Post-Bandmerge Utilities Applied to Spitzer Pleiades Data

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ABSTRACT

Bandmerging extracted point sources observed in multiple wavelengths is generally done purely on the basis of positional information in order to avoid photometric biases. Automated merge decisions can be optimized with better position estimation and more realistic modeling of position estimation errors. Unfortunately, extraction software often does not provide the most accurate position information possible, and so post-bandmerge utilities have been developed and implemented to refine both the source positions and the error modeling. Subsequent bandmerging of the refined data shows improved completeness and reliability in the multi-band source catalog.

We demonstrate some aspects of this processing applied to Spitzer observations of the Pleiades region. "Before" versus "after" cases are presented to illustrate the improvements.

Keywords: image processing, mosaicking, bandmerging, Pleiades star cluster, Spitzer Space Telescope, infrared, astronomy

SPITZER THREE-COLOR MAP OF THE PLEIADES-STAR-CLUSTER REGION

Data courtesy of John Stauffer.

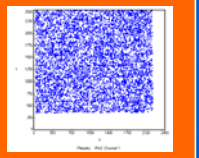
This image is comprised of three single-color mosaics, each of which were separately generated by the SSC's Mopex pipeline from Spitzer-Space-Telescope Infrared-Array-Camera (IRAC) data. The cluster, also known as the Seven Sisters and Messier 45, contains hundreds of stars, but only a handful can be seen by the unaided eye. The entire scene contains thousands of stars and galaxies, and a lot of dust that is readily apparent at longer infrared wavelengths.

IRAC channels 1, 2 , and 4 are shown in the blue, green, and red planes, respectively. The SSC's bandbmerge pipeline found 11,371 point sources that could be merged. Subsequent refined processing using the SSC's post-bandmerge utilities allowed only 11,330 merged point sources (more and higher-quality merging, with fewer output sources).

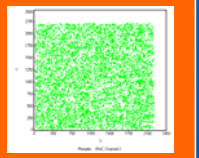
POINT SOURCES EXTRACTED IN THE FOUR IRAC CHANNELS

Usable point sources:

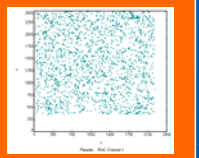
7513



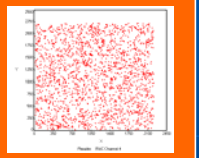
6957



2019



1999



MEAN POSITION OFFSETS OF BANDS 2-4 RELATIVE TO BAND 1 (COMPUTED FROM BANDMERGE STATISTICS BY "GETOFF" UTILITY)

Band	Position dimension	Average offset	One-sigma uncertainty
1-2	X	-0.0369027	0.0030732
1-3	X	0.0653348	0.0067817
1-4	X	0.1513996	0.0096618
1-2	Y	-0.0227577	0.0032733
1-3	Y	0.0308619	0.0069941
1-4	Y	0.0138223	0.0097985

Band	Average position sigma			
	Before		After	
	X	Y	X	Y
1	0.205201	0.199551	0.174618	0.170097
2	0.194868	0.197862	0.132288	0.160856
3	0.181131	0.194612	0.282522	0.288267
4	0.351555	0.341910	0.473487	0.460372

Data units are mosaic pixels (~1.2 arcseconds per side).

The position offsets are subtracted from the detections in bands 2-4, and the uncertainties are adjusted to give average values equal to the recomputed values above. Then another bandmerge run is performed.

Data units for ave. and std. dev. values are mosaic pixels (~1.2 arcseconds per side).

BEFORE/AFTER INTER-BAND STATISTICS (MEAN POSITION DISCREPANCIES AND CHI-SQUARE VALUES)

	B-P	AveDX	AveDY	StdDevX	StdDevY	ChSqX	ChSqY	ChSqXY	NSum
Before:	1-2	-0.03788	-0.02522	0.21907	0.23411	0.41161	0.46603	0.87565	4743
	1-3	0.06738	0.04367	0.33213	0.33471	1.35252	1.29926	2.65369	1170
	1-4	0.17040	0.02944	0.50466	0.49079	1.37929	1.22884	2.60548	834
	2-3	0.09337	0.03768	0.31196	0.33011	0.95717	0.94334	1.90307	992
	2-4	0.18667	0.01456	0.47994	0.47722	2.02209	1.43937	3.47478	1018
	3-4	0.06891	-0.01142	0.37556	0.42162	0.87378	0.98559	1.85641	652
After:	1-2	-0.00081	-0.00188	0.20912	0.21273	0.76063	0.94136	1.70134	4751
	1-3	0.00456	0.02288	0.33349	0.38245	0.96237	0.98211	1.94875	1185
	1-4	0.02165	0.02018	0.51410	0.50644	0.93493	0.93828	1.87326	833
	2-3	-0.00301	-0.02370	0.32617	0.36626	0.88277	0.98109	1.86635	995
	2-4	-0.00335	-0.02540	0.49740	0.51890	0.72225	0.87970	1.60501	1019
	3-4	-0.02308	0.00798	0.38498	0.45440	0.61075	0.71369	1.32363	657

DISCUSSION OF BEFORE/AFTER CASES

Case 1. Typical case of a slightly better fit with the same detections involved; the refined processing actually picked up weak links from band 4 to another in band 1 and another in band 2, so it has same result with tighter fit but warning information in its confusion status.

Case 2. Another typical case like the above, but here, the refined processing moves the band-1 and band-2 detections from outside both 1-sigma contours for bands 3 and 4 to inside of both.

Case 3. Merged links are shown here as black lines joining detection centers. There are badly underestimated uncertainties in bands 3 and 4; two nearby sources in band 1, which are bright, but not nearly as bright as the one merged after refined processing, which was missed before. Obtained nineteen post-refinement sources containing detections in all four bands, which were missing a detection in the pre-refinement merge. There are no cases in which a detection is lost from a source as a result of the position refinement.

Case 4. Similar to above, but no disturbing detections in the neighborhood, and the oddball match is from band 3, not band 1.