33 Double Star Measures Using a CCD Camera in Corona Borealis

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Abstract: I report on my first experience using a CCD camera to measure double stars in light polluted skies near New York City.

Introduction

Following are some recent double star measures made with a CCD camera from my home in Larchmont, NY. Larchmont is situated just 17 miles east from New York City, along the Long Island Sound. While the waters of the Sound tend to keep the skies fairly steady, the proximity to one of the world's largest (and brightest) metropolitan areas means considerable light pollution. My initial attempts at measuring doubles were done using a filar micrometer from Retel, Ltd., in the U.K., but due to the light pollution, the dimmer magnitudes were difficult to see and measure on most nights. After reading several accounts of amateur astronomers using software and CCD cameras to measure doubles, including Bob Argyle's book, "Observing and Measuring Double Stars", I decided to change my setup to utilize CCD imaging techniques and to learn how to use the software to perform astrometric measurements.

Setup and Image Capture

My method is fairly straightforward. I use a Celestron 9.25" (23.5cm) Schmidt-Cassegrain telescope mounted on a Takahashi NJP Temma 2 Goto German equatorial mount. My camera is a Santa Barbara Instruments Group ST2000XM, with 7.4 x 7.4 micron pixels. I image at F/10, yielding a plate scale of .68 arcseconds per pixel. I image on 4 or 5 consecutive clear nights and average the results. Exposures are 20-30 seconds, to obtain a good signal to noise ratio.

The camera is controlled for imaging by CCDSoft v.5, by Software Bisque. Image reduction uses CCDSoft, and astrometric solutions utilize Software Bisque's theSky 6 Pro. The computers I use are an IBM ThinkPad T20 750Mhz PIII, running Microsoft XP pro operating system, outside with the telescope; and a Sony VAIO laptop 3.2Ghz Pentium IV laptop inside the house. They connect using the WIN XP's remote assistance software over a wireless LAN connection.

Targets are chosen using Paul Rodman's Astroplanner software, which has all of the main catalogues for double star work. I primarily use the WDS and the WDS Neglected lists, which I organize by constellation for convenience. I arrange lists of targets that are appropriate to my telescope and camera, by magnitude and separation as defined by my previous experience, so that on any good night, I can obtain images.

Once a target list is chosen, I utilize another Bisque software product, Orchestrate, which is a scripting software that allows me to get the most efficient use of the equipment. Orchestrate sets up commands that control the telescope, pointing it at successive targets; pauses on the target to allow the mount to settle and begin tracking; activates the camera to capture an image of the target for a set exposure; and then proceeds to the next target. Once started, this automated sequence can run for long periods without any intervention; but in practice, I usually attend the computer on each imaging run, though I do so from inside my house about 25 yards from the telescope. I periodically check on the telescope to make sure that no wires have become tangled or equipment loosened, but generally I don't have to intervene during a run. I can capture up to 100 images per evening utilizing Orchestrate – my previous manual imaging run yielded about 25 good images! So Orchestrate has

provided a very efficient use of my limited (mostly due to weather) observing time.

I also utilize Bisque's Tpoint software, which refines the pointing accuracy of my mount, placing the targets on the center of the imaging chip after an initial setup runoff as few as ten stars.

Image Reduction

Once the images are downloaded and the telescope is put away, the images are reduced using CCDSoft and theSky6 Pro. TheSky's image link function links my CCD images to the Sky's software, which automatically provides a plate solution for the image. Measurements of separation and position angle are obtained; clean separations provide the most reliable results, so the targets are scaled to the capabilities of the telescope/imager combinations, based on my previous experience. Exposures of 30 seconds provide images of stars to mag. 15, depending on sky conditions, thus allowing many more doubles to be targeted than with my visual setup.

Results of the measures are entered back into Astroplanner, manually, and the measures for each target are combined and averaged.

REDUC

A new development reflected in 3 results in the table of my measures below is a software program developed by Florent Losse, a French double star observer. REDUC allows me to analyze tighter doubles, using a "webcam" technique of image capture. I take 20, 2 second exposures of the target, using a 2x AP Barlow, resulting in a plate scale of .38"/pixel. REDUC reduces and averages the results in PA and Sep. Although all measurements were taken on the same night, N = 20 was entered into the table of measurements to reflect the number of images used by REDUC to determine the position angle and separation. The three pairs thus measured are labeled REDUC in the notes field of Table 1.

Measurements

With the technique just described, position angle and separation measurements were made for 33 double stars in the constellation Corona Borealis. These measurement are given in Table 1.

