JMMC Evolutive Search Calibrator Tool

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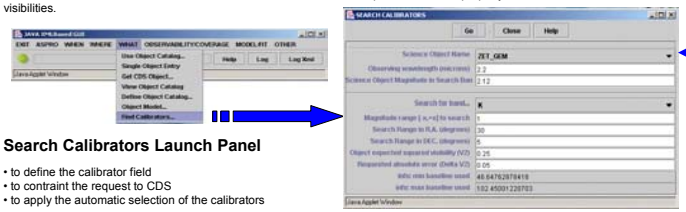
Abstract

In stellar interferometry, the raw fringe visibilities must be calibrated to obtain the true object visibility and then object parameters which can be interpretedin term of astrophysical parameters. The selection of suitable calibration stars is crucial to obtain the ultimate precision of the interferometric instruments like VLTI. So, we have developed a userdedicated software to create an evolutive catalog of stars giving the useful information for the selection of calibrators with respect to the requirements of the astrophysical program and of the instrumental configuration.
A list of possible calibrators is obtained from a set of catalogs available at the Centre de Données astronomiques de Strasbourg (CDS). The CDS request is based on some criteria like the maximum angular distance and the range of magnitude around the scientific target. This calibrator selection tool is integrated to ASPRO the interferometric observing preparation software developed by the JMMC (http://mariotti.ujf-grenoble.fr/ ~aspro/).

Aspro Environment

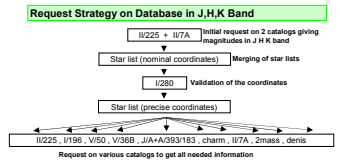
The software tool **ASPRO** allows to prepare interferometric observations (Duvert et al., 2002).
The **Search Calibrators** tool allows to select of the reference stars required to convert properly observed visibilities into calibrated visibilities.



Search Calibrators Launch Panel

- to define the calibrator field
- to contraint the request to CDS
- to apply the automatic selection of the calibrators

CDS Request

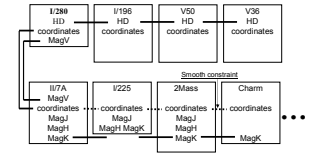


The usable informations for stars found in the calibrators box are compiled from different catalogs in the data base VisieR at CDS (Ochsenbein et al., 2000).
The link between the catalogs, to sort the result, are done from coordinates and m_V (for V band), or from coordinates and m_K (for IR bands).

Requested catalogs

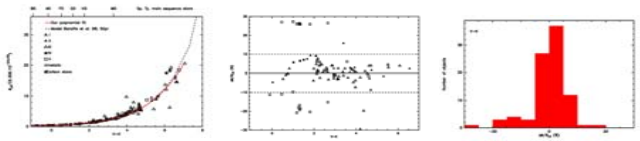
- I/280 : All-sky Compiled Catalog of 2.5 million stars (Kharchenko, 2001)
- II/7A : UBVRIJKLMNH Photoelectric Catalog (Morel et al., 1978)
- II/225 : Catalog of Infrared Observations, Edition 5 (Gezari et al., 1999)
- II/246/out : The 2MASS all-sky survey Catalog of Point Sources (Cutri et al., 2003)
- B/denis/denis : DENIS data base (DENIS consortium, 2003)
- J/A+A/386/492/charm : Catalog of High Angular Resolution Measurements (Richichi, 2002)
- J/A+A/393/183 : Catalog of calibrator stars for LBSI (Borde et al., 2002)
- I/196/main: Hipparcos Input Catalogue, Version 2 (Turon et al., 1993)
- V/50 : Bright Star Catalog, 5th Revised Ed. (Hoffleit et al., 1991)
- V/36B : Supplement to the Bright Star Catalog (Hoffleit et al., 1983)

Links between catalogs to merge the results in one file



Calculations

- Interstellar absorption are calculated from trigonometric parallax using the Chen et al (1998) law and the observed magnitude are corrected with the Fitzpatrick (1999) coefficients.
- Missing photometry is calculated from published *color-luminosity class-spectral type* relation
- Calculation of the angular diameter, and its associated error, from diameter-color relation (see the figure)



Left: newly determined angular diameter (θ_{LD}) – (V-K) relation. Middle: relative residual in angular diameter. Right:distribution of the relative residuals (Delfosse & Bonneau, 2004).
With the knolewdge of the V-K color index, it is possible to determine the angular diameter with typical errors of ~5%.

- Rejection of the calibrators wich doesn't satisfy the test for the coherence of the computed angular diameter from the different color index
- Calculation of the calibrator visibility and its error as function of the angular diameter (measured or computed) and its error for the maximal angular resolution λ/B_{max}
- Rejection of the calibrators with visibility accuracy wich doesn't satisfy contraints fixed by the expected accuracy of the science object and the error on the measurements.

