Double Star Measurements Using a Webcam, Annual Report of 2008

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Abstract: I report on the measurements of 109 double stars of 2008 using a standard webcam. For STF 60, STF 697, STFB 10 and BU 1516 I recommend companions not yet listed in the WDS catalog.

For my observations I use a small 8 inch Newtonian telescope with a standard webcam described in my previous reports (Schlimmer 2007a, Schlimmer 2008b). This webcam is running on a Windows 2000 notebook. For analyzing the records the program REDUC (Version 3.82) is used.

In 2008 I applied my attention more to the double stars from the neglected list and also to optical double stars with high proper motion (Schlimmer, 2009a). Often, background stars are dim and the signal to noise ratio is too low to detect the background star directly in every frame.

To improve the signal to noise ratio an advanced technique called "shift and add" method or also known as "stacking" was used. This technique was first used in speckle interferometry analyses of Betelgeuse (Lynds et. al, 1976). In some cases it's useful to make a "dark frame", which will be subtracted from every single frame. After this procedure, a flat stacked image is the result. Hot pixels are eliminated and background stars are better evaluated. The stacking technique is implemented in REDUC and REGISTAX. Flat images can also be made with REGISTAX.

Figure 1 illustrates this technique using images of 61 Cygni AB with optical companion H. The first row shows a part of a single frame from the webcam record, the histogram of this clipping and a splice through component H and background noise. The second row shows a stacked frame as result of 50 single frames. The histogram shows less variance in the background noise. As a result, we get a much better signal to noise ratio. Component H is easy to detect. The third row shows the stacked frame after subtraction of the dark frame. The brightness in this example is normalized to the background of rows one and two.

In this case, the signal to noise ratio of component H is good enough so that REDUC can analyze every single frame of the 61 Cygni record. However, in this field are background stars fainter than component H.

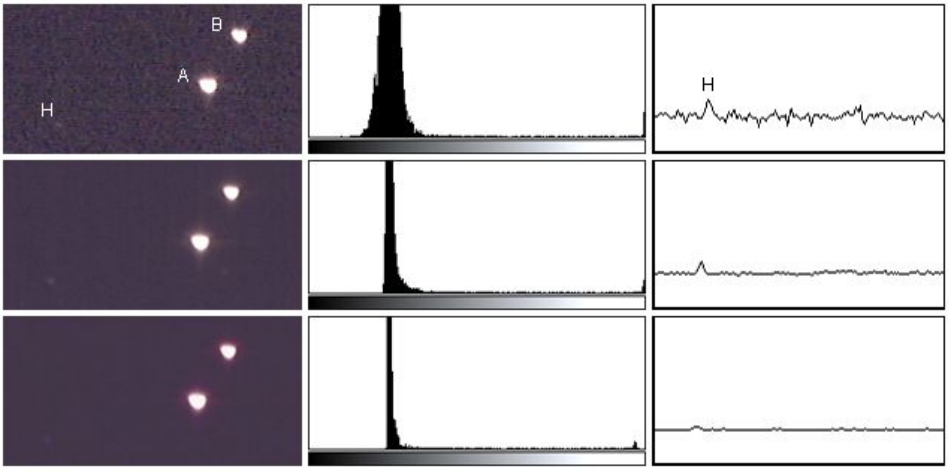

Figure 1: Left Column: images of 61 Cygni; Middle Column: Histogram of images to left; Right Column: slice through component H and background noise

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WDS 00491+5749, STF 60AB is also known as η Cassiopeiae. See Figure 2. Its component B is physical, with a period of about 480 years. Eta Cassiopeiae is also a high proper motion star, with proper motion of nearly 1300 mas per year. In WDS catalog a couple of optical background stars are listed, but in my observations only component E could be identified. Component A moves towards background star E. Time of closest approach is the year 2059, distance will be about 15 as and position angle will be about 205°. In my analyses, I found two small background components which can't be attached to components C through H.

