

# Cluster 257

March 5, 2025

## 1 Identifying Genuine cluster members with 3D Monte-Carlo simulation and HDBSCAN

This is an auto generated report for Cluster 257.

It shows methodology for identifying genuine cluster members with 3D Monte-Carlo Simulation and HDBSCAN\*. Similar reports have been generated for all analyzed clusters.

### 1.1 Determination of membership cut-off from membership distribution

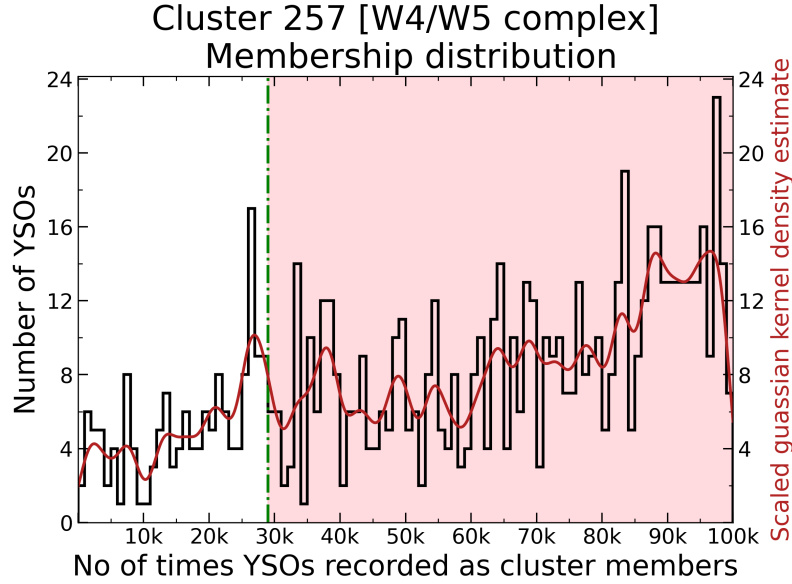


Figure 1: Distribution of YSO membership for 100,000 iterations of HDBSCAN\* for 257

Monte-Carlo threshold (green dash-dotted line): 29000

Number of members above threshold in run 6 of HDBSCAN-MC: 628

### 1.2 Identifying common members across 10 runs HDBSCAN-MC

Figure 2 shows stability of HDBSCAN-MC across 10 runs. The common members across all runs will be considered for further analysis

### HDBSCAN-MC Stability Test: Cluster 257 [W4/W5 complex]

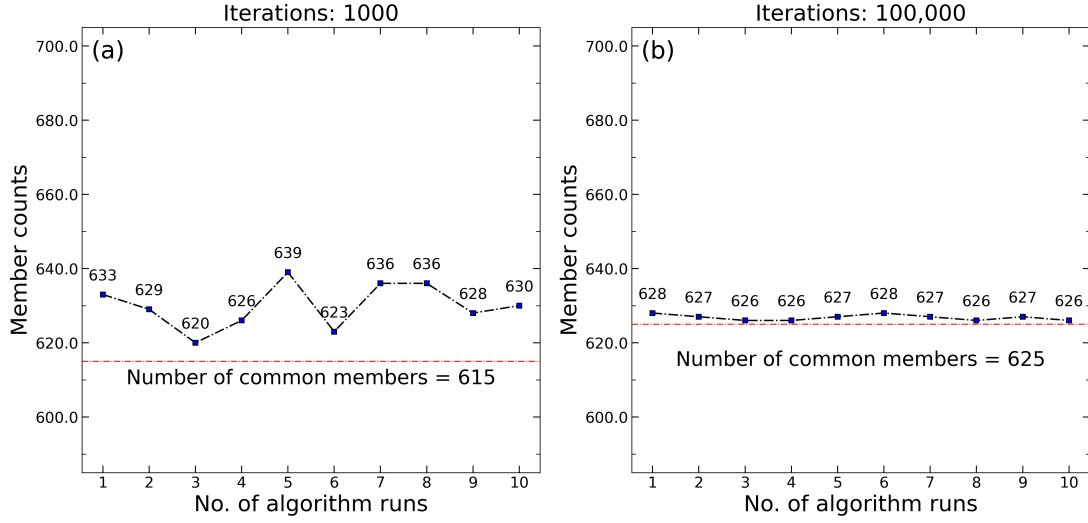


Figure 2: Stability Test for identification of HDBSCAN-MC algorithm across 10 runs. Common members across various runs are taken as final members

### 1.3 Viewing identified genuine cluster members in astrometric space.

Figure 3 shows final identified members in astrometric space along with Gaia color-color diagram.

