Databases for Radio/Optical Objects: Radio Stars, Extragalactic Radio Sources, and Intermediate Reference Stars

A CONFOR Program (CONnection of Frames in Optics and Radio, see Gubanov, Kumkova & Tel'nyuk-Adamchuk 1990) has been undertaken to determine relative orientation of the radio interferometric reference coordinate system with respect to the fundamental optical system for the goal of establishing a universal radio/optical coordinate frame. For this purpose the method of astrophotographic reduction with two steps was used. Fixed systems of intermediate reference stars in the fields with extragalactic radio sources (ERS) has been chosen. This allowed us to obtain more reliable astrometric reduction of photographic plates with ERS images.

Within the framework of the CONFOR program:

1) two star lists of intermediate reference stars (both for meridian and astrographic observations) in 238 fields with extragalactic compact radio sources have been prepared;
2) observations of these stars have been organized and fulfilled with meridian circles and several astrographs of Ukraine, Russia, Romania and Yugoslavia;
3) data of both optical and radio interferometric observations of RS, ERS have been compiled as well as optical observations of stars in the fields centred in ERS (see Tel'nyuk-Adamchuk & Kryvdyk 1991; Tel'nyuk-Adamchuk, Kryvdyk & Pasechnyk 1991);
4) observations of ERS were carried out with several powerful telescopes.

The databases of radio stars (RS), ERS, available for precise radio interferometric observations and intermediate reference stars around ERS have been compiled at the Astronomical Observatory of Kyiv Taras Shevchenko University and at the Institute of Applied Astronomy, Russian Academy of Sciences. There are mostly astrometric data and brief astrophysical description. All the available published data were used as well as original results of the CONFOR Program.

The database on optical and radio interferometric positions of radio stars contains about one hundred objects. The optical proper motions of RS in number about 40 have been determined (Tel'nyuk-Adamchuk, Duma & Smidunovich 1991) as well as the relative orientation angles using available published positions. An example of RS data is shown in Table 1.

Table 1. Example of radio star database structure

021649 -031221				**maser**	
49.076	-22.60		88.1	88.1	40
49.073	0.007-21.22	0.13	80.99	80.99	34
49.082	0.013-22.57	0.09	86.78	86.78	37
49.087	0.003-22.42	0.05	86.80	86.83	38
49.084	0.004-22.35	0.05	86.81	86.89	43
021915 +582133				**maser**	
15.09	33.400		85.5	85.5	38
15.061	0.004 33.560	0.080	86.320	86.320	37
15.100	0.006 33.550	0.050	86.880	86.880	38
15.082	0.011 33.600	0.08	85.70	85.70	43

Notes: Line 1 — approximate R.A. and Decl.
Line 3, 4, 5, ... — seconds of R.A.; m.r.s.e. of R.A.; arcsec of Decl. and m.r.s.e. of Decl.; epochs of R.A. and Decl.; references. All data are from optical observations.
Line 2 — data of radio observations (weighted means).

The database on ERS contains around two hundred sets of optical and radio interferometric positions. An example of ERS data is shown in Table 2. Both the RS and ERS optical positions have been obtained in different reference systems and transformed to the FK5 system using known systematic differences between convenient systems.

Table 2. Example of extragalactic radio source database structure

0006		**-0623**				
13.893255	0.040	35.33307	0.072	88.04	88.04	53
40.296	13	17.23	20	83.	83.	41, 24
0011		**-2612**				
01.246736	0.204	33.37549	0.285	81.97	81.89	48
28.894	11	14.68	21	78.60	78.60	5

Notes: Line 1 — hours and minutes of R.A., degrees and arcmin of Decl.
Line 2 — seconds of R.A., m.r.s.e. of R.A.; arcsec of Decl. and m.r.s.e. of Decl.; observation epochs for R.A. and Decl.; references. All data are from radio observations.
Line 3, 4, 5, ... — data of optical observations.

Combining the data from both RS and ERS allows us to determine the orientation angles and deviation of the FK5 equator relatively to the radio interferometric system one with an accuracy 0.02 arcsec (m.r.s.e.) (see Tel'nyuk-Adamchuk, Molotaj & Kumkova 1992). These results are given in Table 3. To bring the FK5 and VLBI reference frames into coincidence, FK5 should be turned clockwise around the X, Y and Z axes by the angles i1, i2 and i3. The FK5 equator is found to be displaced southwards by angle i4. It is necessary to note that enlargement of RS radio coordinate determinations and improving of the coordinate random accuracy produce more accurate results, as well as adding of optical observations of faint ERS. At present the databases of RS and ERS are in the process of being completed by new data available from astronomical publications.

Table 3. Angles of relative orientation i1, i2, i3, 6 and shift i4 of the FK5 equator obtained from observations of radio stars (RS) and extragalactic radio sources in units of 0.01 arcsec.

Objects	i1	i2	i3	i4	M.r.s.e.	Number of objects
RS	-4	+8	+2	-4	5	59
ERS	+6	+6	-0	-2	3	192
RS + ERS	+0	+7	+2	-3	2	251

There are two sets of data for intermediate reference stars. The first one is the data of 2575 stars in the vicinity of ERS and selected radio stars. The fields centred in ERS contain 9-12 stars in 1-3 square degrees approximately up to 9.0 mag attainable for visual meridian instruments (RRS2 list). The mean brightness is equal to 8.6 visual mag (see Tel'nyuk-Adamchuk & Molotaj 1989). The observations, reductions and compilation of these stars are in progress now. The meridian observations of RS and stars in the vicinity of ERS carried out within framework of similar programs are collected and included in database.

The second set (Photographic Intermediate Reference Star list, PIRS) contains the 12-14 mag stars located around ERS no further than 15-20 arcmin from the centre. That list has been compiled using the HST Guide Star Catalogue. The stars are being observed at present with astrographs of Kyiv University Observatory and Institute of Astronomy, Bucharest, Romania. In this list there are about seven thousand stars over both hemispheres. We plan to prepare the compiled catalogues of RRS2 stars as well as PIRS stars using collected data including our original observations.

References

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