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The Status of the Second Generation Digitized Sky Survey and Guide Star Catalog

B. J. McLean, G. R. Greene

Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218

M. G. Lattanzi

Osservatorio Astronomico di Torino, Strada Osservatorio 20, I-10025 Pino Torinese (TO), Italy

B. Pirenne

ESO/ST-ECF, Karl-Schwarzschild-Strasse 2, D-85748, Germany

Abstract. The STScI is continuing its program to create data products and tools to increase the efficiency of observation planning and telescope operations. These include an long-term commitment to digitize, and distribute to the community, the second generation Schmidt plate surveys for both the Northern (POSS-II) and Southern (SES) hemispheres as an extension to the published Digitized Sky Survey (DSS). In addition to providing the images, STScI is leading a consortium to create a second version of the Guide Star Catalog (GSC-II) which will be used for both ground and space-based telescope operations.

1. Introduction

While the original Guide Star Catalog (GSC-I) was developed with the goal of increasing the efficiency of telescope operations and observation planning for HST, this catalog and its companion, the Digitized Sky Survey CDROM set (DSS-I), have proven to be key revolutionary tools to modern astronomy. The Catalogs and Surveys Branch of the STScI, which created and published the GSC-I and DSS-I (Lasker & Cannon 1990, Russell et al. 1990, Jenkner et al. 1990), has been working to provide second-generation versions of these products. Another set of more recent all-sky survey plates is being digitized at STScI, and the recent advances in computer technology have allowed us to process these images and create a much larger catalog of astronomical objects than before. A summary of available plate material and our current status is shown in Table 1.

Recognizing the importance of these products for telescope operations and planning tools, a number of international partners are collaborating with us and supporting our efforts with the DSS-II and/or GSC-II projects. These include OATo, ESO, GEMINI, ESA/ST-ECF, ESA/SA, CADC, CDS, AAO, NAOJ, BAO. A preliminary release of the GSC-II will be provided to the GEMINI and VLT telescopes at the end of this year, while an improved version with better calibrations will be made available to the community at the end of 2000.

Table 1. Summary of Digitized Survey Plates Available for GSC-II

Survey	Epoch	Band	Depth	Dec.Zones	N.Plates	Status[a]
Pal-QV	1983-85	V	19.5	+90:+06	613	100/100/100/0%
SERC-J	1975-87	J	23.0	−90:−20	606	100/99/100/92%
SERC-EJ	1979-88	J	23.0	−15:−00	288	100/99/100/92%
POSS-I	1950-58	E	20.0	+90:−30	935	100/100/99/2%
POSS-I	1950-58	O	21.0	+90:−30	935	100/2/0/0%
POSS-II	1987-98	J	22.5	+90:+00	894	100/100/99/99%
POSS-II	1987-99	R	20.8	+90:+00	894	100/100/98/100%
POSS-II	1987-xx	N	19.5	+90:+00	894	100/88/5/5%
AAO-SES	1990-99	R	22.0	−90:−20	606	100/100/94/91%
SERC-ER	1990-xx	R	22.0	−15:−00	288	100/88/85/91%
SERC-I	1990-xx	N	19.5	−90:−00	894	100/26/0/0%

[a]Observed/Scanned/Compressed/Processed Oct 1999

2. Digitized Sky Survey II

The originally published Digitized Sky Survey consisted of the Palomar POSS-I E survey and the SERC-J survey scanned at 25 micron resolution with modified PDS microdensitometers (Laidler et al. 1994). These have been substantially redesigned and modified to be multi-channel laser scanning machines and we are now scanning the additional plate material at 15 microns. STScI has negotiated access to the original plates of the POSS-II survey, and in partnership with the Anglo-Australian Observatory (AAO) undertook the Second Epoch Southern (SES) survey with the UK Schmidt (Lasker & Cannon 1990). In addition, we have begun scanning the SERC-I plates so that we will have the entire sky in at least 3 passbands (J, F, IV-N) and a sufficient baseline to determine proper motions. These data are being compressed using the same HCOMPRESS algorithm (White & Postman 1992) used for the published DSS-I and made available on a number of web servers around the world. The J and F bands are nearing completion and the I band will be completed by 2001. A decision on the format of a final distribution will depend on community interest.

