Jonckheere Double Star Photometry – Part I: Cyg

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Abstract: If any double star discoverer is in urgent need of photometry then it is Jonckheere. There are over 3000 Jonckheere objects listed in the WDS catalog and a good part of them have magnitudes which are obviously far too bright. To keep the workload manageable only one image per object is taken and photometry is done with a software allowing a simple point and click procedure – even a single measurement is better than the current estimate.

Preamble: This report in no way intended to belittle the work of Jonckheere – on the contrary: He was obviously a very dedicated and able double star observer fighting with a lot of obstacles until his equipment was destroyed in war. It seems that the basic double star parameters, RA/Dec coordinates and separation as well as position angle, were his main concern, while the estimation of magnitudes was rather a side issue to him. To give Jonckheere the credit he deserves I invited John Nanson (Star Splitters Double Star Blog) to contribute historical background information about the life and work of Jonckheere.

1. Introduction

Starting with visual double star observations several years ago I quickly became aware that there is some variation in reliability of the parameters listed in the WDS catalog especially regarding magnitudes of faint secondaries. Especially in regard to all objects with discoverer designation J, it is usually a sure bet that there is room for mag data improvement. Soon I started communication with Brian Mason on this topic leading to corrections based on my observation reports and the Vmag data to be found in other catalogs especially UCAC4. But with the given means this resulted in just another estimation even if based on new impressions. After discovering the possibility of doing photometry with iTelescope V-filter images with tools like AAVSO VPhot, MaxIm DL6, and Astrometrica, I decided to give this issue a direct approach. In a perfect world this would mean several images per object in B- and V-filter for stacking with several telescopes with known B-V transformation coefficients all delivering more or less similar results. The latter would anyway not be the case and the former would take years to complete. To keep the workload within my personal possibilities I thought it might be best to take only one single iT24 3s image per object and do photometry with Astrometrica allowing a kind of point and click procedure as Astrometrica simply uses all plate solving based reference stars as comparison stars - because even a single image based precise measurement is better than mere estimation. For a starter I selected all J-objects in Cyg given in Table 1 with all values based on WDS data as of April 2015.

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Table 1: WDS April 2015 values for the Jonckheere objects in Cyg sorted by designation number

WDS ID	Name		RA	Dec	Sep	M1	M2	PA
WDS20334+4752	J4	AB	20:33:24.188	+47:51:37.101	2.5	11.36	12.05	0
WDS19534+2923	J25	AB	19:53:21.849	+29:22:43.300	1.7	10.65	10.90	8
WDS19308+3614	J117	AB	19:30:46.829	+36:13:42.697	26.7	6.25	13.70	158
WDS19308+3614	J117	AC	19:30:46.829	+36:13:42.697	22.6	6.25	13.70	27
WDS19430+3526	J122	AB	19:42:57.303	+35:26:31.795	9.7	10.19	13.20	53
WDS19510+4140	J125	AB	19:50:57.172	+41:40:41.093	2.1	10.18	10.66	210
WDS20239+3912	J129	AB	20:23:51.828	+39:12:34.802	3.3	10.45	11.16	34
WDS20300+4149	J130	AB	20:30:00.783	+41:48:44.396	2.5	10.26	10.75	265
WDS20338+3312	J190	AB	20:33:44.018	+33:12:08.806	2.4	10.29	12.60	342
WDS20338+3312	J190	AC	20:33:44.018	+33:12:08.806	9.0	10.29	14.40	106
WDS20368+3157	J568	AB	20:36:48.300	+31:57:07.899	5.0	11.20	11.40	351
WDS21145+4329	J610	AB	21:14:29.279	+43:28:48.603	3.3	9.50	10.70	26
WDS21467+4533	J616	AB	21:46:42.111	+45:34:33.505	4.9	9.70	12.70	302
WDS19221+2907	J770	AB	19:22:03.097	+29:07:08.803	3.3	9.70	10.80	15
WDS19393+3406	J775	AB	19:39:07.888	+34:05:29.095	2.0	11.20	13.30	93
WDS19401+3037	J776	AB	19:40:08.450	+30:35:50.203	3.5	11.16	11.50	47
WDS19401+3037	J776	AC	19:40:08.450	+30:35:50.203	26.5	11.16	14.30	32
WDS19425+3337	J777	AB	19:42:29.913	+33:35:58.003	2.7	9.50	12.50	187
WDS19436+3339	J778	AB	19:43:38.742	+33:38:55.501	3.6	10.98	14.30	350
WDS19436+3339	J778	AC	19:43:38.742	+33:38:55.501	4.7	10.98	11.50	284
WDS19486+3339	J779	AB	19:48:37.749	+33:41:15.398	4.8	10.37	12.40	286
WDS19501+3130	J780	AB	19:50:06.182	+31:29:53.099	2.4	11.75	11.10	92
WDS19553+3011	J781	AB	19:55:16.951	+30:11:26.501	2.9	11.50	11.40	126
WDS19553+3011	J781	AC	19:55:16.951	+30:11:26.501	10.0	11.50	14.30	98
WDS19553+3011	J781	BC	19:55:17.130	+30:11:24.798	7.4	11.40	14.30	91
WDS19565+3156	J782	AB	19:56:32.358	+31:56:48.103	2.4	11.00	11.23	68
WDS19576+4033	J783	AB	19:57:35.880	+40:33:11.299	6.4	10.66	11.00	353
WDS20165+3406	J785	AB	20:16:28.893	+34:04:08.799	2.6	9.50	9.80	24
WDS20165+3406	J785	AC	20:16:28.893	+34:04:08.799	9.9	9.50	10.00	11
WDS20233+3351	J786	AB	20:23:19.123	+33:53:26.497	3.3	11.99	12.03	93
WDS20231+4047	J787	AB	20:23:07.299	+40:46:55.205	2.6	9.40	12.00	165
WDS20231+4047	J787	AC	20:23:07.299	+40:46:55.205	9.5	9.40	12.50	112
WDS20231+4047	J787	AD	20:23:07.299	+40:46:55.205	15.9	9.40	13.10	293
WDS20231+4047	J787	CD	20:23:08.068	+40:46:51.896	25.3	12.50	13.10	292
WDS20271+3322	J788	AB	20:27:10.618	+33:23:16.596	4.0	10.57	12.20	345
WDS20300+3448	J789	AB	20:29:58.771	+34:48:01.796	2.3	11.18	11.29	97
WDS20350+3419	J791	AB	20:35:02.481	+34:20:30.894	3.3	11.91	12.90	179
WDS20350+3419	J791	AC	20:35:02.481	+34:20:30.894	18.4	11.91	11.59	230
WDS20356+3432	J792	AB	20:35:31.787	+34:32:00.699	3.4	9.50	9.70	321
WDS20359+3458	J793	AB	20:35:55.058	+34:57:18.103	2.9	11.40	11.40	67

