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HST/ACS Associations: the Next Step after WFPC2

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Abstract. After the release of the successful WFPC2 associations, the CADC, ST-ECF and STScI are now working on joint pipeline software to produce associations of images from the HST's Advanced Camera for Surveys instrument.

Although the basic approach is very similar to the WFPC2 associations (Durand et al., 2004) there are some fundamental differences because of the high level of geometric distortion of the ACS optics. The core of the ACS association pipeline will perform image combination using the Drizzle method and hence there will be no need to constrain the position angle of associated observations as was done with WFPC2. Our goals are the production of high quality products for the HST archive users and eventual 'publication' of these products within the Virtual Observatory.

1. Introduction

Associations are groups of images taken of the same region of the sky and with compatible instrument modes which can be combined to create a useful static high-level science data product for access through an archive interface. The CADC and ST-ECF have already collaborated on the production of associations of images from the Hubble Wide Field Planetary Camera 2 (WFPC2) (Micol et al. 2000) and are now working on defining similar products from the Advanced Camera for Surveys (ACS). This paper outlines how these associations

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will be defined, combined and designed for future access through the Virtual Observatory.

Associations greatly facilitate archive browsing and are intended for immediate science usage as great care is taken to ensure faithful astrometric and photometric products. Associations are also uniform and well described and include supplementary products such as weight maps and appropriate PSF images.

2. Definition of Associations

For ACS the definition of associations is more relaxed than that for WFPC2 as more sophisticated software is available for the image combination stage. We require only that observations were made with the same filter and that they are within a specified radius of each other on the sky (currently 480 arcsecs). They may come from different programs and there are no roll-angle restrictions. This definition, which may be extended, includes as subsets the standard STScI associations which are defined on the basic of observation plans made at Phase II, but also allows for many other, more extensive, data groupings.

3. Pipeline Processing

A pipeline is being assembled to automate the preparation of ACS associations. The first step is the construction of the associations from the observing log. This step also involves the deconstruction of the STScI associations which group datasets from the same proposal and visit. Data files for the association are then run through the standard CALACS pipeline, using the best reference files, and drizzled (Fruchter & Hook 2002) to remove geometrical distortion. Shifts between images are then determined, either through catalog-based approaches or by using cross correlation. The cosmic-rays and other defects are then detected and flagged and the images stacked into clean combined data products, either using the MultiDrizzle script (Koekemoer et al. 2002) or using the artificial skepticism method developed by Stetson.

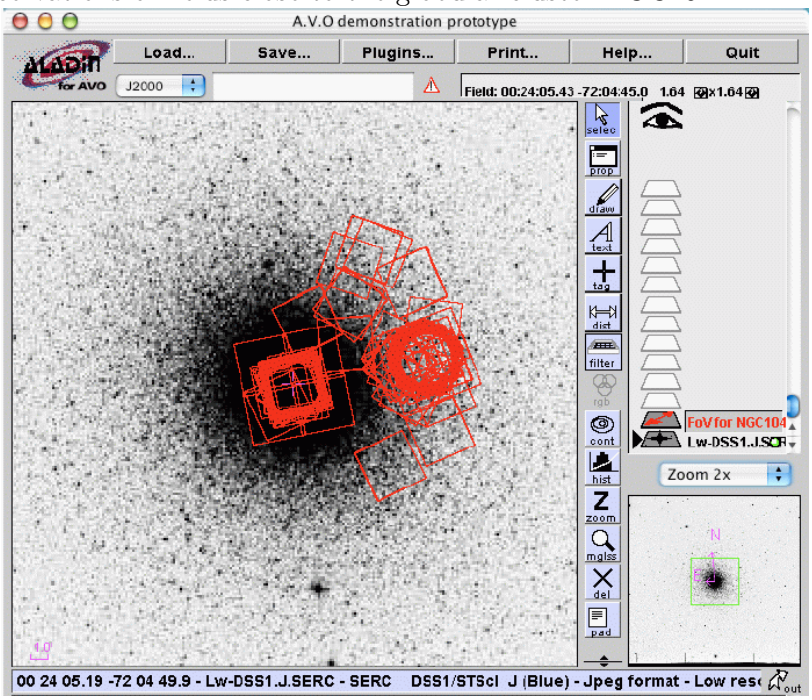
Once a clean combined image has been produced by the pipeline the image contents will be characterized and source catalogs created. It is also intended to create appropriate PSFs for objects in the image using Tiny Tim (Krist 1995) to simulate point objects in the input frames and to combine them to create appropriate output PSFs by repeating the drizzle commands with the PSF images.

The final stages of association processing are the saving of all output products and the ingestion into the CADC storage system and subsequent publication within the Canadian Virtual Observatory and others.

4. Statistics

As of July 2003 there were more than 3000 ACS associations defined, having a total of more than 22000 members. Table 1 shows the histogram of how many associations have a certain number of members. A very complex association is

Figure 1. An Example of a Complex Association of ACS Images. Observations of fields close to the globular cluster NGC104



shown graphically in Figure 1. At present the full processing of a three member association takes about 40 minutes on a 1.8GHz Linux machine with 2GB of memory. This includes the conversion of POD files to RAW files and processing through CALACS and MultiDrizzle.

5. Quality Assessment

Quality assurance is a very important step. Photometry obtained from catalogs of association data products will be compared to external catalogs available in published results. Absolute astrometry will be limited to the precision of available catalogs (e.g., GSC2) but relative astrometry will be much more precise. Detailed comparisons of the relative merits of MultiDrizzle and Stetson's 'artificial skepticism' methods will be made.

6. Conclusions

Once the ACS associations are made available, probably in Summer 2004, the pipeline will allow us to make available deeper and more uniform data products, offer a faster turn-around time for delivery and make ACS products available through the Canadian and other virtual observatory access points.

Table 1. ACS Association Statistics

Images	Assocs	Images	Assocs	Images	Assocs	Images	Assocs
2	1211	23	7	45	2	86	2
3	378	24	18	46	1	92	3
4	378	25	6	48	4	103	1
5	132	26	5	50	6	116	1
6	190	27	6	51	2	120	2
7	46	28	5	52	4	134	1
8	189	29	4	53	1	140	1
9	39	30	7	54	1	149	1
10	77	31	2	56	2	172	1
11	26	32	27	58	1	211	1
12	50	33	4	63	1	278	1
13	12	34	4	64	7	584	1
14	21	35	5	66	1		
15	12	36	6	67	1		
16	52	37	5	68	1		
17	12	38	5	70	2		
18	18	39	1	72	2		
19	3	40	6	73	1		
20	16	41	2	76	1		
21	9	42	2	78	1		
22	6	44	3	82	1		

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