3. Guide Star Catalog II

The GSC-II extends the GSC-I to fainter magnitude limits and consists of multiple epochs and bandpasses. These add significant value to the original catalogue by providing the necessary components to derive colours and proper motions for most objects. This all-sky catalog will contain an estimated 2 billion objects and will be complete to a magnitude of at least J=18 and as faint as J=21 at high galactic latitudes. These data are being loaded into an object-oriented database which is designed to allow easy recalibration of the data as better algorithms and data models are developed. The formal goals of the GSC-II are as follows:

- At least 2 epochs and passbands over entire sky,
- Limiting magnitude at least 18 (plate limited where possible),

- Positional accuracy 0.15 arcsec,
- Proper motion errors 5-20 mas /yr,
- Magnitude errors 0.2 mag,
- Classifications 95%.

Interim data deliveries (GSC 2.1.x) will be supplied for telescope operations over the next year whilst the final calibrations are derived and applied. The first general community release (GSC 2.2) will occur around the end of 2000, with a final version available (GSC 2.3) a year later. The published version of the catalog will be exported from our object database (described in section 4) as binary FITS tables for each HTM region on the sky (approximately 1 square degree). Access software to read entries from this distribution format has already been developed and integrated into a number of tools including ESO SKYCAT and STScI SEA.

4. COMPASS Database

We have developed an object-oriented database, COMPASS (Catalogs of Objects and Measured Parameters from All-Sky Surveys), built on the kernel of Objectivity/DB commercial system. This database is now into full production with the loading and cross-matching of catalogue data derived from image processed Schmidt photographic plates. There are clear advantages to object-oriented technology. Firstly, the hierarchical kernel of Objectivity easily scales to the estimated 4 TB of plate observations we intend to archive. Secondly, an oo database provides a very efficient methodology for establishing relationships between the variable physical representations of the stored observations and associated metadata. The primary utilization of the database is to provide rapid access to plate data for advanced astrometric and photometric calibrations as well as multi-plate operations that will yield colours and proper motions. The calibrations depend on the ability to do large scale transactions on many plates at a time to remove well-known systematic errors that are inherent to photographic plates. With this requirement, we have developed access methods to COMPASS that will allow global updates to all calibrated plate parameters.

Our other goal in the design of COMPASS is to promote database interoperability between GSC-II and other astronomical archives. Following the reasoning of having manageable amounts of data of roughly the same quantity as in the GSC-I custom database, the sky is partitioned into approximately equal areas using the Hierarchical Triangulated Mesh (HTM), a quad tree based on a spatial subdivision of the celestial sphere into approximately equal area spherical triangles (Barrett 1995). Each of the triangular subdivisions corresponds to an Objectivity database within the all-sky Federated database. This strategy has also been adopted by the SDSS Science Archive and 2MASS and is an ideal example for supporting interoperations between large-scale astronomical archives. The HTM can serve as a common identification basis for any user or agent selected spatial region of the sky. Within each triangular region database we are creating several containers: one for each plate to store the measured and calibrated parameters for each source; a container for each astronomical catalog with reference sources; and an Index container which has derived multi-plate parameters and links references to the same source in the plate and catalog containers. There will typically be 5-8 observations of the same source measured on different plates, and each plate will be split up among 50-60 region databases. Depending on the nature of the query, we can easily retrieve sources grouped by plate or region after determining the appropriate list of region databases containing the sources. Access to the source parameters is achieved by iterating over the index in each region database, retrieving the derived data or using the references to directly access the raw data from the individual plates.

5. Summary

At this time, most of the Digitized Sky Survey images are available via the web and we are continuing to scan the remaining available plates. Production processing of the images for construction of the GSC-II is also well advanced, and database operations are in progress. We expect to complete both of these projects within the next 18-24 months, and expect them to be as useful to the community as the original datasets.

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