Table 1 continues on next page.

Jonckheere Double Star Photometry – Part I: Cyg

Table 1(continued) : WDS April 2015 values for the Jonckheere objects in Cyg ...

WDS ID	Name		RA	Dec	Sep	M1	M2	PA
WDS20581+3544	J795	AB	20:58:01.993	+35:43:42.299	2.7	11.10	11.70	228
WDS20581+3544	J795	AC	20:58:01.993	+35:43:42.299	13.8	11.10	13.70	311
WDS20581+3547	J796	AB	20:58:02.982	+35:45:29.306	3.7	10.68	13.30	200
WDS19363+4138	J800	AB	19:36:21.857	+41:38:28.296	1.6	10.01	11.44	178
WDS19409+3300	J815	AB	19:40:58.328	+32:47:23.097	2.8	9.60	10.60	272
WDS20302+3245	J843	AB	20:30:10.931	+32:45:16.095	4.0	9.60	9.80	138
WDS20595+3019	J847	AB	20:59:30.941	+30:18:29.997	2.1	10.70	11.00	127
WDS19435+2750	J1034	AB	19:43:29.569	+27:50:04.898	2.6	9.67	13.30	102
WDS19576+3914	J1069	AB	19:57:38.592	+39:14:21.699	2.3	13.20	13.90	245
WDS19584+3830	J1070	AB	19:58:21.171	+38:30:35.994	3.7	9.60	9.60	71
WDS20057+3905	J1072	AB	20:05:41.908	+39:05:36.003	4.1	10.30	11.80	252
WDS20580+3713	J1076	AB	20:57:57.908	+37:13:57.900	2.0	9.60	9.80	82
WDS21029+3554	J1078	AB	21:02:52.183	+35:53:27.802	2.6	9.95	10.85	110
WDS21029+3554	J1078	AC	21:02:52.183	+35:53:27.802	24.4	9.95	12.20	138
WDS20344+3513	J1143	AB	20:34:22.202	+35:12:50.897	4.0	11.10	11.80	270
WDS19595+3548	J1158	AB	19:59:30.021	+35:47:32.202	1.4	10.51	12.50	161
WDS19595+3546	J1159	AB	19:59:27.171	+35:47:22.699	2.8	11.57	12.10	291
WDS19514+3435	J1160	AB	19:50:56.369	+34:37:11.406	5.9	12.70	12.70	293
WDS19514+3435	J1160	AC	19:50:56.369	+34:37:11.406	6.8	12.70	15.20	57
WDS19514+3434	J1161	AB	19:51:29.067	+34:35:00.998	4.9	10.00	10.20	313
WDS20099+3324	J1163	AB	20:09:37.187	+33:24:39.199	4.6	10.84	12.30	276
WDS20312+4137	J1196	AB	20:31:08.218	+41:35:32.597	5.0	9.50	10.50	4
WDS19332+3614	J1207	AB	19:33:17.239	+36:13:52.201	1.1	10.45	11.21	72
WDS20472+3730	J1210	AB	20:47:12.330	+37:29:39.099	2.9	10.07	14.10	238
WDS21001+3627	J1219	AB	21:00:04.731	+36:27:00.305	3.6	9.67	11.90	171
WDS21194+3306	J1228	AB	21:19:23.033	+33:05:41.002	3.8	9.30	10.60	281
WDS21210+3304	J1229	AB	21:21:00.118	+33:04:56.906	2.2	10.69	11.20	303
WDS20233+3338	J1231	AB	20:23:19.940	+33:39:53.605	6.3	9.10	12.00	83
WDS21389+4249	J1232	AB	21:38:48.497	+42:50:26.404	2.7	12.60	13.10	204
WDS21117+3038	J1235	AB	21:11:45.357	+30:38:17.900	2.7	9.80	10.30	184
WDS21319+3121	J1236	AB	21:32:01.371	+31:20:52.400	2.1	12.48	12.39	292
WDS20484+4002	J1237	BC	20:48:21.833	+40:02:07.496	5.5	11.92	12.60	355
WDS20391+3103	J1238	AB	20:39:13.292	+31:03:02.902	3.6	9.60	10.50	17
WDS19444+2903	J1240	AB	19:44:22.310	+29:04:09.403	66.2	10.42	12.11	97
WDS19444+2903	J1240	BC	19:44:27.323	+29:04:01.500	3.3	12.11	12.10	356
WDS19514+3332	J1259	AB	19:51:15.629	+33:32:06.302	4.3	10.92	14.50	89
WDS19514+3332	J1259	AC	19:51:15.629	+33:32:06.302	8.5	10.92	13.50	257
WDS21070+3001	J1319	AB	21:07:02.733	+30:01:04.600	1.9	10.26	13.90	203
WDS20234+3007	J1772	AB	20:23:26.257	+30:06:54.500	2.4	10.46	10.77	97
WDS20563+2954	J1779	AB	20:56:16.469	+29:53:46.801	2.4	11.90	11.90	247

