Measurements of Visual Binary Stars: 2018 Report

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Abstract: This paper presents the measurements of 113 visual binary stars obtained between January and December 2018 with an 11" reflector telescope and an ASI 290MM CMOS-based camera. Observations focused on close binaries (71 of them having a separation smaller 1 arcsec) and not observed for decades (82 of them were last observed before 2008 and 45 before 1998). In the continuation of some of our previously published papers [1,2], a significant part of these stars are binaries discovered by R.G. Aitken. All measurements were obtained using the bispectrum-based reduction technique described in our previous paper. The observed set also includes 13 binaries having an orbit in the Sixth Catalog of Orbits, for which O-C values are reported. For one of these binaries (A 2157), our observation, along with the previously recorded ones, seems to indicate that an orbit recalculation is required. Finally, for each observed pair, we give, when available, an indication of the probability of being physical, as derived from a score computed from Gaia DR2 data, as described by Harshaw in [9].

1. Instrumental Setup

The instrumental setup is the same as that described in [1,2]. The telescope is a 280 mm Schmidt-Cassegrain reflector (Celestron C11) and the camera an ASI 290MM camera, A 2x Barlow focal length amplificator gives a plate scale of 0.095 arcsec/pixel. Observations are performed with a broad L-band filter (λ_c = 530 nm, $\Delta\lambda$ = 300 nm) and an Atmospheric Dispersion Corrector providing a full correction down to $\delta = 0°$ for our latitude (45° N).

2. Image acquisition and analysis

Acquisition is carried out with the Genika Astro software [3] controlling the ASI 290MM camera. Compared to our previous work the camera gain has been set to a lower value (400 instead of 550). This setting significantly reduces the amount of noise in the raw images. Comparison to our previous results shows that this does not impact the maximum magnitude of the pairs which can be successfully reduced – at least when using bispectrum-based techniques. Exposure time for individual images range from 10 to 80 ms typically.

For each target, N+1 distinct sequences of 1000 images are typically acquired: N of the target itself and one of a nearby reference single star – with similar magnitude and spectral type – to be used for deconvolution later. For most of observations, N=4.

Calibration is carried out using the sideral drift method using the dedicated module of the SpeckleToolBox software [4], again as described in [1,2].

3. Data reduction

All acquired sequences are pre-processed using Reduc [5] and reduced using the bispectrum reconstruction technique described in [1,2] and supported by the latest version of the SpeckleToobox software. The global processing pipeline is sketched in Figure 1.

For each pair, each of the N acquired cube is first dark-subtracted and cropped to 128x128 dimension to speedup subsequent processing and limit the amount of storage needed for archiving. All the resulting cubes are then processed separately (using the reference star cube for deconvolution) and the final results (PA, SEP and Δm) are obtained by computing the statistical mean of the corresponding values. The associated standard error is computed as

$$e = f\sqrt{\frac{\sum_{i=1}^{N}(x_i-\mu)^2}{N-1}}$$

where the x_i are the individual measurements, μ the statistical mean, N the total number of measurements and f a correction factor introduced here to compensate the

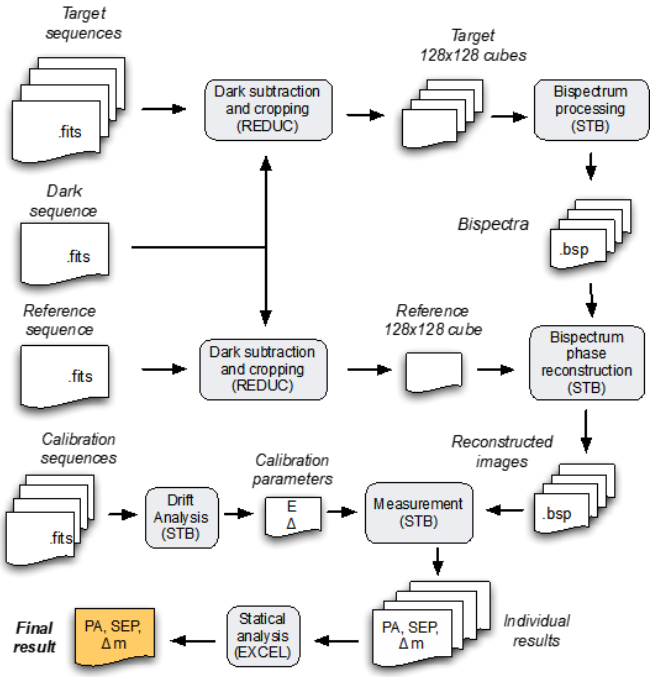

Figure 1. Processing pipeline

small size of the population from which the standard deviation is computed, here set, rather arbitrarily, to 2.