Problematic and method

For numerous program the calibrators must have properties close to those of the scientific target :
- close sky location and apparent magnitude to observe with same instrument configuration,
- similar color (spectral type) in case of interferometric observation in large band to limit the chromatic effect.

Ideally, a calibrators must be a point source giving a fringe visibility equal to 1.0. In practice, the smaller the calibrators the lesser the sensibility of the angular diameter determination to their intrinsic visibility or sources of instabilities. Strictly, no objects with a measured angular diameter will respect them. That is particularly true in the case of faints objects (use of new generation of interferometer as the VLTI).

Method :

To create a dynamical catalog of calibrations stars surrounding the science object, we adopt a method of the ''virtual observatory'' type.

Definition of calibrator field
• Rectangular box centered on the in scientific object. Size defined by the maximum distance in rigth ascension and declination

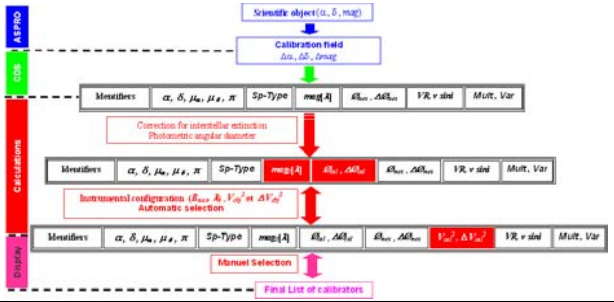
Selection of possible calibrators from CDS inquiry
• Requests to the VisieR data base at CDS using the calibrator field parameters in a given photometric band (V, J, H or K). Gives a list of stars with known parameters (astrometry, spectral type, photometry, indication of variability and multiplicity, measured angular diameter.

Calculation (For each star)
• The angular diameter is computed using a surface brightness method and color index calibration.
• The squared visibility computed using an unifrom disc model.

Automatic selection
The accuracy of the calibrator visibility must satisfy constraints fixed by the expected accuracy of the science object visibility, the values adopted for the instrumental visibility and the error on the measured fringe contrast.

Final selection
To refine the choice of the calibrators by changing, *a posteriori*, the selection criteria (field around the science object, object – calibrator magnitude difference, spectral type and luminosity class, accuracy on the calibrator visibility, indications of variability and multiplicity.

Block diagram

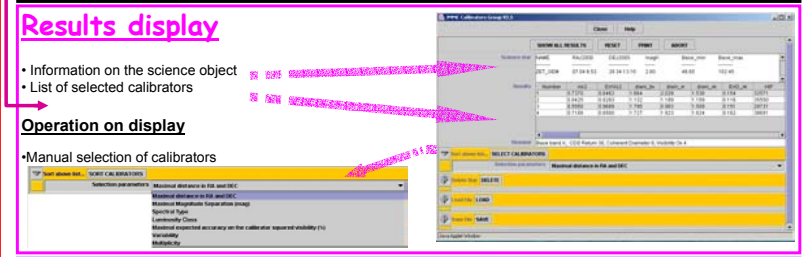


Results display

- Information on the science object
- List of selected calibrators

Operation on display

•Manual selection of calibrators



Technical aspects

Example of request on Vizierat CDS to extract stars with constraint on the K magnitude in the II/225/main catalog

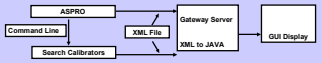
GET /viz-bin/asu-xml?-source=II/225/catalog&-c.ra=05+45+22.6&-c.dec=09+04+12&x_F(IR)=M&F(IR)=2.5..6.5&lambda=2.20&-out.max=50&-c.bm=1800/300&-c.u=arcmin&-out.add=_RAJ2000,_DEJ2000&-oc=hms&-out=lambda&-out=F(IR)&-out=x_F(IR)&-sort=_r

Magnitude range *Wavelength* *Magnitude range*

Data fields defined by UCDs *(Unified Content Descriptors)* or labels

UCD	Column	Description
POS_EQ_RA_MAIN	RAJ2000	Right Ascension IRCS 2000
PHOT_FLUX_IR_MISC	F(IR)	Infrared flux
UNITS	X_F(IR)	Infrared flux unit
INST_WAVELENGTH_VALUE	lambda	Wavelength in microns

***Display* using Xml to Java**



Coming Next

Search Calibrator for faint science objects . Limiting magnitdue *Kmag* ≥ *14*

Using Votable Database Files in the context of the Astrophysical Virutal Observatory (AVO) project. Using CDS Web Service through SOAP technology

Computation of the multiplicity probability for the selection of faint calibrators

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