SCIENCE POTENTIAL FOR THE HUBBLE SOURCE CATALOG

Steve Lubow
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BUILDING CATALOG

• Determine mosaics

• Determine nearby source pairs with some threshold separation

• Minimize pair separations by adjusting image positions (astrometric correction)

• Determine matching sources across images

• Build catalog
PROPERTIES OF MATCHES

• First correct astrometry, then determine matching sources.

• Distribution of positional sigma for matches involving more than one visit.

• Astrometric corrections made for about half the WFPC2 and ACS/WFC images

• Matches cover a broad range of times (hours to 17 y) and filters
FLUX DIFFERENCE DISTRIBUTION

- Matching based only on position
- Consider pairs of sources in same match with same instrument/detector/filter
- Determine flux distribution difference
- Most pairs have small flux differences, a few percent. So, few false matches.
- What accounts for large flux differences?
LARGE FLUX DIFFERENCES

- Preliminary investigation of > 2X flux variations
- Time spans from hours to years
- Some sources have real time variations
- Others involve random matches due to bad image alignment, sources contaminated with CRs, etc.

Cases With > 2X Flux Differences
TIME VARIABLE SOURCES

• Examined some matches with large flux variations
• Some appear real
• Example show evidence \( \sim \) 1000 min variations in 2 filters
• Nearby sources shows much smaller variations (e.g., Match A)
USE CASES

• A few examples to show science potential and test catalog accuracy/completeness.

• Demonstrate current capabilities and areas for improvement in data and tools.

• Does the catalog recover/discover variable objects?

• Can the catalog be used for photometry?
TIME VARIABILITY

- Forms search for supernova progenitor by position
  - Bright SN2004DG. Found in single epoch ACS. Not found at earlier epoch covered by WFPC2.

- Forms search for known supernova by position
  - Faint SN Thames (Riess, Strolger, et al 2007). Detected changes in brightness, position, and CI.
  - Several SN not found.

- Database search for objects with large flux variations.
  - Find some GRBs
  - Also find various problems: poorly aligned images, etc.
Object name: SN2004DG resolved by NED (via SANTA cache) to SN 2004dg (SN)
RA: 14 59 58.96 Dec: 1 53 25.58 (J2000)

number of rows returned = 10

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March 2005

July 2001
SN THAMES

- Forms search based on known position
- Select filter F850LP
- Change in mag, d (position offset), and CI (concentration index)
- Drop off in follow-on observations
- Several other cases not found, e.g., SN too far from galaxy
- Can we find others? All sky search based on mag, d, and CI changes?
• Database search for flux changes > 2x, point sources, within 10 mas from match position

• 4K records of pairs: 9 records describe 4 GRBs

• 600 records of pairs with extreme flux variations > 10x. Includes bad images and GRB021004. What else is there?
COMPARISON OF HSC AND UDF

- HSC goes to about 25 mag.
- ~0.14 mag photometric offset
- Colors agree well
UDF FIELD

- Illustrates problems with current source lists
- Also possibly matching limited by too fine a scale.
LIMITATIONS

• About 50% of Images have astrometric corrections
  - About 80% of images have source lists
  - About 40% of images with source lists have no astrometric corrections
  - Of these, about 60% are nonoverlapping and so cannot be improved. Will get better with more instruments, e.g., WFC3.
  - Some not corrected because offset too large (to be improved in future)

• Source list quality limited
  - Lack of consistency in detections
  - Problems with subtracting background, edge effects, etc.
  - Large absolute astrometric errors ~ 1 arc-sec still present in some images. May improve with new astrometry initiative.
  - WFC3 source lists much improved. Plan similar improvements for ACS and WFPC2.

• Matching of sources is conservative (few false matches)
  - Cases of nearby matches that should be merged (nearly same flux)
  - Need to adjust parameters or alter the algorithm
PLANS

• Improve Source Lists
  - Run improved software for WFPC2 and ACS
  - Apply improved absolute astrometric corrections

• Adjust astrometric correction parameters and matching parameters

• Include WFC3

• Explore cases of large flux variations and fix/reject bad images.

• SQL CASJobs Interface

• Develop more use cases