WDS 05235+1602, STF 697AB was discovered in 1828. Figure 3 is an image of this system. A second component (WAL 38AC) was discovered in 1901. In the WDS (Mason et. al., 2008) 45 measurements for AB and 7 measurements for AC are listed. In nearly

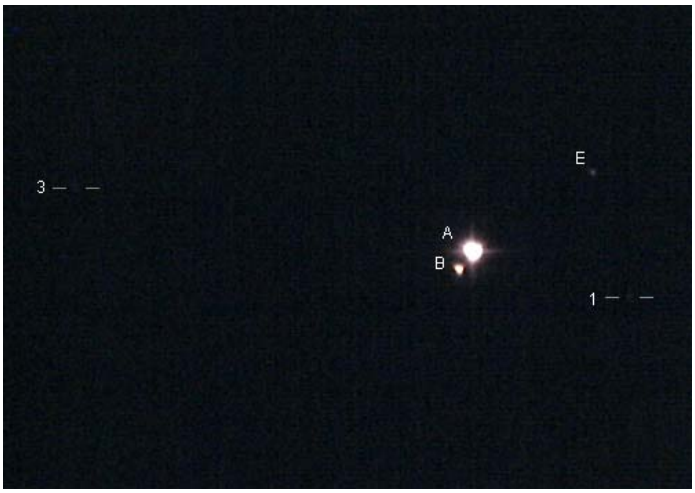

Figure 2: Eta Cassiopeiae with background stars marked 1 and 3, not listed in WDS catalog

200 years of observation, no movement can be found for component B. For component C there is a very small movement in 100 years of observation.

At a distance of about 248 arc seconds a further background star can be found. Figure 3 shows a result of 50 stacked frames. The unknown background star is marked with lines. Because the position angles of all four components are the same, all components are in line.

WDS 19508+0852, STFB 10, Altair, is in constellation Aquila. See Figure 4. Altair is not known as binary star, but three optical companions are listed in the WDS catalog. Because of these companions, the high proper motion of Altair is easy to observe. In my

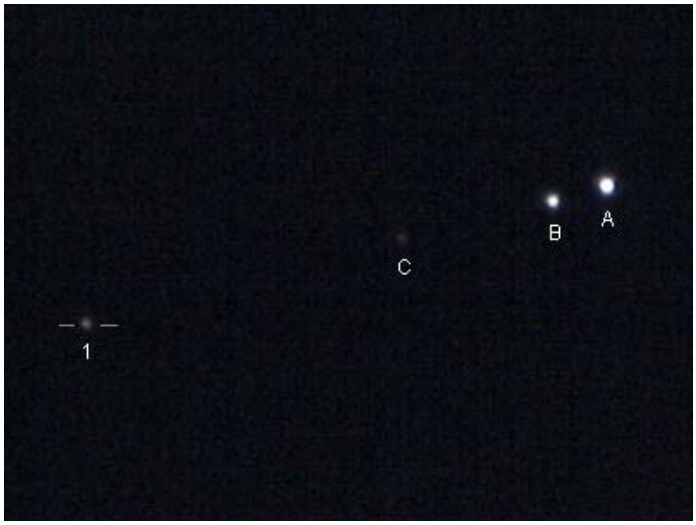

Figure 3: WDS 05235+1602 with an unlisted background star marked with lines

own observations I found two further optical companions, marked with lines.

WDS 22415+1050, BU 1516 was discovered in 1879. The primary star is known as 42 Pegasi. Two background stars B and C are listed in the WDS catalog. Component B has a brightness of 11.6 magnitudes and has been observed only 7 times. Because of its low brightness, component B is not visible in figure 5. Component C is a little bit brighter (magnitude 11.0) and has been observed only 2 times (1879 and 2000). A third measurement was done by the author. Two further components which are not listed in WDS catalog were also found.

Figure 4: WDS 19508+0852, STFB 10, Altair with two companions which are not listed in WDS catalog

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References

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Schlimmer 2008b, Double Star Measurements Using a Webcam: Annual Report of 2007, Journal of Double Star Observations, Vol. 4 No. 2, Pages 81-83

Schlimmer 2009a, An Investigation on the Relative Proper Motion of Some Optical Double Stars, Journal of Double Star Observations, Vol. 5 No. 1, Pages 10-17

Figure 5: WDS 22415+1050 with component C and two further companions not listed in WDS catalog.

