Measuring Binaries with Position-Circle and Filar Micrometer-Screw

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Abstract: A method for measuring visual binaries using position-circle and modified microscope accessories is described. The measurements of 61 binaries measured in the fall of 2012 are presented and some deviations from values published in the WDS are discussed.

I have done systematic binary observations, i.e. measuring separation and position angles, since 2008. Before that, this category of targets mostly met my interest for test purpose only.

Now that I am 63 years old, my patience while observing has improved, but the sensitivity of my eyes has decayed. So I changed from visual observing deep-sky-objects to the "realm of binaries".

My telescope is quite a veteran; a C8 "orange", manufactured by Celestron in the late '70's. It is an excellent telescope, able to completely resolve binaries down to 0.6" and doing (for a telescope of its class) outstanding work on the planets! See Figure 1. The instrument is mounted on an also veteran Vixen ATLUX based on a massive concrete pier. The ATLUX stepper motors are driven by an FS2-control unit from Michael Koch, Germany. This mounting may be judged as oversized for a C8, but gives excellent positioning and a very fine and sensitive handling.

In choosing the method to measure p.a. and separation I decided for the old-fashioned way: using position circle and filar screw micrometer. The reasons: First, because my observatory no electricity. Current comes only from two modest solar panels; enough to drive my scopes, but no more. For this reason I cannot afford extended computer-sessions necessary for digital imaging and processing the results obtained. Also, working with the Internet can be problematic.

Second, I am an old fashioned man and do prefer observations at the ocular. Purchasing and configuring the equipment was not easy. I was able to buy a second-hand Zeiss position circle with a 10 cm diameter in good condition. Far more difficult was the search for an astronomical reticle ocular combined with a micrometer-screw. In my experience, there are no such items, new or used, at an affordable price on the market.

Instead, I found interesting microscope accessories from the Russian manufacturer Lomo. On the European market there is a micrometer screw device with moving reticle plate and ocular available for about €150. I ordered one and found that this device can be used with an astronomical telescope: Some modifications and an adapter to fit the different diameters are necessary, but this should be no problem for the do-it-yourself-experienced amateur. A great advantage of the device: its components can be freely adjusted together over wide ranges.

The focal length of the ocular is about 16mm, thus resulting in a magnification of about 120x. This allows measuring separations greater than 10". I thought about using a Barlow lens, but finally decided not to do so because that would bring one more mechanical component into the system, increasing the risk of instability. For this reason all my observations and measures also are done without using a zenith diagonal.

Furthermore, there is the need to make the fine engraved markings of the reticle visible against the background. All my efforts failed to make the markings "shine" by illumination from the side, so I illuminated the background of the 17′ field of view. A small red LED, its luminosity regulated by a variable resistor, was placed in front of the measuring device. This worked quite well, but limited the observable magnitude to about 9.5. Weaker components are "drowned" in the red-glowing background.

Overall my equipment allows measuring binaries

Figure 1. Orange C8 used in this study. The attached micrometer and PA circle are also visible just above the eyepiece.

with a rho over 10" and component magnitudes better than 9.5.

Given these limits, I extracted from the WDS lists of objects in the reach of my equipment. One more restriction I added was to look for binaries, whose rho and/or theta values showed noticeable changes over the times reported.

With the equipment described here, I can observe and measure in one 3 hour session - if longer, my eyes get tired - between five and seven pairs. Every pair must "pass" two runs, if the results do not match even more. The results obtained can be evaluated instantly - in my opinion an advantage of the described "handcraft" method.

Table 1 gives a list of 61 observation results obtained in the Fall of 2012 .

Acknowledgements:

I want to thank William Hartkopf, USNO for friendly and immediate help and information in some uncertainties. Gianluca Sordiglioni maintains a useful tool with his website: http://stelledoppie.goaction.it, that gives fast and complex information on double stars.

References

Mason, Brian. 2012. *Washington Double Star Catalog*. Astrometry Department, U.S. Naval Observatory. http://ad.usno.navy.mil/wds/wds.html

Table 1. Measurements made with equipment described in the text.

Name	RA	Dec	Mags 1/2	Sep. (as)	Angle (deg)	Date	N	Rem.
S 838AD	00h 04.2	62° 17	5.9/8.2	244	197°	2012.805	1	1
STTA256AB	00h 08.0	31° 23	7.1/7.3	110	113.5°	2012.753	1	2
BU 483AC	00h 09.1	40° 51	7/7.7	158.2	269°	2012.753	1	3
BU 484AC	00h 09.7	52° 02	7.6/8.5	81.8	51°	2012.8	1	4
ARY 7AB	00h 10.4	58° 31	7.8/8.3	122.7	1°	2012.8	1	2
ARY 9	00h 11.6	58° 13	7.1/8.6	135.1	81.5°	2012.8	1	5
HJ 1944	00h 13.2	-17° 11	7.7/9	65.3	335°	2012.8	1	6
STF 30AB	00h 27.2	49° 59	7/8.9	14.2	313°	2012.805	1	2
HJ 1968AB	00h 27.7	-16° 25	7.3/8	36.92	232.5°	2012.805	1	7
HJ 323	00h 40.7	-4° 21	6/8.5	62.2	285.5°	2012.8	1	2
H 5 82AB	00h 47.4	51° 06	8/8.4	56	75.5°	2012.808	1	2
STTA 9AB	00h 49.9	30° 27	7.8/8.8	120.9	243.5°	2012.761	1	8
STTA 11AB C	01h 07.2	38° 39	7.6/8.8	60.5	163.3°	2012.761	1	9
HJ 2052	01h 31.6	-19° 01	6.9/7.5	80.5	114°	2012.805	1	2
STF 142AB	01h 39.9	13° 15	8.9/9.2	21.3	65°	2012.805	1	2
KPR 1AC	01h 44.3	9° 29	7.9/8.4	189.8	285°	2012.805	1	2