Table 1 concludes on next page.

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Table 1(conclusion) : WDS April 2015 values for the Jonckheere objects in Cyg ...

WDS ID	Name		RA	Dec	Sep	M1	M2	PA
WDS21162+2928	J1784	AB	21:16:04.902	+29:28:30.702	4.8	11.00	12.00	341
WDS20554+3059	J2329	AB	20:54:48.991	+30:59:11.399	6.5	9.70	11.40	11
WDS20576+3003	J2333	AB	20:57:25.072	+30:02:10.497	7.7	12.80	13.80	327
WDS20578+3002	J2334	AB	20:57:35.722	+30:00:49.198	5.1	12.70	12.70	16
WDS21046+3116	J2336	AB	21:04:32.818	+31:15:42.702	9.1	11.30	11.30	40
WDS21086+3135	J2337	AB	21:08:29.882	+31:34:51.000	6.1	9.40	11.80	349
WDS21229+3149	J2344	AB	21:22:51.238	+31:47:03.397	6.6	12.70	13.60	227
WDS21242+3358	J2346	AB	21:23:41.892	+33:57:18.199	4.1	9.50	9.70	227
WDS21307+3107	J2351	AB	21:30:17.043	+31:08:14.501	4.7	10.00	12.50	347
WDS21346+2856	J2352	AB	21:34:43.681	+28:57:47.800	6.4	10.00	12.00	248
WDS21441+3205	J2354	AB	21:44:16.350	+32:05:06.395	4.9	11.50	11.80	199
WDS21441+3203	J2355	AB	21:44:17.881	+32:03:02.195	3.4	11.90	12.90	345
WDS21457+3152	J2356	AB	21:45:37.388	+31:51:55.503	6.3	12.81	12.97	135
WDS19216+2832	J2963	AB	19:21:30.832	+28:33:11.602	4.2	12.00	12.50	345
WDS19393+2822	J2989	AB	19:39:12.379	+28:21:02.103	4.5	9.70	12.00	272
WDS20135+3031	J3063	AB	20:13:30.091	+30:31:03.803	4.7	12.00	12.30	76
WDS20538+3029	J3117	AB	20:53:35.623	+30:28:05.097	5.3	13.05	13.10	40
WDS20590+2929	J3119	AB	20:59:07.389	+29:30:22.398	8.5	11.40	12.30	131
WDS21050+3109	J3124	AB	21:04:35.558	+31:06:20.697	4.7	12.20	12.40	206
WDS21085+3355	J3126	AB	21:08:23.448	+33:55:01.598	6.0	10.00	12.90	348
WDS21132+3202	J3127	AB	21:13:15.238	+32:01:23.400	4.0	12.30	12.30	20
WDS21132+3202	J3127	AC	21:13:15.238	+32:01:23.400	11.9	12.30	13.00	195
WDS21138+3500	J3128	AB	21:13:46.117	+34:57:57.104	5.0	10.00	10.50	52
WDS21138+3500	J3128	AC	21:13:46.117	+34:57:57.104	15.3	10.00	12.50	93
WDS21149+3407	J3129	AB	21:14:48.073	+34:05:35.797	4.7	12.50	13.00	325
WDS21149+3407	J3129	AC	21:14:48.073	+34:05:35.797	11.5	12.50	15.00	148
WDS21166+3018	J3131	AB	21:16:19.012	+30:20:27.798	24.8	12.10	12.52	253
WDS21166+3018	J3131	BC	21:16:17.110	+30:20:20.203	5.6	12.52	14.50	229
WDS21205+3107	J3135	AB	21:20:14.333	+31:09:50.302	4.1	11.00	13.50	96
WDS21214+3321	J3136	AB	21:21:01.828	+33:18:59.694	7.8	12.30	12.40	178
WDS21256+2957	J3139	AB	21:25:31.350	+29:58:57.900	6.7	10.80	10.90	332
WDS21331+2958	J3141	AB	21:33:06.280	+29:57:12.101	6.7	12.20	12.20	314
WDS21340+4156	J3142	AB	21:34:01.871	+41:55:19.395	5.3	11.30	11.80	56
WDS21412+3043	J3143	AB	21:41:11.079	+30:45:08.102	6.6	10.00	12.50	262
WDS21520+3653	J3149	AB	21:52:01.971	+36:51:44.805	4.9	9.40	12.00	93
WDS21533+4144	J3152	AB	21:53:12.208	+41:43:38.303	4.6	10.00	14.00	240
WDS19421+3336	J3217	AB	19:42:14.072	+33:34:40.907	4.9	11.27	12.70	156

