QSOs PHOTOMETRIC IDENTIFICATION FOR ASTROMETRIC REDUCTION OF CCD IMAGES

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ABSTRACT. Because of their important distances, Quasi-Stellar Objects (QSOs) seem point-like sources with no apparent proper motion. This is the reason why QSOs are quasi-ideal objects for linking a CCD image to another one or for linking directly a CCD image to the OCRF and with the forthcoming 'GAIA reference Frame'. One of the difficulties of astrometric reduction using QSOs as reference points is to distinguish QSOs from stars in CCD images. We present in this poster three distinct QSOs identification methods based only on the photometric characteristics of QSOs and we study the advantages and disadvantages of each one from an astrometric point of view.

1. QSOs IDENTIFICATION METHODS

The QSOs identification methods we have developed and tested are ones using photometric characteristics of celestial objects only, easily obtained from several CCD images of a same sky-field taken with different filters. The first method studied here is based on a Multi-Layer Perceptron Neural Network (MLP-NN). The second method is based on a parametrization of the stellar accumulation points in a three-dimensional (3D) colour space, as explained by H.J. Newberg and B. Yanny (1997). The third and last method is based on two rejection masks built from a two-dimensional (2D) mapping of high stellar density and a 2D mapping of high QSO density respectively. More details about these three methods are given in the electronic file of this poster available on the following site : `http://syrte.obspm.fr/~bouquillon/JSR/2008/poster.pdf`.

2. USED DATA SETS

We used two data sets to parametrize and test these three methods. These data sets are subsets of two catalogs of stars and QSOs coming from recent large sky-survey (the 2QZ and the SDSS surveys) and limited to the Galactic Pole regions to avoid disturbance from Milky Way stars (see figure 1). For each object found in these data sets, we have the magnitudes in three (or four) different broad optical bands and the redshift value for the celestial objects identified as QSOs. We used the redshift value only to discriminate QSOs from stars and to parametrize the learning phase of the MLP-NN method.

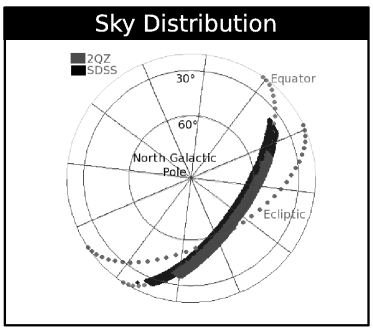

Figure 1: SDSS and 2QZ sky distribution

3. FIRST RESULTS, CONCLUSION AND PERSPECTIVES

The efficiency of each method is estimated with the help of two criteria commonly used in statistical decision theory:

- A “completeness criterion” to estimate the percentage of QSOs missed (type I error) by each algorithm.
- A “false alarm error criterion” to estimate the percentage of false QSOs (type II error) produced by each algorithm.

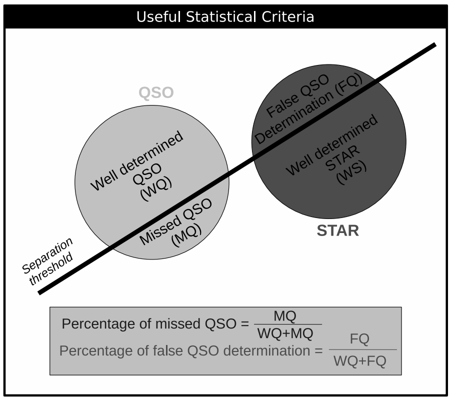

Figure 2: “Completeness criterion” and “false alarm error criterion”

With these methods, it seems that the identification of QSOs among stars, only with the help of their photometric characteristics, is reachable with some low percentage of false QSOs determination and low percentage of missed QSOs.

- With the first method (Multi-Layer Perceptron Neural Network), we obtained for the SDSS data set 25 % of missed QSO for 5.2% of false QSOs determination and for the 2QZ data set 25 % of missed QSO for 9.6% of false QSOs determination
- With the second method (Parametrization of the stellar accumulation points), we obtained for the SDSS data set 24 % of missed QSO for 5% of false QSOs determination. This method is not a suitable method for the 2QZ data set.
- With the last method (Two rejection masks), we obtained with masks build with the 2QZ data set and applied to the SDSS data set 49 % of missed QSO for 7.6% of false QSOs determination.

We also found that we could improve the efficiency of these methods by combining with one another. More details about our results are in the electronic file of this poster available on the site given before.

Nevertheless, to be used for astrometric reduction, these methods need improvements. Indeed, if we consider for instance the results obtained by applying the first method to the SDSS data set with magnitudes in three colors (25 % of missed QSO for 12.6% of false QSOs determination) and if we suppose a density around 14 QSOs by square degree (for QSOs magnitude lower than 20), to make an astrometric reduction of a CFHT CCD image, this method would provide only 10 QSOs with around two ‘false QSOs determination’. This is very little.

4. REFERENCES

Newberg, H.J and Yanny, B., 1997 “Three-dimensional parameterization of the stellar locus with application to QSO color selection” The Astrophysical Journal Supplement Series, Vol 113, pp. 89-104