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Table 1 (continued). Measurements made with equipment described in the text.

Name	RA	Dec	Mags 1/2	Sep. (as)	Angle (deg)	Date	N	Rem.
STFA 4AB	01h 56.2	37° 15	5.8/6	207.1	298	2012.808	1	10
ARN 90AB	01h 56.8	38° 02	9/9.2	36.9	194.5	2012.808	1	11
STTA 24AB	02h 12.9	57° 12	7.1/8.8	91.1	333	2012.808	1	12
H 6 1AC	02h 19.3	-2° 59	6.7/9.3	124	69.5	2012.816	1	13
BUP 30AC	02h 22.8	41° 24	5.8/7.4	302.2	9.5	2012.816	1	2
WAL 20AC	03h 02.3	41° 24	8/8.9	96.5	211	2012.816	1	2
ENG 11	03h 07.7	36° 37	7.5/9.2	132.5	260	2012.816	1	14
STFA 6	03h 09.2	7° 28	7.7/7.8	80.9	164	2012.816	1	2
SHJ 227AB	16h 21.9	19° 09	3.8/8.8	42.7	228	2012.704	1	2
STT 356AB	18h 33.2	40° 10	7.3/9.2	28	301.3	2012.619	1	15
H 6 50AC	18h 49.7	-5° 55	6.2/8.2	111.3	170.3	2012.614	1	2
HJ 5505	18h 57.7	9° 42	9.4/9.4	14.8	123.8	2012.619	1	16
STF2424AB	18h 59.1	13° 38	5.3/9.3	20.5	301.3	2012.619	1	17
STF2461AD	19h 07.4	32° 30	5.3/9	137.8	291.3	2012.619	1	18
STTA181AB	19h 20.1	26° 39	7.4/7.5	63.8	0.5	2012.622	1	19
HJ 2866AB	19h 23.4	-18° 00	8.6/8.7	23.1	51.5	2012.655	1	20
ARY 19AB	19h 33.3	26° 29	8.9/9.4		13.3	2012.622	1	21
HJ 599AC	19h 40.7	-16° 18	5.4/7.7	45.3	40.3	2012.655	1	22
STF2594	19h 54.6	-8° 14	5.7/6.4	36.7	170	2012.614	1	2
STT 592AC	20h 04.1	7° 04	5.9/6.9	215.1	334	2012.655	1	23
STF2637AC	20h 09.9	20° 55	6.6/7.5	92	221.3	2012.685	1	24
STF2637BC	20h 09.9	20° 55	7.5/8.9	95.1	215	2012.685	1	25
S 735	20h 11.3	-00° 08	7.1/8	55.3	211	2012.685	1	2
ARN 50AC	20h 22.9	27° 08	8.3/8.9	84	330.8	2012.685	1	26
STF2690	20h 31.2	11° 16	7.1/7.4	16.9	255	2012.685	1	27
STF2703AB	20h 36.8	14° 44	8.4/8.5	25.3	291.8	2012.704	1	28
STF2703AC	20h 36.8	14° 44	8.4/8.8	76.2	234.5	2012.704	1	29
STF2703BC	20h 36.8	14° 44	8.5/8.8	66.2	215	2012.704	1	30
S 788	21h 23.8	-06° 35	7.7/8.3	57.3	94	2012.704	1	31
STF2822AD	21h 44.1	28° 45	4.8/6.9	196.5	44.3	2012.712	1	32
BU 696AE	22h 04.5	15° 51	8/10	120	3	2012.704	1	33
HN 56AC	22h 14.3	-21° 04	5.6/8.9	209.8	44.8	2012.712	1	34
ARN 24AC	22h 25.8	-20° 14	6.7/8	129.4	92.3	2012.712	1	35

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Table 1 (conclusion). Measurements made with equipment described in the text.