Name	RA + DEC	Mags	PA	Sep	Date	N	Notes
H 5 32Aa-B	00084+2905	2.22, 11.11	284.4	89.55	2008.916	1	α And
STFA 1	00464+3057	7.25, 7.43	47.4	47.03	2008.916	43	1
STF 60AB	00491+5749	3.52, 7.36	323.0	12.97	2008.908	85	η Cas
STF 60AE	00491+5749	3.52, 10.15	124.3	82.61	2008.908	19	η Cas
STF 60A1	00491+5749	3.52	75.2	94.32	2008.908	1	2
STF 60A3	00491+5749	3.52	272.0	234.70	2008.908	1	3
STF 180AB	01535+1918	4.52, 4.58	0.9	7.70	2008.016	15	γ Ari
STF 180AB	01535+1918	4.52, 4.58	0.3	7.47	2008.906	51	γ Ari
STF 180AB-C	01535+1918	4.52, 8.63	82.1	214.65	2008.906	54	γ Ari
STT 47Aa-B	02500+2716	3.63, 11.04	290.2	32.77	2008.995	1	41 Ari
STT 47Aa-C	02500+2716	3.7, 10.66	230.3	27.17	2008.995	1	41 Ari
STT 47Aa-D	02500+2716	3.58, 8.80	233.3	121.39	2008.995	30	41 Ari
MLB 115	03162+5810	10.99, 11.38	3.0	4.80	2008.992	23	
STFA 7	03311+2744	7.41, 7.81	233.3	43.96	2008.992	41	
STF 401	03313+2734	6.58, 6.93	269.4	11.31	2008.995	35	Mayer 11

Table 1: Double star measurements by the author in 2008.

Table continued on next page.

Double Star Measurements Using a Webcam, Annual Report of 2008

Name	RA + DEC	Mags	PA	Sep	Date	N	Notes
STFA 11AB	04393+1555	4.69, 5.09	194.2	436.34	2008.016	73	σ Tau
STF 620	04583+1357	8.77, 9.81	237.8	3.92	2008.107	61	
SHJ 49AB	04590+1433	6.06, 7.43	305.4	39.15	2008.090	81	
SHJ 49AC	04590+1433	6.06, 9.60	88.7	54.37	2008.090	61	
STF 697AB	05235+1602	7.27, 8.10	285.7	25.88	2008.102	78	
WAL 38AC	05235+1602	7.27, 10.83	284.4	97.19	2008.102	32	
STF 697A1	05235+1602	7.27, ...	284.7	248.32	2008.102	1	4
HJ 3273	05267+1513	9.4, 9.9	47.6	11.48	2008.102	32	
STF 738AB	05351+0956	3.51, 5.45	43.5	4.12	2008.107	22	λ Ori AB
STF 738AC	05351+0956	3.7, 10.72	184.6	28.71	2008.107	53	λ Ori AC
STF 738AD	05351+0956	3.51, 9.63	271.5	77.96	2008.107	75	λ Ori AD
GUI 9AE	05351+0956	3.51, 9.22	279.2	150.44	2008.107	86	λ Ori AE
STF 748Aa-B	05353-0523	6.55, 7.49	31.0	8.85	2008.016	17	θ1 Ori
STF 748Aa-C	05353-0523	6.55, 5.06	131.8	12.79	2008.016	36	
STF 748Aa-D	05353-0523	6.55, 6.38	96.2	21.53	2008.016	24	
STFA 16AB	05354-0525	5.03, 6.19	93.1	52.04	2008.016	36	θ2 Ori
STFA 16AC	05354-0525	5.2, 9.1	98.4	128.04	2008.016	37	
STF 761AB	05386-0233	7.86, 8.39	202.6	68.06	2008.016	39	
STF 761AB	05386-0233	7.86, 8.55	208.9	71.89	2008.016	39	
STF 762AB-C	05387-0236	3.73, 8.79	238.9	10.94	2008.016	7	σ Ori
STF 762AB-D	05387-0236	3.76, 6.56	83.8	12.94	2008.016	40	
STF 762AB-E	05387-0236	3.76, 6.34	61.6	41.41	2008.016	32	
J 1905	05456+2141	9.4, 9.7	266.0	5.76	2008.109	68	
HJ 712	05498+0605	9.4, 9.8	83.9	9.01	2008.109	41	
STF 816	05549+0552	6.90, 9.27	286.3	4.63	2008.107	1	
STF 919AB	06288-0702	4.62, 5.00	132.5	7.21	2008.090	213	β Mon
STF 919AC	06288-0702	4.63, 5.39	125.8	9.92	2008.090	167	
STTA 77Aa-	06290+2013	4.10, 8.01	329.9	112.16	2008.109	42	ν Gem
J 394	06320+1311	10.7, 11.5	291.1	4.50	2008.178	20	
AG 326	06324+1312	8.7, 9.5	4.1	23.54	2008.178	1	
STF1110AB	07346+3153	1.93, 2.97	59.2	4.59	2008.016	51	Castor
STF1110AC	07346+3153	1.93, 9.83	166.0	70.29	2008.016	42	

