

INVESTIGATION OF THE GUIDE STAR CATALOG

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Abstract. The Guide Star Catalog (GSC) was initially created at STScI to support the operational requirements of the Hubble Space Telescope (HST), specifically, to provide an all-sky set of reference coordinates for pointing and tracking. A new version of the catalog, GSC 1.1, includes bright stars from the HIPPARCOS INCA database. The GSC is widely used by the astronomical community for many different applications. Some results of the investigation of the GSC at the Moscow Center for Astronomical Data are presented here.

Key words: catalogs – data analysis

1. GSC

The main purpose of the creating the GSC was to provide the HST with a dense grid of objects distributed over the entire sky from which guide stars for telescope control could be chosen. The GSC is thus the deepest and most complete all-sky photometric survey, containing magnitudes and positions, which are accurate to about 1 arc-second, for approximately 20 million astronomical objects brighter than 13 to 15 mag. The GSC is a unique catalog for many astronomical studies; however, its potential still cannot be fully realized. At present the GSC lacks even rudimentary cross-identifications with other astronomical catalogs, and consequently little is known either about the nature of GSC objects themselves or their relationship with other data already catalogued and available independently in machine-readable form. The work that we report here is an essential step toward a general availability of the scientific potential of the GSC (for previous analogous study, see Preite-Martinez & Ochsenbein 1993).

2. SOFTWARE DEVELOPMENT FOR READING THE GSC

The distribution format of the catalog (a set of two CD ROMs) requires minimum hardware and it is well suited for all sorts of conditions, especially observations. Unfortunately, the actual data in the catalog is not easily accessible. It is stored in the form of FITS tables, and the coordinates are given in a single standard system (J2000.0). To help PC users solve the problem of data retrieval, we have developed the Guide Star Catalog Data Retrieval Software, or GUIDARES. This is a user friendly program allowing easy extraction of text samples from the catalog and generation of sky maps in Aitoff or celestial projections. The main purpose of GUIDARES is to produce an ASCII table of object entries within a specified area and, optionally, a graphical sky map for a certain area. The GUIDARES package allows one to retrieve GSC samples and generate simulated charts for circular or rectangular areas specified in one of four coordinate systems (equatorial, ecliptic, galactic, supergalactic), and provides various useful options for handling of multiple object entries, retrieving only objects of a particular type or within a particular range of magnitudes, etc.

Moreover, we have created a compressed version of the GSC, called ZGSC. We used a binary format and an adaptive compression algorithm to compress the GSC by a factor of 6 without any loss of information, giving the ZGSC a total size of about 200 Mb. This makes it possible to store the ZGSC on-line on a hard disk. We have developed an extensive software package to work with the ZGSC. This includes a C library under Unix that provides functionality similar to that of the GUIDARES package, a set of IDL routines that retrieve data from the ZGSC into IDL arrays, and XSKYMAP – a graphical IDL application for visualization of the ZGSC.

In addition, we have developed a WWW interface to the ZGSC allowing a quick visualization of data from ZGSC over the WWW. Using a forms-capable WWW browser, such as NCSA Mosaic or Netscape, the user may define an area in any coordinate system, and receive either a GIF or JPEG image of the selected area reconstructed from the ZGSC, or a ZGSC sampling of the selected area in ASCII, FITS ASCII table, or FITS BINTABLE format.

3. RGSC

One of our goals is to create a new version of the GSC, the Refined GSC (RGSC). For each object, each RGSC entry will contain a complete GSC entry for the star, plus additional information about the nature of the object and a statistical estimate of reliability.

The GSC is refined using various methods. First, objects are cross-identified with existing specialized catalogs. As a result, a set of relationships between the GSC data and the true nature of the object is established. Second, the distribution of objects of different nature according to coordinate and magnitude is used to create "probability maps", which can help in estimation of the probability that a particular object belongs to a particular class. Third, there is multiplate analysis which is based on the fact that many GSC objects are registered on several plates, and thus have multiple entries in the catalog, which can be compared to produce additional constraints in the reclassification. At the final stage, the GSC is fed into an expert system, which uses the result of the above three methods to produce a final classification of objects, along with statistical probability estimates.

The RGSC provides a unique possibility of comparing the observed luminosity function with that given by various galaxy models, and draw conclusions about the structure of galactic components. This catalog will also be used as a part of an input catalog for the "Spectrum-UV" mission (see the presentation by Piskunov & Shustov (1997) in this colloquium). Results of cross-identifications with existing catalogs will also be provided to the creators and/or administrators of those catalogs.

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