Name	RA	Dec	Mags 1/2	Sep. (as)	Angle (deg)	Date	N	Rem.
ARN 24AC	22h 25.8	-20° 14	6.7/8	127.7	89.5	2012.718	1	35
HJ 975	22h 55.7	36° 21	5.7/9.2	53.8	244.5	2012.704	1	36
S 826AC	23h 14.1	-08° 55	7.6/9.1	82	132	2012.704	1	37
STTA246AB	23h 28.0	23° 35	8/8.9	80.9	123	2012.704	1	38
STFA 60AB	23h 28.0	23° 35	7.3/7.5	231.1	208.5	2012.712	1	39
WEB 10AB	23h 38.6	44° 41	8.3/8.8	128	304	2012.721	1	40
ENG 88AaF	23h 43.5	58° 05	7.2/9	277.4	197	2012.712	1	41
STF3041AB	23h 47.9	17° 03	8.4/9	57	358.5	2012.721	1	42
STF3041AC	23h 47.9	17° 03	8.4/9.2	60.7	358.5	2012.721	1	42
STF3044	23h 53.0	11° 55	7.3/7.9	20	283.2	2012.721	1	2
STTA251AB	23h 53.6	51° 31	6.9/9.1	48	209.5	2012.721	1	43
HO 205AD	23h 54.1	39° 17	6.7/9.4	122.7	215.5	2012.721	1	44
ARY 33	23h 59.2	50° 32	7.3/8.1	99.6	140	2012.721	1	2

Remarks:

1. Measures reported from 1991; theta increased 1°, rho decreased 2" .
2. Consistent with reported measures.
3. Theta 2°, rho increased 2" . Consistent with trend reported.
4. Theta is more than 8°, rho less than 2" compared with WDS reports. My measured theta is quite consistent with values reported till 2002.
5. WDS reports theta of 125°. Measured theta of 135° is near to formerly measured values between 136° and 138°.
6. Theta quite consistent, rho 2" under reported WDS value. November 2008 I measured theta 336° and rho 67.6".
7. Theta 1.5° under value to expect. rho with an increase of 1.2"; that is consistent with trend reported.
8. Theta consistent, rho increased 7" – consistent with trend reported.
9. With respect to the last values reported for 1999 theta and rho are unchanged.
10. Theta 1° decreased. rho 7" increased, both consistent with trend reported.
11. Theta 2.5° increased against the only reported measure, rho unchanged.
12. Theta unchanged, rho increased for 2", both consistent with trend reported.
13. Mira. Theta increased 1.5° to latest value, rho quite consistent with 123" reported.
14. Theta increased 2°. rho unchanged.
15. Theta decreased 1°; rho decreased 2". Consistent with trend reported.
16. Theta decreased 1°, consistent with trend reported. rho unchanged.
17. Theta increased 1.5°. Consistent with trend reported.
18. Theta somewhat decreased, rho increased 2". Both consistent with trend reported.
19. Theta no change, rho 2" increased. Consistent with trend reported.
20. Theta 1.5° under the reported measure. rho 1" under the reported measure. Both results against the reported trend.
21. Theta consistent with trend reported. No rho measured due to clouds rolling in.
22. Theta 1.5° under the reported value. Rho consistent with reported trend.
23. Theta increased 1°, rho increased 1". Both consistent with reported trend.
24. Theta decreased 1°. rho increased 2". Both consistent with reported trend.
25. Theta 1° under reported value; rho quite consistent with the trend.
26. Theta decreases 1°, rho decreases 1". Both consistent with reported trend.
27. Theta unchanged, rho increased 1". Rho consistent with reported trend, theta not.

28. Theta increased 2°. Rho no change. Theta consistent with reported trend, rho not.
29. Theta consistent; rho 1" under reported value.
30. Theta 1° under reported value, but in the trend. Rho consistent.
31. Theta increased 1°, rho 2.5". Both consistent with trend reported.
32. Theta no change, rho decreased 1.5". Rho consistent with trend reported.
33. Theta of 3° not consistent with 316° reported in WDS for 2010. But in good consistence with values obtained before. Rho quite consistent.
34. Theta and rho over reported values and not consistent.
35. The rho reported here gives a value 5" higher than last WDS value. A repeated observation gave quite the same result. Last value in WDS maybe erroneous?
36. Theta no change, rho increased 2". Theta value against, rho with trend reported.
37. Noticeable increase in theta 3° and rho 6". Both consistent with trend reported.
38. Theta increased 2°, rho 1". Both results against reported trend.
39. Theta 1.5° decreased; rho 3" decreased. Last value with reported trend.
40. Theta unchanged; rho increased 2". Thats with trend reported. But only one run measured.
41. Theta slightly increased; rho noticeable increase for 5". Both consistent with reported trend.
42. Both A and B show unchanged theta with respect to C. Both rho have decreased by ~ 4" with respect to C.
43. Theta increased by 2.5°, rho increased 1". Results with trends reported.
44. Theta no change, rho increased by 5". An increase of rho is with the trend, but 5" in 10 years appear not to be very probable. Theta consistent with reported trend.

The author is a retired lawyer. For 10 years he has enjoyed his astronomical passion in a quiet place somewhat apart from civilization in the Bavarian mountains, where he lives and observes in his log-cabin home at 3300 ft above sea level.