and the $(K-1)^{th}$ frame.
2. **sm_TM_CP_F** : (double) - The focal length of the star sensor (Units - cm)

**Output:**

1. **m_A** : ((2N,3) - Matrix) - Jacobian Matrix constructed using the Focal Length and the u,v coordinates from the set of centroids