2. Robert Jonckheere (1888-1974)

During the course of a long career devoted to double star astronomy Robert Jonckheere discovered a total of 3350 double stars, which he collected and published in his 1962 *Catalogue Général de 3350 étoiles doubles de faible éclat observées de 1906 à 1962*. The vast majority of those stars have separations of between two and six arc seconds, with the magnitudes of the secondaries typically ranging between tenth and eleventh magnitude. Those characteristics are not accidental, but were based on a goal set by Jonckheere at the beginning of his career. In late 1908/early 1909, when he began an examination of the sky between declinations of +50° and -10°, he set a separation limit of five arc seconds for pairs with primaries fainter than seventh magnitude (Jonckheere, 1917, p. 12-13).

He began his career in 1908 as an amateur astronomer, working first from a small observatory built on the roof of the family home in Roubaix in northeastern France, near the Belgian border, and then from a more elaborate observatory constructed a short distance away in Hem, not far from the University of Lille. The first observatory was equipped with a 22cm (8.7 inch) refractor, and the second with a 33cm (13 inch) refractor. By his own accounting he discovered seventy double stars at the first facility in 1906 and 1907, and another 1010 at the second observatory between 1908 and 1928 (Jonckheere, 1962, p.3).

Jonckheere's observations were interrupted in August, 1914, by the beginning of World War I, which forced him to leave northeastern France. He was able to secure a position at the Greenwich Observatory in England, where he discovered another 252 pairs between 1914 and 1919 with the 71cm (28 inch) refractor. At the end of the war, he returned to France, restored his damaged observatory, and continued observing until 1928. The economic turmoil of the period soon forced him to sell the observatory and equipment at Hem, after which he moved to Marseille and engaged in a series of unsuccessful business ventures.

Unable to ignore his deep-rooted passion for double star astronomy, Jonckheere presented himself at the Marseille Observatory in March, 1930, and was assigned the use of a 25.8cm (10 inch) refractor for a two week period, during which he discovered nine new pairs. In 1942 he obtained a position with the National Center for Scientific Research and was assigned to the Marseilles Observatory, which marked the beginning of a new career as a professional astronomer. Between 1930 and his retirement in 1962, Jonckheere discovered another 1857 new pairs of double stars, most of those at Marseilles, but also at observatories in Strasbourg, Nice, Toulouse, and St. Michel.

Like his predecessor S.W. Burnham, who with his 152mm (six inch) refractor demonstrated as early as the late 1870's there were still more double stars to be discovered despite arguments to the contrary, Jonckheere found himself probing new double star frontiers even as Burnham wrote to him in 1908 "all one should do now is re-measure the pairs already discovered" (Jonckheere, 1948, p. 150). Toward the end of his career, he still felt there was a need to continue the search for double stars. In response to a statement by R.G. Aitken that "we do not need more double star discoveries . . . There is little to be gained in adding to the number we now know", Jonckheere wrote "I should be very sorry if young men of today were discouraged in this field" (Jonckheere, ibid).

Also like S.W. Burnham, Jonckheere seems to have had particularly acute vision. In 1914, while looking at a pair of 9.8 magnitude stars (J 900, separated by 2.17") with the 28 inch at Greenwich, which he had discovered in 1912, he discovered they were actually two condensed nebula (Jonckheere, 1917, p. 10). Edward Emerson Barnard was unable to duplicate the feat with the 102cm (40 inch) refractor at Yerkes Observatory, but photographic confirmation by H.D. Curtis took place four years later. Georges van Biesbroeck was unable to confirm some of Jonckheere's faint pairs with the 210cm (82.7 inch) telescope at McDonald Observatory, and at Lick Observatory, Willem H. van den Bos remarked on Jonckheere's ability (Thorel, 2001).

In a discussion of magnitudes on page five of his *Catalogue Général*, Jonckheere alluded to his sensitive vision when he wrote ". . . for the faint stars magnitude estimates vary greatly from one observer to another. There can sometimes be two magnitudes of difference between the ones I have published and the estimates given by van Biesbrock; is it because I see the faint star too easily?"

Jonckheere retired in 1962, but retained his ties to astronomy up until his death at Marseilles twelve years later, just one month short of his 86th birthday.

3. Photometry

For each of the listed J-objects one single image was taken (in Bessel epoch 2015.640) with iTelescope iT24 with 3s exposure time. Initial plate solving was done by VPhot and in the few cases with negative VPhot result again but positive with MaxIm DL6/ PinPoint. Each image was then once more plate solved with Astrometrica giving not only RA/Dec coordinates but also photometry results for all reference stars used

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Table 2: Bessel epoch 2015.640 photometry results for the J objects in Cyg. "M1 WDS" and "M2 WDS" are the catalog values. "M1 new" stands for reported M1, "dM1" stands for delta between "M1 WDS" and "M1 new". "M2 new" stands for reported M2, "dM2" stands for delta "M1 WDS" and "M1 new". "dVmag" stands for the average delta Vmag over all reference stars used in the image

