Guide Star Catalogues for space telescopes: the INAF-OATo contribution

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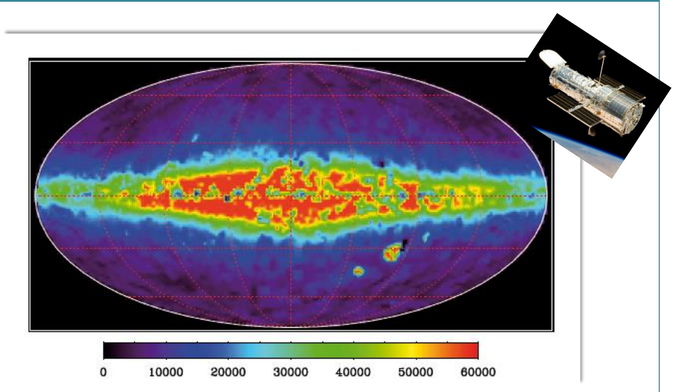
in collaboration with Beatrice Bucciarelli, Ronald Drimmel, Mario G. Lattanzi, Roberto Morbidelli, Sibilla Perina, Paola Re Fiorentin, Maria Sarasso, Richard Smart

Abstract

Guide Star Catalogues are fundamental for the operation of high precision space telescopes because they provide the information to compute an accurate attitude (ie. orientation) and a fine pointing control.
The Astrometry team of the Osservatorio Astrofisico di Torino has been involved for many years in projects for the study and construction of guide star catalogs for important space telescopes, such as HST, JWST, EUCLID, CSST, as well as in the construction of the initial source list for the bootstrapping of the Gaia catalogue.
Here we summarize the properties of the ongoing all-sky surveys in the optical and infrared wavelength in order to support the study and operation of the future scientific missions, in collaboration with the space agencies and industries.

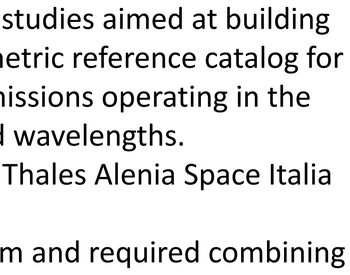
Guide Star Catalogue II



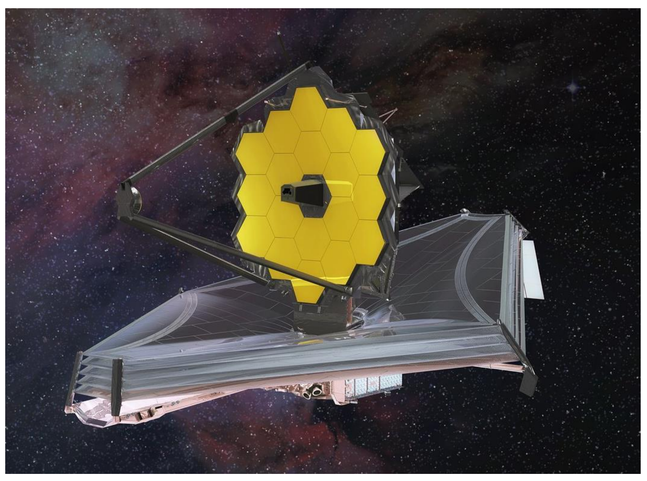
1992-2008 The second guide star catalogue. Study and construction of GSC 2.2 (2001) and GSC 2.3 (2006), astrometric and photometric catalog of 945,592,683 stellar and non-stellar objects (Lasker, Lattanzi et al. 2008) derived from the scans of the photographic surveys of the Schmidt Palomar and UK telescopes (DSS). The GSC-II was created in collaboration between StScI and INAF-OATo.
Co-PI: M.G. Lattanzi

Initial Gaia Source List

The IGSL was a compiled catalog that acted as the primary target list for the Gaia mission during the first three years of the Gaia mission. In the IGSL there were 1,222,598,530 entries including objects from the Tycho2, LQRF, UCAC4, SDSS-DR9, PPMXL, GSC23, GEPC, OGLE, Sky2000 and 2MASS catalogues (Smart & Nicastro 2014)
The figure shows the difficulty of using a ground based survey with a large psf. Gaia observations of high proper motion objects may be outside the IGSL position estimate or what the IGSL sees as just a slightly elliptical object Gaia sees as two resolved objects.
P.I. R. Smart