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Name	RA + DEC	Mags	PA	Sep	Date	N	Notes
LAM 6AC	07393+0514	0.38, 11.7	20.8	175.22	2008.178	1	Procyon
D 29AE	07393+0514	0.38, ...	67.5	467.84	2008.178	1	Procyon
STF1196AB	08122+1739	5.30, 6.25	42.6	0.98	2008.330	55	ζ Cnc
STF1196AC	08122+1739	5.31, 5.85	70.3	6.21	2008.319	116	
HJ 2452	08316+1806	5.35, 10.0	62.7	72.11	2008.319	1	θ Cnc
STFB 6AB	10084+1158	1.40, 8.24	308.3	174.93	2008.341	81	Regulus
STF1424AB	10200+1950	2.37, 3.64	126.1	4.64	2008.319	140	Algieba
STF1424AD	10200+1950	2.60, 10.0	302.1	367.77	2008.319	22	
STF1523	11182+3132	4.33, 4.80	224.8	1.59	2008.330	413	ξ UMa
STF1744AB	13239+5456	2.23, 3.88	152.4	14.39	2008.653	77	Mizar
STF1744AC	13239+5456	2.23, 4.01	70	706.08	2008.653	77	5
STF1744A1	13239+5456	2.23,	101.8	492.25	2008.653	21	6
SHJ 169	13547+1824	2.72, 9.99	85.8	111.99	2008.352	42	η Boo
STF1864AB	14407+1625	4.88, 5.79	112.7	5.47	2008.352	68	π Boo
STF1864AB-C	14407+1625	4.88, 10.6	166.2	126.2	2008.352	24	π Boo
STF1888AB	14514+1906	4.76, 6.95	308.8	6.17	2008.352	83	ξ Boo
STF1909	15038+4739	5.20, 6.10	59.2	1.72	2008.341	160	44 Boo
STFA 31Aa-B	16406+0413	5.76, 6.92	230.0	69.32	2008.560	56	36 Her
STF3127Aa-B	17150+2450	3.14, 8.3	286.3	11.85	2008.497	43	δ Her
STF3127Aa-C	17150+2450	3.12, 10.5	353.3	173.34	2008.497	45	δ Her
STF3127Aa-D	17150+2450	3.12, 10.6	90.4	191.85	2008.497	36	δ Her
STF1670AE	12417-0127	3.48, 8.94	168.2	258.75	2008.319	34	γ Vir
STF1670AF	12417-0127	3.48, 9.53	267.8	422.81	2008.319	22	γ Vir
STFA 34AB	17346+0935	5.80, 7.50	190.3	40.98	2008.560	53	53 Oph
STFA 34AC	17346+0935	5.80, 11.9	344.0	97.15	2008.560	1	53 Oph
STFA 34AD	17346+0935	5.80, 10.8	213.4	127.04	2008.560	1	53 Oph
STFA 34BD	17346+0935	7.50, 10.8	223.7	91.10	2008.560	1	53 Oph
STF2272AB	18055+0230	4.20, 6.20	133.2	5.69	2008.538		70 Oph
TOB 271AC	18073+1557	6.82, 8.70	340.6	111.87	2008.653	44	
H 5 39AB	18369+3846	0.02, 9.5	183.2	80.67	2008.497	34	Vega
STFA 37AB-	18443+3940	5.15, 5.25	172.3	208.58	2008.689	53	ε Lyr
STFA 37AI	18443+3940	6.10, 10.43	137.4	150.13	2008.689	40	ε Lyr
STFA 37Cc-I	18443+3940	5.25, 10.43	37.4	121.00	2008.689	33	ε Lyr
STF2383CD-E	18443+3940	4.56, 11.71	333.0	64.48	2008.560	1	ε Lyr