References

Observing and Measuring Double Stars, Robert Argyle, Springer-Verlag, 2004.

Florent Losse,, REDUC software; http://www.astrosurf.com/hfosaf/

Brian Mason, et al., USNO WDS 2001 and Neglected Doubles lists

Paul Rodman, Astroplanner program; http://www.ilanga.com

Software Bisque, suite of astronomy programs: CCDSoft v.5, theSky 6 Professional version, Tpoint, Orchestrate; http://www.bisque.com

Name	RA	Dec	Mags	PA	SEP	N	Date	Notes
KZA81	15h 21.1m	+31° 02'	10.5, 11.0	171.2	8.3	6	2006.384	
KZA82	15h 21.2m	+30° 49'	10.5, 11.5	93.1	13.4	4	2006.384	
KZA83	15h 21.6m	+30° 59'	10.5, 11.0	44.2	12.2	6	2006.384	
KZA87	15h 24.8m	+29° 34'	12.0, 12.5	358.9	11.6	4	2006.384	
KZA90	15h 27.4m	+31° 02'	12.5, 13.0	297.3	19.6	3	2006.384	
KZA94	15h 31.1m	+39° 25'	9.5, 11.5	256.2	15.8	4	2006.384	
HJ2786	15h 33.3m	+38° 27'	8.3, 11.7	169.4	26.6	4	2006.384	
BRT252	15h 37.8m	+30° 26'	12.1, 12.3	216.9	4.7	20	2006.386	REDUC
ALI862	15h 38.6m	+38° 26'	12.8, 13.2	0	0	3	2006.386	not there
HJ572	15h 44.0m	+35° 26'	9.2, 11.7	275.3	21.6	4	2006.384	

Table 1: Double Star Measures. *Continued on next page*

33 Double Star Measures Using a CCD Camera in Corona Borealis

Name	RA	Dec	Mags	PA	SEP	N	Date	Notes
HJ2791	15h 44.8m	+38° 34'	10.7, 14.2	129	11.4	4	2006.384	
ALI369	15h 50.1m	+36° 39'	11.9, 11.9	337.8	8.2	4	2006.384	
HJ2792	15h 50.3m	+31° 14'	11.0, 12.0	351.7	26.7	4	2006.384	
HJ574	15h 50.3m	+32° 24'	9.3, 10.9	96.4	76.5	4	2006.384	
HJ574AB	15h 50.3m	+32° 24'	9.3, 11.3	93.5	15.8	4	2006.384	
HJ2795	15h 52.3m	+31° 19'	11.0, 11.0	29.2	12.4	4	2006.384	
HJ1280	15h 53.0m	+39° 13'	9.9, 12.9	0.7	32.3	4	2006.384	
HJ258	15h 56.9m	+36° 13'	9.8, 10.8	86.7	25.6	4	2006.384	
HJ2800	15h 57.3m	+30° 05'	9.7, 11.7	279.7	14.3	4	2006.384	
VKI23	16h 00.0m	+36° 50'	11.2, 13.2	349.6	4.2	20	2006.386	REDUC
AG349	16h 01.1m	+28° 08'	9.1, 10.1	227.0	11.7	4	2006.384	
HJ580	16h 02.8m	+37° 05'	9.2, 12.2	7.3	40.6	4	2006.384	
HJ581	16h 04.5m	+32° 26'	10.3, 11.4	55.8	21.0	4	2006.384	same as GYL 14?
HJ582	16h 07.1m	+35° 07'	9.7, 12.0	232.0	22.3	4	2006.384	
ALI370	16h 07.6m	+35° 48'	13.7, 14.1	146.4	13.1	8	2006.384	same as HJ259?
COU1276	16h 08.9m	+37° 58'	10.0, 12.0	54.7	2.7	20	2006.386	REDUC
HJ1289	16h 10.6m	+39° 28'	12.5, 13.4	238.5	11.3	4	2006.384	
HJ260	16h 11.8m	+37° 25'	10.0, 11.0	27.1	19.9	4	2006.384	
HO551	16h 12.4m	+26° 26'	8.3, 12.8	78.6	7.1	4	2006.384	
STF2032AB	16h 14.7m	+33° 52'	5.2, 6.3	240.2	8.0	4	2006.384	
COU980AC	16h 17.2m	+33° 41'	10.1, 10.5	81.3	39.4	4	2006.384	
HJ584	16h 17.7m	+39° 14'	10.3, 11.5	203.3	15.2	4	2006.384	

Table 1: Double Star Measures. *Continued from previous page*