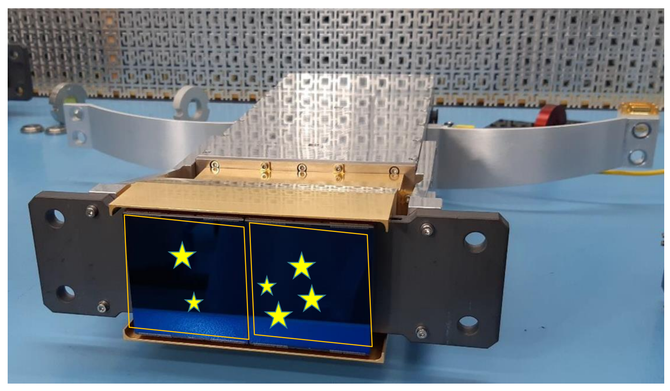


Guide stars for NGST / JWST



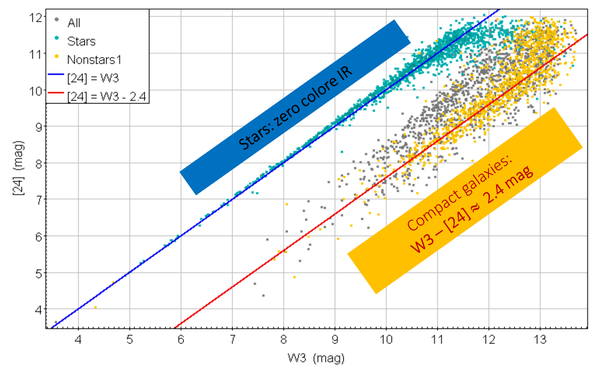
1999 - 2000 Guide Star Requirements for NGST. Study commissioned by the Space Telescope Science Institute (STScI) of Baltimore (USA) on the availability of infrared reference catalogs and the requirements of the guidance system of the James Web Space Telescope (JWST), former Next Generation Space Telescope (NGST).
PI: A. Spagna

Euclid FGS Input star catalog



2010-2021. Study and construction of the astrometric and photometric catalog of 554,356,800 stellar and non-stellar objects. The catalog is derived from Gaia DR2 and was produced by INAF-OATo to be used for pointing operations of the EUCLID satellite.
PI: M.G. Lattanzi (study phase) and R. Drimmel (construction, testing and commissioning phase)

Star catalogs for IR missions

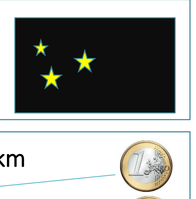


2020–2023 – Feasibility studies aimed at building astrometric and photometric reference catalog for FGS of scientific space missions operating in the medium and far infrared wavelengths.
Study commissioned by Thales Alenia Space Italia (TASI).
This is a complex problem and required combining the Gaia optical catalog with the AllWISE infrared catalog, and estimate the magnitude at wavelengths for both stellar and non-stellar sources (see figure showing [24] vs. W3).
P.I. A. Spagna

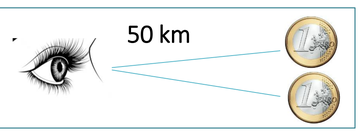
Requirements for the Euclid FGS Input Star Catalog

The OATo team delivers the Euclid FGS ISC to TASI

N= 3 Minimum number of sources within FGS FOV brigher than the magnitude limit (R=19)

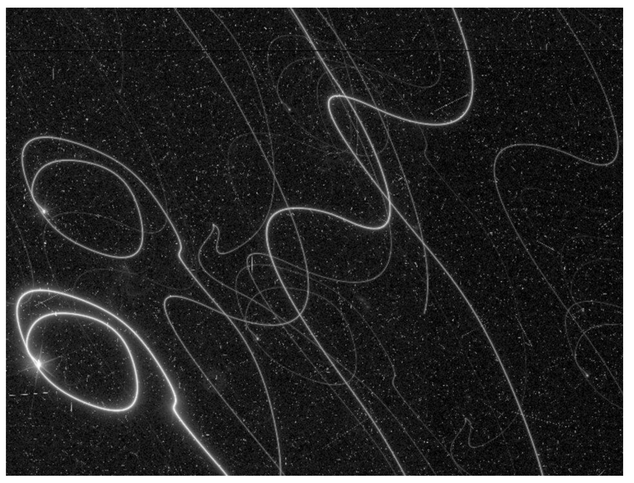


0.1'' position accuracy
(at the observation epoch)



0.1 - 0.2 mag photometric accuracy in the FGS passband

Classification



Loopy star trails show the effect of Euclid's FGS intermittently losing its guide stars (Image credits: ESA)

Contact

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Scheda INAF-GSCS *Cataloghi di stelle di guida: studio e costruzione di cataloghi di riferimento per le operazioni dei telescopi spaziali*

References

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2. Smart, R.L. & Nicastro, L. 2014,A&A, 570, A87 *The initial Gaia source list.*
3. Perina, S., Drimmel, R., Spagna, A., Bucciarelli, B., Smart, R.L., Lattanzi, M.G., Re Fiorentin, P. & Morbidelli, 2019, EUCL-OATOTN-2-006-1, 30 pp, *Euclid FGS Input Star Catalog Generation Approach of Release ISC.R3,* http://hdl.handle.net/20.500.12386/33527
4. Spagna, A., Bucciarelli, A., Drimmel, R., Morbidelli, R., Perina, S., Smart, R.L. 2020, OATO-SPICA-FGS-TNO-001, 48 pp, *Input Star Catalogue for SPICA* Mission, http://hdl.handle.net/20.500.12386/33521