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Name	RA + DEC	Mags	PA	Sep	Date	N	Notes
STFA 39AB	18501+3322	3.63, 6.69	148.1	45.59	2008.664	85	β Lyrae
BU 293AE	18501+3322	3.63, 10.14	318.6	66.84	2008.664	17	β Lyrae
BU 293AF	18501+3322	3.63, 10.62	18.9	86.74	2008.664	17	β Lyrae
STFB 10AB	19508+0852	0.95, 9.82	285.9	192.49	2008.653	35	Altair
STFB 10AC	19508+0852	0.77, 10.1	107.1	188.78	2008.653	1	Altair
STFB 10A1	19508+0852	0.77, 11.0	354.9	153.36	2008.653	1	7
STFB 10A2	19508+0852	0.77	44.7	298.38	2008.664	1	8
STT 532AC	19553+0624	3.81, 11.24	348.7	214.83	2008.664	1	β Aql
LAU 4	20309+1126	10.0, 11.26	270.8	28.21	2008.664	1	
STF2690Aa-BC	20312+1116	7.12, 7.39	254.8	17.66	2008.664	57	9
STF2727	20467+1607	4.36, 5.03	266.1	9.16	2008.664	73	γ Del
STF2742	21022+0711	7.41, 7.64	214.2	2.82	2008.741	18	HIP103813
STFA 54AD	21103+1008	4.70, 6.06	152.2	334.62	2008.741	48	γ Equ
S 781AB-D	21135+0713	7.42, 7.17	172.0	183.13	2008.741	24	
STF2777AB-C	21145+1000	4.54, 10.17	7.2	73.90	2008.741	1	δ Equ
STT 433AB	21179+3454	4.43, 10.0	219.5	14.15	2008.689	1	66 Cyg
STT 433AC	21179+3454	4.43, 9.95	181.0	21.23	2008.689	1	66 Cyg
BU 1516AC	22415+1050	3.40, 11.0	8.9	175.49	2008.771	1	42 Peg
BU 1516A1	22415+1050	3.40, ...	164.8	147.03	2008.771	1	10
BU 1516A2	22415+1050	3.40, ...	129.2	62.32	2008.771	1	11
BU 1144Aa-BC	22430+3013	3.02, 9.87	338.1	93.12	2008.771	33	η Peg
HJ 301AB	22467+1210	4.19, 12.36	91.0	10.46	2008.771	1	46 Peg
STTA241	22586+1203	8.28, 8.37	160.7	84.13	2008.771	38	12
GIC 192AB	23266+4520	7.36, 9.83	330.1	55.10	2008.908	34	
GIC 192AC	23266+4520	7.37, 12.39	353.9	57.13	2008.908	1	
GIC 192BC	23266+4520	7.37, 12.39	67.2	23.18	2008.908	1	
STF3048AB	23581+2420	7.94, 10.17	313.6	8.49	2008.916	35	
STF3048AC	23581+2420	7.94, 11.33	265.0	37.46	2008.916	1	

Notes:

1. STFA 1 = Mayer 1 (Schlimmer 2007b)
2. Components are not one of C,D,F,G or H in WDS. See report above and Figure 2.
3. Components are not one of C,D,F,G or H in WDS. See report above and Figure 2.

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4. Companion or background star not listed in Washington Double Star Catalog. See report above and Figure 3.
5. Measured with Leitz ocularmicrometer and not electronically.
6. Star between Mizar and Alcor, not yet listed in Washington Double Star Catalog.
7. Companion or background star near Altair not listed in Washington Double Star Catalog, magnitude estimated to be 11.0
8. Companion or background star near Altair not listed in Washington Double Star Catalog, magnitude estimated to be 11.0
9. STF2690Aa-BC = Mayer 65 (Schlimmer, 2007a)
10. Companion not listed in Washington Double Star Catalog.
11. Companion not listed in Washington Double Star Catalog.
12. Near 52 Pegasi