WDS ID	Name		M1 WDS	M1 new	dM1	M2 WDS	M2 new	dM2	dVmag	Notes
WDS20334+4752	J4	AB	11.36	**11.222**	0.14	12.05	**11.447**	0.60	0.14	Overlapping star disks
WDS19534+2923	J25	AB	10.65	**10.428**	0.22	10.90	**12.266**	-1.37	0.22	Overlapping star disks
WDS19308+3614	J117	AB	6.25			13.70	**14.090**	-0.39	0.09	M1 not measured, too bright
WDS19308+3614	J117	AC	6.25			13.70	**14.140**	-0.44	0.09	M1 not measured, too bright
WDS19430+3526	J122	AB	10.19	**10.222**	-0.03	13.20	**13.261**	-0.06	0.18	WDS mags confirmed
WDS19510+4140	J125	AB	10.18	**10.062**	0.12	10.66	**10.276**	0.38	0.08	Overlapping star disks
WDS20239+3912	J129	AB	10.45	**10.495**	-0.04	11.16	**11.161**	0.00	0.06	Touching star disks, WDS mags confirmed
WDS20300+4149	J130	AB	10.26	**10.146**	0.11	10.75	**10.686**	0.06	0.06	Touching star disks, WDS mags confirmed
WDS20338+3312	J190	AB	10.29	**10.223**	0.07	12.60	**12.212**	0.39	0.07	Touching star disks, WDS mags confirmed
WDS20338+3312	J190	AC	10.29	**10.223**	0.07	14.40	**13.622**	0.78	0.07	
WDS20368+3157	J568	AB	11.20	**11.556**	-0.36	11.40	**12.598**	-1.20	0.06	
WDS21145+4329	J610	AB	9.50	**11.522**	-2.02	10.70	**12.434**	-1.73	0.08	Touching star disks
WDS21467+4533	J616	AB	9.70	**11.625**	-1.93	12.70	**14.226**	-1.53	0.08	
WDS19221+2907	J770	AB	9.70	**11.077**	-1.38	10.80	**12.082**	-1.28	0.18	Touching star disks
WDS19393+3406	J775	AB	11.20	**11.053**	0.15	13.30	**12.078**	1.22	0.16	Touching star disks
WDS19401+3037	J776	AB	11.16	**11.006**	0.15	11.50	**11.609**	-0.11	0.11	Touching star disks, WDS mags rather confirmed
WDS19401+3037	J776	AC	11.16	**11.006**	0.15	14.30	**12.946**	1.35	0.11	
WDS19425+3337	J777	AB	9.50	**11.161**	-1.66	12.50	**12.719**	-0.22	0.10	
WDS19436+3339	J778	AB	10.98	**10.854**	0.13	14.30	**13.229**	1.07	0.11	Touching star disks
WDS19436+3339	J778	AC	10.98	**10.854**	0.13	11.50	**12.260**	-0.76	0.11	Touching star disks
WDS19486+3339	J779	AB	10.37	**10.322**	0.05	12.40	**12.377**	0.02	0.09	WDS mags confirmed
WDS19501+3130	J780	AB	11.75	**11.251**	0.50	11.10	**11.208**	-0.11	0.10	Touching star disks
WDS19553+3011	J781	AB	11.50	**11.624**	-0.12	11.40	**11.576**	-0.18	0.13	Touching star disks
WDS19553+3011	J781	AC	11.50	**11.624**	-0.12	14.30	**14.582**	-0.28	0.13	
WDS19553+3011	J781	BC	11.40	**11.576**	-0.18	14.30	**14.582**	-0.28	0.13	
WDS19565+3156	J782	AB	11.00	**10.861**	0.14	11.23	**11.008**	0.22	0.10	Touching star disks
WDS19576+4033	J783	AB	10.66	**10.889**	-0.23	11.00	**11.822**	-0.82	0.08	
WDS20165+3406	J785	AB	9.50	**11.262**	-1.76	9.80	**11.784**	-1.98	0.11	Touching star disks
WDS20165+3406	J785	AC	9.50	**11.262**	-1.76	10.00	**12.053**	-2.05	0.11	

Table 3 continues on next page.

Table 2 (continued): Bessel epoch 2015.640 photometry results for the J objects in Cyg. ...