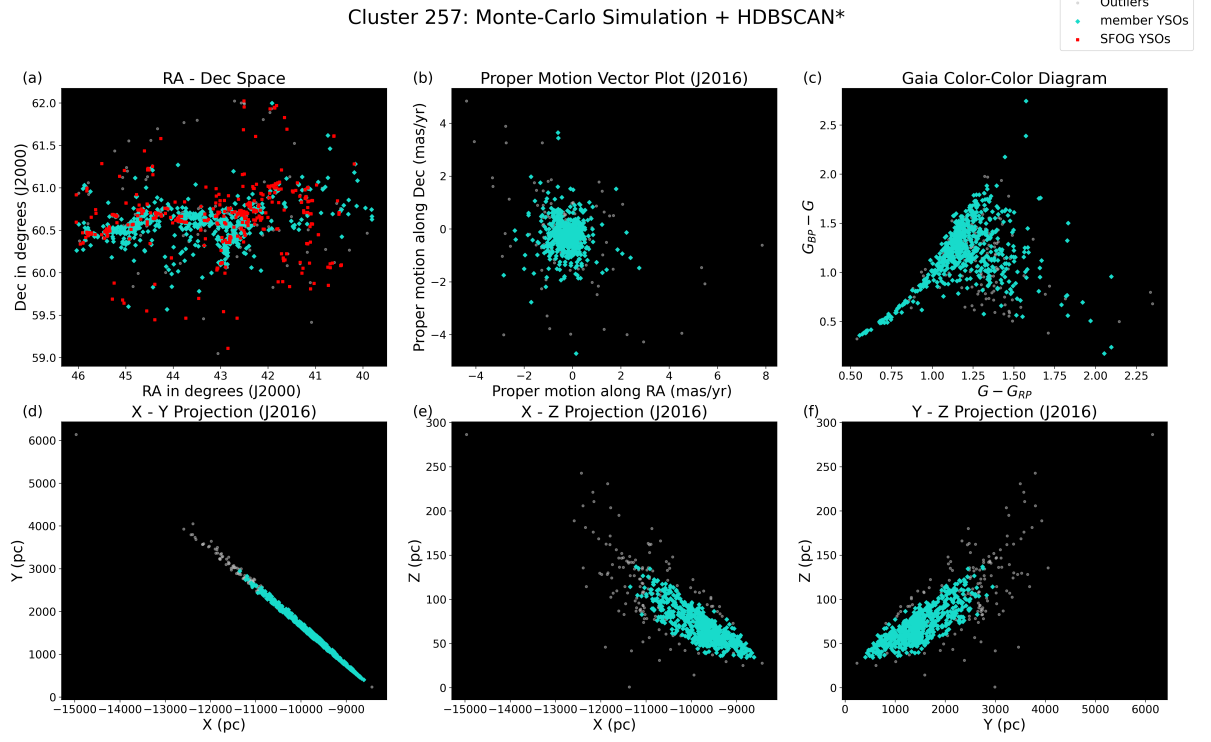


Figure 3: Astrometric analysis by application of HDBSCAN-MC for Cluster 257

## 1.4 Summarizing Cluster Statistics

Cluster Statistics	
Median Distance	2108 pc +/- 798 pc
Mean Distance	2174 pc +/- 798 pc
Kinematic Distance (Winston et.al. 2020)	2000 pc +/- 400 pc
Simulation predicted distance estimate	2158 pc +/- 180 pc
No. of Gaia matched SFOG YSOs	605 out of 761
No. of Gaia only YSOs	11 out of 18
Total cluster members (with Gaia counterparts)	616 out of 779
Predicted false positives	187 out of 616
New Gaia-matches SFOG members	324
SFOG only YSOs in region	450
SFOG cluster members as reported in Winston et.al. (2020)	632
No. of outlier in Winston et.al. (2020) SFOG cluster members	50
Cluster $\beta$ value	0.7371

## 1.5 Proper Motion Analysis

Figure 4 shows direction distribution of proper motion vectors for identified cluster members. The angle is measured from positive x-axis. The proper motion magnitude distribution is given by Figure 5.

