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The 'JMMC Stellar Diameters Catalogue' v2 (JSDC) A new release based on SearchCal improvements

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Abstract. The *JMMC* Calibrator Workgroup has long developed methods to ascertain the angular diameter of stars and provides this expertise in the *SearchCal* software. *SearchCal* dynamically finds calibrators near science objects by querying CDS hosted catalogs according to observational parameters using either the bright ($magK < 5.5$) or the faint ($magK > 5$) scenarios. This 2nd *JSDC*[1] release is based on a new *SearchCal* scenario (derived from the bright one) applied to 110 000 Hipparcos stars instead of aggregating *SearchCal* results on the whole celestial sphere. It benefits from important *SearchCal* improvements for 3 years: new catalog queries (*HIP2*, *AKARI*), enhanced cross match algorithm taking into account proper motions / catalog epochs (*ASCC*, *HIP2*, *2MASS*) and major changes on diameter and error computations (more color relations used and magnitude error propagation). We describe the new JSDC scenario and *SearchCal* improvements, study catalog results (more than 55 000 stars, more giant stars) and compare this new release with the former one (*VizieR* II/300).

1. Building the JSDC v2

For efficiency and accuracy concerns, a new scenario was created to use a local input catalog containing 111 108 *HIP2* stars providing coordinates (epoch 2000), proper motions and parallaxes compliant with *SearchCal*'s bright scenario ($e\_plx/plx < 25\%$).

1.1. SearchCal scenario for JSDC

This new scenario (see Fig. 1) is run by the *SearchCal* server (C/C++) to query CDS *VizieR* catalogs by chunks of 512 stars, perform angular diameter computations using gathered star photometry data and finally produce the output *VOTable* document.

To complete and improve accuracy on photometric magnitudes, new catalogs are used: *HIP* for $B = V + (B - V)$ and $Ic = V - (V - I)$; *AKARI* to compute N from IR fluxes. Moreover, photometric magnitude errors are now retrieved from *ASCC*, *HIP* & *2MASS* catalogs which are the only ones providing errors among queried catalogs.

[1]JMMC Stellar Diameters Catalogue (JSDC) `http://www.jmmc.fr/jsdc`

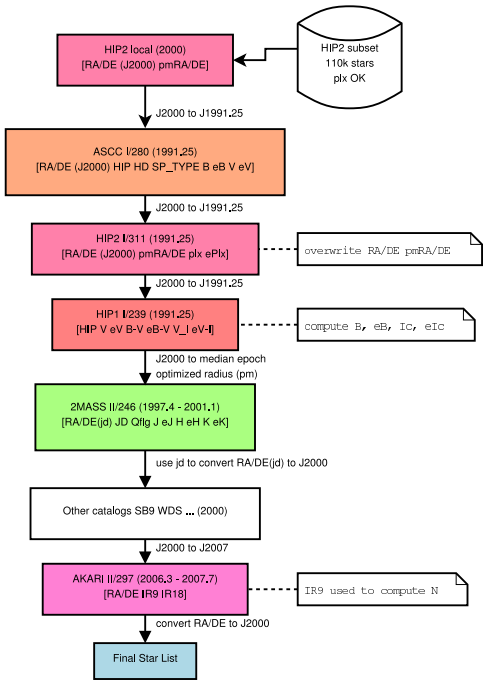

Figure 1. JSDC scenario diagram

SearchCal cross-matching algorithm was improved to deal with large star lists and handle properly star proper motions by applying epoch correction depending on the queryied catalog: J1991.25 (*ASCC*, *HIP*, *HIP2*) or varying epoch (*2MASS* & *AKARI*). The latter case requires to enlarge the *VizieR* cone search radius to get all possible star candidates within the epoch range, then correct their coordinates according to the observation epoch (jd) and finally perform an internal cross-match within 2.5 arcsec.

Finally new color relations are used to compute angular diameters & their errors based on photometric magnitude errors & the interstellar absorption.

To produce the final JSDC catalog, a *STILTS VOTable / FITS* pipeline applies following filters: remove *SB9* / *WDS* stars (binarity); filter multiplicity & variability; reject *BadCal* stars; query *SIMBAD* to filter specific object types (algol, binaries ...).