The estimation of Δm obtained using BS-based reduction must be taken with care because it can biased in several manners. First, the iterative image reconstruction process does not always succeed in completely removing the secondary peak. The reconstructed flux of the secondary component is then likely to be distributed between the two peaks and hence the derived Δm value biased. Second, when the companion sits on the diffraction rings of the primary, the correct way to perform aperture photometry is not well defined. This issue is discussed in detail in [6] (section 7). Because we currently have no definite solution to these problems, we have chosen not to report Δm values when they occur.

4. Results

The reported measurements have been obtained during 16 nights, between 2018-04-06 and 2018-10-22.

Figures 1, 2, and 3 show the distribution of these measurements according to the separation of the components, the magnitude of the secondary component and the date of the last measurement recorded in the WDS catalog [7] at the date of our observation.

The measures themselves are listed in Table 1. In this table, columns 1-11 respectively give

- the discoverer code of the pair
- its identifier in the WDS catalog

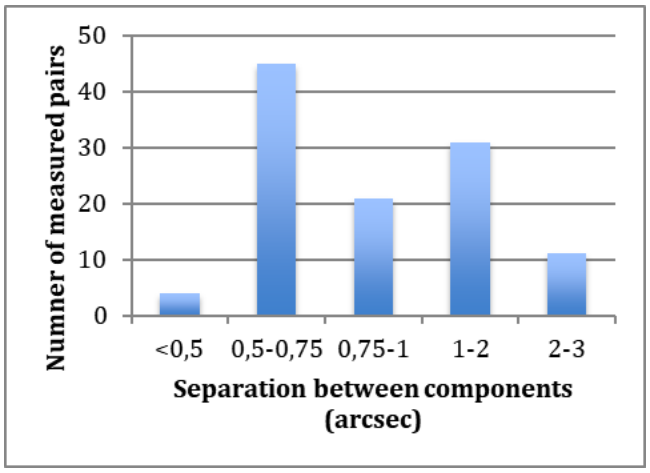

Figure 1. Distribution of measurements according to the separation of components

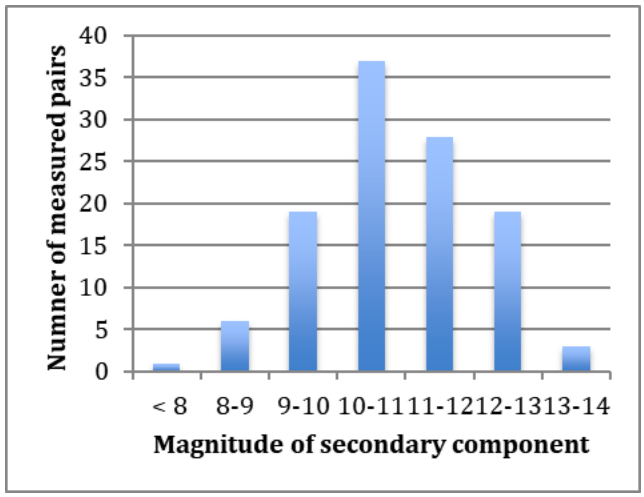

Figure 2. Distribution of measurements according to the magnitude of the secondary component

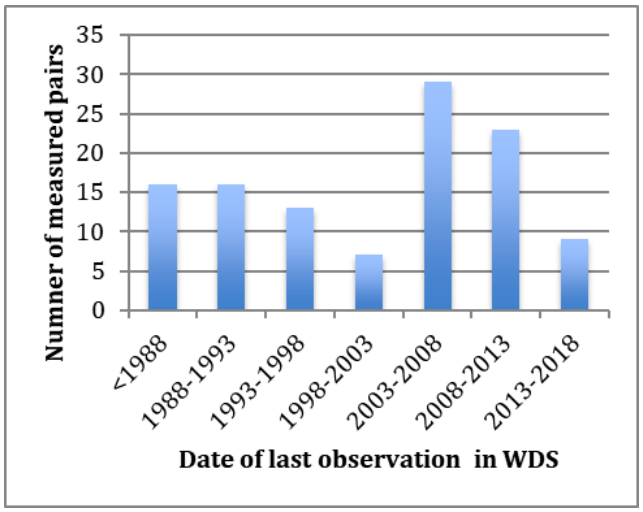

Figure 3. Distribution of measurements according to the date of the last observation recorded in the WDS