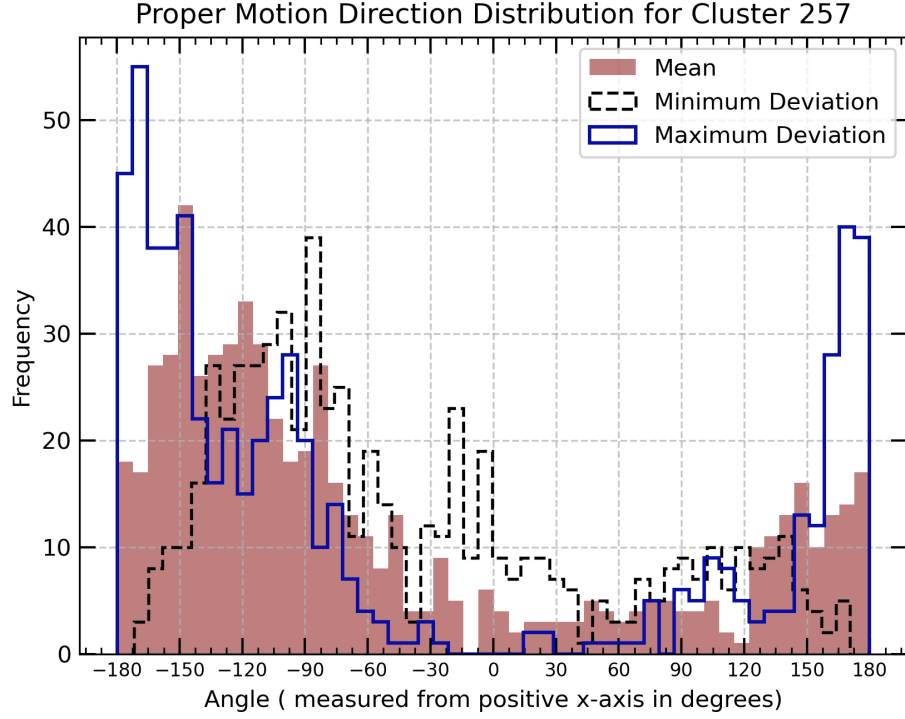


Figure 4: Proper motion direction distribution for Cluster 257

## 1.6 Cluster simulation

The table below gives weighted parameters and unbiased weighted standard deviation obtained from optimization process. The weighted parameters are calculated using optimized parameter sets having MSD less than three times best-fit solution.

Iteration	center_dist	mem_frac	noise_lower	noise_upper	c	pm_scale	MSD
	2158 pc +/- 180 pc	57.352 +/- 3.675	803.502 +/- 216.246	3757.489 +/- 313.854	619.323 +/- 158.306	4481.781 +/- 641.264	
5	2379.0	58.0	561.0	3878.0	579.0	5689.0	242.2935
14	1963.0	59.0	715.0	3582.0	688.0	4158.0	268.1343
25	1994.0	59.0	1040.0	3531.0	532.0	4094.0	333.5025
12	2265.0	61.0	1089.0	3706.0	563.0	4825.0	426.5522
24	1925.0	57.0	971.0	3365.0	478.0	3773.0	430.7413
17	2276.0	50.0	710.0	3601.0	558.0	4391.0	464.0796
18	2331.0	60.0	903.0	4455.0	966.0	4583.0	477.3532
13	2215.0	54.0	634.0	4028.0	621.0	4700.0	483.3831
6	2269.0	52.0	458.0	4245.0	763.0	4384.0	519.8756
23	1931.0	58.0	627.0	3764.0	628.0	3672.0	527.3333
11	2306.0	65.0	1097.0	3463.0	580.0	5104.0	638.995
27	2248.0	54.0	1003.0	3898.0	258.0	4312.0	648.01
8	1967.0	56.0	898.0	3404.0	864.0	3650.0	677.7761