WDS ID	Name		M1 WDS	M1 new	dM1	M2 WDS	M2 new	dM2	dVmag	Notes
WDS20233+3351	J786	AB	11.99	**12.128**	-0.14	12.03	**12.349**	-0.32	0.12	
WDS20231+4047	J787	AB	9.40	**10.519**	-1.12	12.00	**11.405**	0.60	0.07	Touching star disks
WDS20231+4047	J787	AC	9.40	**10.519**	-1.12	12.50	**12.990**	-0.49	0.07	
WDS20231+4047	J787	AD	9.40	**10.519**	-1.12	13.10	**12.423**	0.68	0.07	
WDS20231+4047	J787	CD	12.50	**12.990**	-0.49	13.10	**12.423**	0.68	0.07	It seems that the current WDS mag data is a mismatch of C and D as the original Jonckheere observation also reports C about 0.5mag fainter than D
WDS20271+3322	J788	AB	10.57	**10.358**	0.21	12.20	**12.021**	0.18	0.13	
WDS20300+3448	J789	AB	11.18	**11.127**	0.05	11.29	**11.168**	0.12	0.08	Touching star disks, WDS mags confirmed
WDS20350+3419	J791	AB	11.91	**11.890**	0.02	12.90	**12.594**	0.31	0.09	
WDS20350+3419	J791	AC	11.91	**11.890**	0.02	11.59	**11.458**	0.13	0.09	WDS mags confirmed
WDS20356+3432	J792	AB	9.50	**11.419**	-1.92	9.70	**11.833**	-2.13	0.09	
WDS20359+3458	J793	AB	11.40	**11.522**	-0.12	11.40	**11.587**	-0.19	0.08	Touching star disks, WDS mags rather confirmed
WDS20581+3544	J795	AB	11.10	**10.852**	0.25	11.70	**11.182**	0.52	0.08	Touching star disks
WDS20581+3544	J795	AC	11.10	**10.582**	0.52	13.70	**12.964**	0.74	0.08	
WDS20581+3547	J796	AB	10.68	**10.632**	0.05	13.30	**12.418**	0.88	0.09	Touching star disks
WDS19363+4138	J800	AB	10.01	**10.2**	-0.19	11.44	**11.6**	-0.16	0.09	Overlapping star disks - no separate photometry possible. Combined magnitude measured with 9.942 gives estimated “M1 new” and “M2 new” values
WDS19409+3300	J815	AB	9.60	**11.965**	-2.37	10.60	**13.344**	-2.74	0.10	
WDS20302+3245	J843	AB	9.60	**11.752**	-2.15	9.80	**12.711**	-2.91	0.08	
WDS20595+3019	J847	AB	10.70	**11.036**	-0.34	11.00	**11.599**	-0.60	0.09	Overlapping star disks
WDS19435+2750	J1034	AB	9.67	**9.426**	0.24	13.30	**13.152**	0.15	0.11	Overlapping star disks, WDS mags rather confirmed
WDS19576+3914	J1069	AB	13.20	**13.159**	0.04	13.90	**13.441**	0.46	0.16	WDS mags rather confirmed
WDS19584+3830	J1070	AB	9.60	**11.402**	-1.80	9.60	**11.599**	-2.00	0.17	
WDS20057+3905	J1072	AB	10.30	**10.161**	0.14	11.80	**11.541**	0.26	0.09	WDS mags rather confirmed
WDS20580+3713	J1076	AB	9.60	**11.8**	-2.2	9.80	**12.0**	-2.2	0.07	Overlapping star disks - no separate photometry possible. Combined magnitude measured with 11.162 gives estimated “M1 new” and “M2 new” values
WDS21029+3554	J1078	AB	9.95	**9.736**	0.21	10.85	**10.423**	0.43	0.09	Overlapping star disks
WDS21029+3554	J1078	AC	9.95	**9.736**	0.21	12.20	**11.830**	0.37	0.09	
WDS20344+3513	J1143	AB	11.10	**11.796**	-0.70	11.80	**12.838**	-1.04	0.09	

Table 3 continues on next page.

Table 2 (continued): Bessel epoch 2015.640 photometry results for the J objects in Cyg. ...

WDS ID	Name		M1 WDS	M1 new	dM1	M2 WDS	M2 new	dM2	dVmag	Notes
WDS19595+3548	J1158	AB	10.51	**10.5**	0.01	12.50	**12.5**	0.0	0.10	Overlapping star disks - no separate photometry possible. Combined magnitude measured with 10.371 gives estimated "M1 new" and "M2 new" values
WDS19595+3546	J1159	AB	11.57	**10.121**	1.45	12.10	**13.389**	-1.29	0.09	No double star at WDS position. UCAC4 suggests position error. Correct position for A seems to be UCAC4-629-086966 RA 19:59:32.630 Dec +35:46:41.994 with UCAC4-629-086962 as secondary. Given mags are for these UCAC4 coordinates
WDS19514+3435	J1160	AB	12.70	**13.461**	-0.76	12.70	**13.652**	-0.95	0.09	
WDS19514+3435	J1160	AC	12.70	**13.461**	-0.76	15.20			0.09	Not resolved in this image, too faint
WDS19514+3434	J1161	AB	10.00	**14.894**	-4.89	10.20	**15.667**	-5.47	0.10	Magnitude differences with WDS this huge suggest position mismatch.
WDS20099+3324	J1163	AB	10.84	**8.192**	2.65	12.30	**9.006**	3.29	0.09	Magnitude differences with WDS this huge suggest position mismatch.
WDS20312+4137	J1196	AB	9.50	**11.256**	-1.76	10.50	**12.223**	-1.72	0.07	
WDS19332+3614	J1207	AB	10.45	**10.5**	-0.05	11.21	**11.3**	-0.09	0.12	Overlapping star disks - no separate photometry possible. Combined magnitude measured with 10.104 gives estimated "M1 new" and "M2 new" values
WDS20472+3730	J1210	AB	10.07	**9.996**	0.07	14.10	**12.653**	1.45	0.09	Touching star disks
WDS21001+3627	J1219	AB	9.67	**9.587**	0.08	11.90	**11.907**	-0.01	0.09	WDS mags confirmed
WDS21194+3306	J1228	AB	9.30	**10.658**	-1.36	10.60	**12.018**	-1.42	0.09	
WDS21210+3304	J1229	AB	10.69	**10.318**	0.37	11.20	**11.668**	-0.47	0.13	Overlapping star disks
WDS20233+3338	J1231	AB	9.10	**10.844**	-1.74	12.00	**13.230**	-1.23	0.16	
WDS21389+4249	J1232	AB	12.60	**12.245**	0.36	13.10	**12.526**	0.57	0.07	Touching star disks
WDS21117+3038	J1235	AB	9.80	**12.378**	-2.58	10.30	**12.380**	-2.08	0.08	
WDS21319+3121	J1236	AB	12.48	**11.874**	0.61	12.39	**11.942**	0.45	0.11	Touching star disks
WDS20484+4002	J1237	BC	11.92	**12.381**	-0.46	12.60	**13.720**	-1.12	0.08	
WDS20391+3103	J1238	AB	9.60	**11.447**	-1.85	10.50	**12.443**	-1.94	0.07	
WDS19444+2903	J1240	AB	10.42	**10.325**	0.10	12.11	**11.849**	0.26	0.09	WDS mags rather confirmed
WDS19444+2903	J1240	BC	12.11	**11.849**	0.26	12.10	**11.918**	0.18	0.09	Touching star disks
WDS19514+3332	J1259	AB	10.92	**10.721**	0.20	14.50	**13.221**	1.28	0.12	
WDS19514+3332	J1259	AC	10.92	**10.721**	0.20	13.50	**12.892**	0.61	0.12	
WDS21070+3001	J1319	AB	10.26	**10.3**	0.04	13.90	**13.9**	0.0	0.13	Overlapping star disks - no separate photometry possible. Combined magnitude measured with 10.303 gives estimated "M1 new" and "M2 new" values