1.2. New Angular diameter / Color relations

A new compilation of limb-darkened angular diameters (LDD) was built from observations (paper in preparation). It contains roundly 150 stars completed with their magnitudes in [B V I J H K] bands (*HIP*, *2MASS* and high precision JHK magnitudes from Pickles & Depagne (2010)).

For all 15 color indexes $[M_1 - M_2]$ polynomial fits of the the following color relation were performed on reference stars (*IDL*): $log(LDD\ /\ 9.306) + 0.2 * M_1 = POLYNOM(M_1 - M_2)$ with M_1 & M_2 magnitudes corrected by interstellar absorption. This gives second-degree polynomial coefficients $COEFS$ but also the covariance matrix MAT to compute analytically the diameter error (papoulis): $eLDD = f(M_1, eM_1, eM_2, COEFS, MAT)$. Plots in Fig. 2 shows angular diameter fit results for the [V-K] color relation: dispersion: 6.2% & error bias: 3.3%.

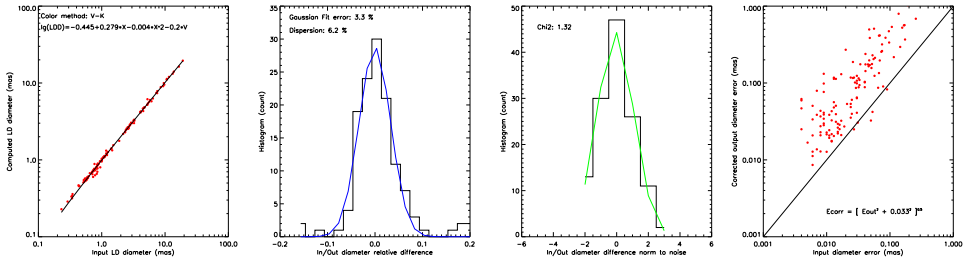

Figure 2. Diameter fit results using V-K color relation

For the final JSDC v2 release, following improvements remain to be done: improve diameter error propagation due to interstellar absorption; use correlations of color relations (for example $[V-K]$ vs $[B-V]$) to compute rigorously the weighted mean diameter & error from all color relations.

2. Results & comparison with JSDC v1

The JSDC v2 contains more than 57 000 stars vs 38 472 stars in v1 with 35 000 matches, 22 000 more but 3 500 'lost' stars. Most stars are in ranges $4 < V < 11$ and $2 < K < 8$.

On plots in Fig. 3, new stars are present in all star classes (more giant stars) and gives a better sky coverage in particular arround celestian poles and for $DEC > 0$; the 'lost' stars are mostly not present in the *HIP2* input catalog or rejected by diameter consistency checks between color indexes.

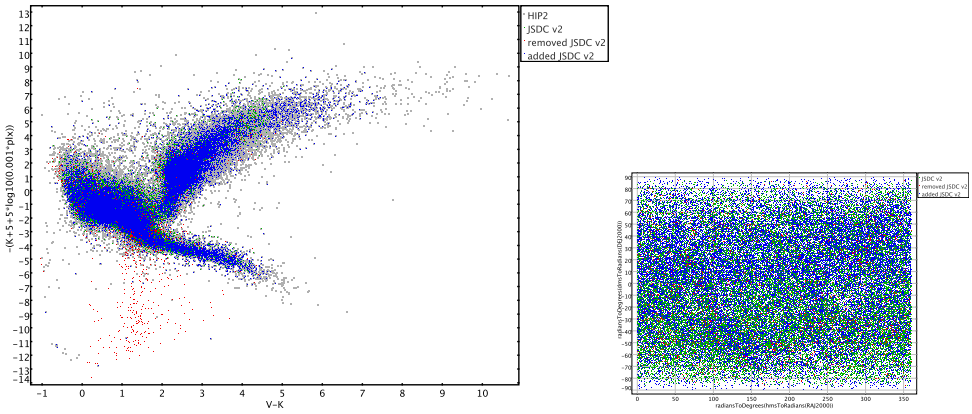

Figure 3. Comparative HR diagram and sky coverage of JSDC releases

Plots in Fig. 4 shows the diameter distribution versus V & K magnitudes:
$0.0074 < LDD < 31.66$ with $mean = 0.357$ and $stddev = 0.676$ so 95% stars have an angular diameter lower than 1.7 mas.