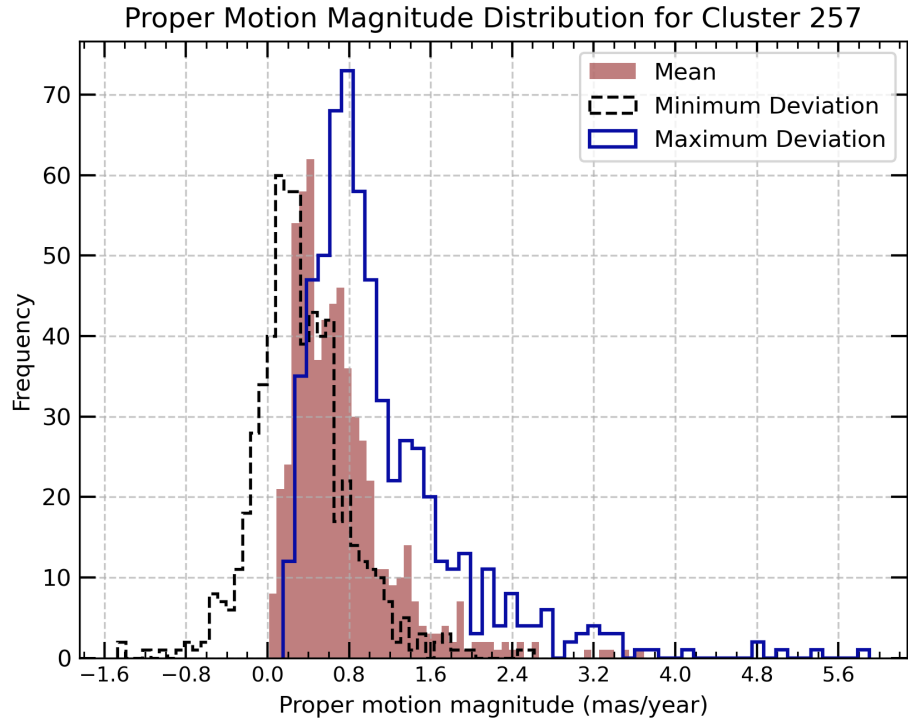


Figure 5: Proper motion magnitude distribution for Cluster 257

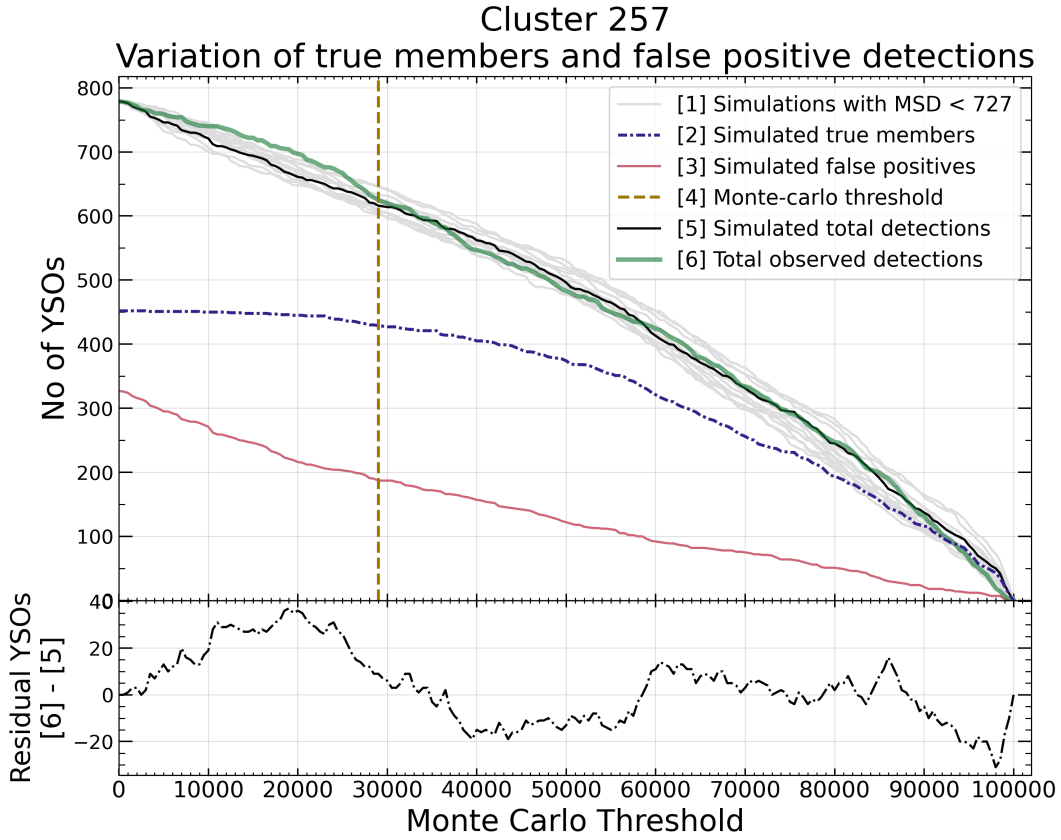


Figure 6: Monte Carlo spectra and simulation result for Cluster 257