Table 3 continues on next page.

Table 2 (continued): Bessel epoch 2015.640 photometry results for the J objects in Cyg. "...

WDS ID	Name		M1 WDS	M1 new	dM1	M2 WDS	M2 new	dM2	dVmag	Notes
WDS20234+3007	J1772	AB	10.46	**10.294**	0.17	10.77	**10.620**	0.15	0.11	Overlapping star disks, WDS mags rather confirmed
WDS20563+2954	J1779	AB	11.90	**11.791**	0.11	11.90	**11.840**	0.06	0.14	Touching star disks, WDS mags rather confirmed
WDS21162+2928	J1784	AB	11.00	**12.211**	-1.21	12.00	**13.369**	-1.37	0.17	
WDS20554+3059	J2329	AB	9.70	**11.314**	-1.61	11.40	**13.613**	-2.21	0.15	
WDS20576+3003	J2333	AB	12.80	**13.169**	-0.37	13.80	**14.257**	-0.46	0.15	Potential C component 15.107Vmag (UCAC4-601-123681) See Image 1
WDS20578+3002	J2334	AB	12.70	**12.804**	-0.10	12.70	**13.104**	-0.40	0.14	
WDS21046+3116	J2336	AB	11.30	**11.663**	-0.36	11.30	**12.088**	-0.79	0.10	
WDS21086+3135	J2337	AB	9.40	**11.084**	-1.68	11.80	**13.384**	-1.58	0.11	
WDS21229+3149	J2344	AB	12.70	**12.983**	-0.28	13.60	**13.783**	-0.18	0.14	
WDS21242+3358	J2346	AB	9.50	**11.529**	-2.03	9.70	**12.291**	-2.59	0.09	
WDS21307+3107	J2351	AB	10.00	**12.515**	-2.52	12.50	**13.827**	-1.33	0.07	
WDS21346+2856	J2352	AB	10.00	**12.791**	-2.79	12.00	**14.249**	-2.25	0.08	
WDS21441+3205	J2354	AB	11.50	**13.555**	-2.06	11.80	**13.646**	-1.85	0.07	
WDS21441+3203	J2355	AB	11.90	**13.184**	-1.28	12.90	**14.025**	-1.13	0.08	
WDS21457+3152	J2356	AB	12.81	**12.262**	0.55	12.97	**12.816**	0.15	0.10	
WDS19216+2832	J2963	AB	12.00	**13.146**	-1.15	12.50	**13.190**	-0.69	0.18	
WDS19393+2822	J2989	AB	9.70	**11.152**	-1.45	12.00	**12.595**	-0.60	0.09	
WDS20135+3031	J3063	AB	12.00	**13.325**	-1.33	12.30	**14.338**	-2.04	0.06	
WDS20538+3029	J3117	AB	13.05	**12.192**	0.86	13.10	**12.277**	0.82	0.10	
WDS20590+2929	J3119	AB	11.40	**11.507**	-0.11	12.30	**12.425**	-0.13	0.10	WDS mags rather confirmed
WDS21050+3109	J3124	AB	12.20	**10.992**	1.21	12.40	**13.082**	-0.68	0.09	
WDS21085+3355	J3126	AB	10.00	**11.961**	-1.96	12.90	**13.650**	-0.75	0.09	
WDS21132+3202	J3127	AB	12.30	**11.931**	0.37	12.30	**13.620**	-1.32	0.07	
WDS21132+3202	J3127	AC	12.30	**11.931**	0.37	13.00			0.07	No C star to be seen in this position. Bogus or fainter than mag 15?
WDS21138+3500	J3128	AB	10.00	**12.399**	-2.40	10.50	**12.988**	-2.49	0.13	
WDS21138+3500	J3128	AC	10.00	**12.399**	-2.40	12.50	**13.651**	-1.15	0.13	
WDS21149+3407	J3129	AB	12.50	**13.030**	-0.53	13.00	**14.361**	-1.36	0.09	
WDS21149+3407	J3129	AC	12.50	**13.030**	-0.53	15.00			0.09	No C star in this position. Fainter than mag 15 or bogus?
WDS21166+3018	J3131	AB	12.10	**11.785**	0.32	12.52	**13.368**	-0.85	0.13	
WDS21166+3018	J3131	BC	12.52	**13.368**	-0.85	14.50	**14.860**	-0.36	0.13	

Table 3 continues on next page.