Contrary to JSDC v1, the diameter error is now computed using new color relations as illustrated in Fig. 5. For the color index $[V-K]$, the error was set to 6.9% (upper limit) in JSDC v1 and is less than 4% in JSDC v2 for 50 000 stars and higher than 10% for 4 500 stars which are bright stars ($K < 4$) having a very high K magnitude error ≈ 0.2 *mag* given by *2MASS* (bad quality flag).

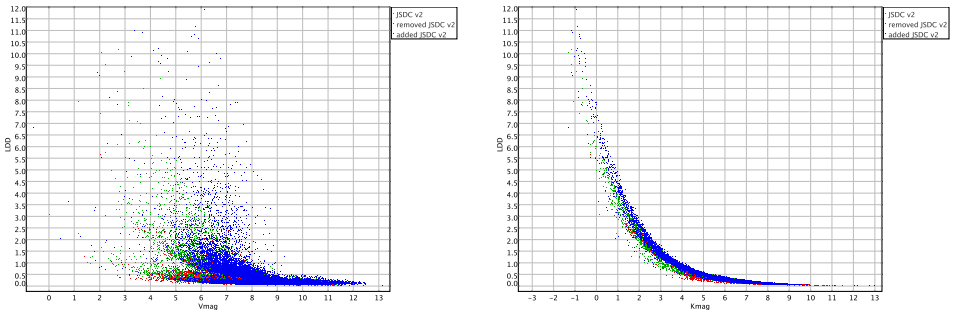

Figure 4. LD diameter vs V and K magnitudes

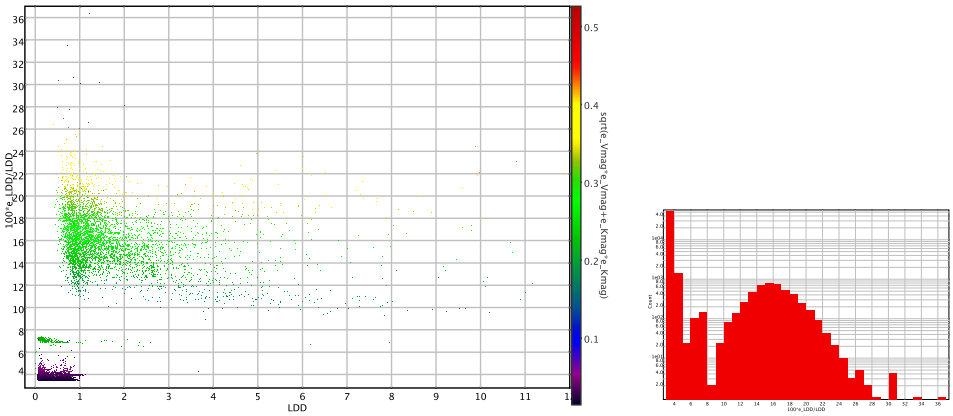

Figure 5. Relative diameter error coloured by $var(eV, eK)$ and their distribution

To improve again fiability on diameters & errors, two solutions are in study: use a robust estimator on all computed diameters & errors by color relations; query other catalogs to get better magnitude errors: IR bands [J H K] for bright stars; photographic bands [B V R] for fainter stars.

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References

Pickles, A., & Depagne, É. 2010, PASP, 122, 1437. 1011.2020

Taylor, M. B. 2005, in Astronomical Data Analysis Software and Systems XIV, edited by P. Shopbell, M. Britton, & R. Ebert, vol. 347 of Astronomical Society of the Pacific Conference Series, 29

— 2006, in Astronomical Data Analysis Software and Systems XV, edited by C. Gabriel, C. Arviset, D. Ponz, & S. Enrique, vol. 351 of Astronomical Society of the Pacific Conference Series, 666