Table 2 (conclusion): Bessel epoch 2015.640 photometry results for the J objects in Cyg. "...

WDS ID	Name		M1 WDS	M1 new	dM1	M2 WDS	M2 new	dM2	dVmag	Notes
WDS21205+3107	J3135	AB	11.00	**12.768**	-1.77	13.50	**14.151**	-0.65	0.10	
WDS21214+3321	J3136	AB	12.30	**12.487**	-0.19	12.40	**12.570**	-0.17	0.09	No double star at WDS position. UCAC4 suggests position error. Correct position seems to be UCAC4-617-121822 RA 21:21:07.829 Dec +33:18:59.763 with UCAC4-617-121823 as secondary. Seems to be a typo with "1" instead of "7" for the RA seconds. Given mags are for the UCAC4 coordinates
WDS21256+2957	J3139	AB	10.80	**12.990**	-2.19	10.90	**13.312**	-2.41	0.08	
WDS21331+2958	J3141	AB	12.20	**14.185**	-1.99	12.20	**15.039**	-2.84	0.09	
WDS21340+4156	J3142	AB	11.30	**12.470**	-1.17	11.80	**13.637**	-1.84	0.10	
WDS21412+3043	J3143	AB	10.00	**13.181**	-3.18	12.50	**14.610**	-2.11	0.07	
WDS21520+3653	J3149	AB	9.40	**11.033**	-1.63	12.00	**12.462**	-0.46	0.08	
WDS21533+4144	J3152	AB	10.00	**12.599**	-2.60	14.00	**14.729**	-0.73	0.10	
WDS19421+3336	J3217	AB	11.27	**11.988**	-0.72	12.70	**12.656**	0.04	0.10	

Specifications of the used telescope iT24: 610mm CDK with 3962mm focal length. Resolution 0.625 arcsec/pixel. V-filter. No transformation coefficients available. Located in Auberry, California. Elevation 1405m

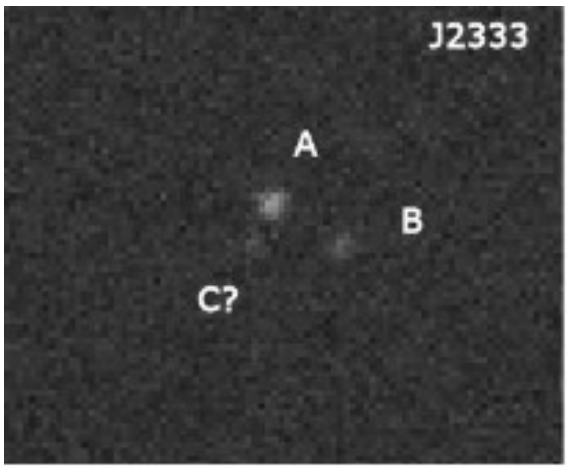

Image 1: J2333 with a hint of a third component.

including an average dVmag error. The J-objects were then located in the center of the image (worked fine with few exceptions indicating that the given RA/Dec coordinates are correct with the exceptions suggesting position problems) and photometry was then done by the rather comfortable Astrometrica procedure with point and click at the components delivering Vmag measurements based on all reference stars used for plate solving. The only changing parameter was the aperture radius used for photometry aiming to keep it equal or at least near 1.5x FWHM. In cases with smaller separation the star disks touched or overlapped but allowed nevertheless individual photometry even if less reliable than with clear separated disks. Several cases allowed only the measurement of the combined magnitude but even in these cases it is then possible to make a well-founded estimation based on the initial observed delta_m between the components based on the formula combined magnitude = 0-LOG_2.521(2.521^-M1+2.521^-M2).

4. Summary

Table 2 shows with few exceptions quite large differences for the magnitudes compared with the WDS data even in cases where double digit values suggest recent precise measurements.

The question remains how reliable are the "point and click" measurements with Astrometrica based only on one single image are in comparison with stacked images and photometry with VPhot. For this purpose I did a comparative analysis based on in total 10 images of J2336 and J3124 processed as single images and as 2 stacks of 5 images each to get an impression of the spread of the single image results compared with the stacked results. See Table 3.

At first look there seems to be a problem with the single image Astrometrica results for J3124B but a closer look shows that this is more a problem for the VPhot stacked image results because these images offered no good choices for the "framing" of J3124B with reference stars nearby.

The general conclusion here is that the overall additional error by using single images instead of image stacks is far less than 0.1mag and on average very well covered by the given dVmag error estimation for each single result.

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AAVSO APASS (via the UCAC4 catalog)
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iTelescope iT24
MaxIm DL6 v6.08
SIMBAD, VizieR
UCAC4 catalog via the University of Heidelberg website and directly from USNO DVD
Washington Double Star Catalog

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Table 3. Error estimation for using single images compared to stacked images.

	Spread of single image Astrometrica values compared with stacked image VPhot values	Comment
J2336A	-0.020 to +0.012	Average spread 0.010
J2336B	-0.042 to +0.019	Average spread 0.020
J3124A	-0,052 to +0.004	Average spread 0.028
J3124B	-0.201 to -0.131	Average spread 0.162 with negative bias

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