† At th
‡ Our

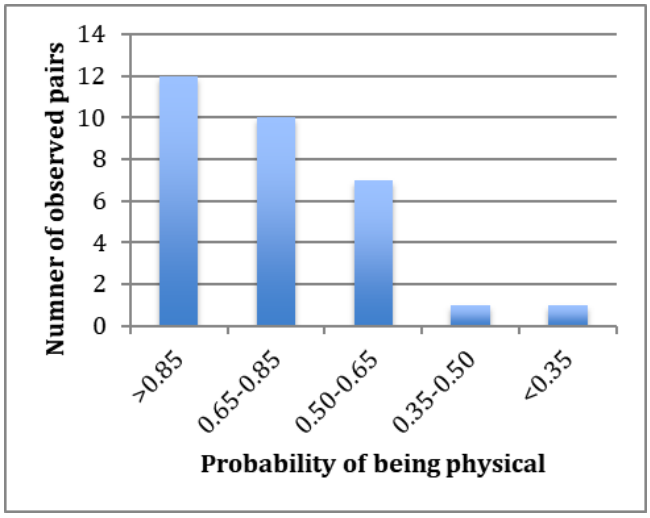

Figure 4. Distribution of observed binaries according to the ''physicality score'' defined in [9]

- the magnitudes of the primary and secondary component, as reported in the WDS catalog
- the date of the last measurement recorded in the WDS catalog†
- the final PA and SEP measurement (in degree and arcsec, resp.) with estimated error when available
- the estimated difference of magnitude, when it can be reliably estimated (see Sec. 3), with estimated error when available,
- the date of the measurement (computed as AAAA.FFF where AAAA is the current year and FFF is obtained by dividing the number of days since Jan 1, 2018 by 366)
- the number of individual measurements,
- an index φ related to the estimated probability for the pair of being physical (see below)
- additionnal notes, to be detailed after the table.

The mean standard error is 0.027 arcsec for SEP and 0.91° (resp. 1.93°) for PA when SEP>1 (resp. <1 arcsec).

The index reported in column φ is derived from the classification given by Harshaw in [9]. Pairs with index 1, 2, 3, 4 and 5 are those having respectively a "physicality score"

above 0.85 (class "Y" in [9]‡)
between 0.85 and 0.65 (class "Y?" in [9])
between 0.65 and 0.50 (class "Maybe" in [9])
between 0.50 and 0.35 (class "??" in [9])
under 0.35 (class "No" in [9])

Pairs listed with class "Uknown" in [9] are given an index φ=0.

As described in in [9], the "physicality score" is computed as a weighted sum of four factors, all derived from data extracted from the Gaia Data Release 2 [10]. These factors include the distance of the components (computed from their parallaxes), their relative motion through space, an R2 fit to trend lines in the data, and the relative radial velocities vis a vis system escape velocity. According to Harshaw, binaries with a score > 0.85 have a high probability of being physical, and those with a score between 0.65 and 0.85 a "medium to high" probability. Binaries with a score between 0.5 and 0.65 "might be" physical, those with score between 0.35 and 0.50 are "questionable" and those under 0.35 are almost certainly not. Among our observations, only 31 binaries have a score in [9]. The repartition of these scores for the corresponding stars is given in Figure 4. It is interesting to see that 22 of the observed binaries are very likely to be physical and only two are probably not.

A few pairs were viewed as simple or perceived as binaries but cannot be reliably measured because their separation was too close (< 0.4 arcsec typically). These pairs are listed in Table 2.

For pairs having a known orbit, Table 3 gives the O -C residuals, computed from the ephemerides published in the 6th Catalog of Orbits [8]. For A 2157 (11162+3136), the large O-C value for PA seems to be related to an incorrect orbit estimation. The two last measurements (Worley, 1979 and Gili, 2008) give PA=2.4° and 1.1° respectively).

Table 4 lists the stars that were last observed before 1988, giving in columns 3-6 respectively, the date of the last observation (as recorded in the WDS), the total number of measurements in the WDS and the variation in PA and SEP between the last WDS measurement and ours. Interestingly, six of these neglected binaries (A 3083, A 1787, COU 192, HU 351, HO 584 and A 1674CD) have a medium to high probability of being physical, justifying *a posteriori* our observation.

Acknowledgments

This research has made use of the Washington Double Star and 6th Orbit catalogs maintained at the U.S. Naval Observatory. Data reduction was carried out using the SpeckleToolbox software (v 1.13) developed and maintained by D. Rowe and the Reduc software (v 5.3) developed and maintained by F. Losse. The "physicality" score reported in Table 1 were extracted from data provided online by R. Harshaw. History of measurements for some pairs listed in Table 1 and 3 have been kindly provided by B. Mason.

† At the date of our observation
‡ Our observations were carried out before the publication of Harshaw's paper.

(Text continues on page 321)

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Table 1. Measurements

NAME	WDS	M1	M2	DATE2	PA(°)	SEP (arcsec)	Δm	DATE	N	φ	NOTE
A 1502	00220+4033	10.3	10.3	2008	245.6 ± 0.1	0.94 ± 0.007	0.2 ± 0.00	2018.734	3	3	
A 912BC	00336+4509	9.7	12.9	2008	334.5 ± 2.8	0.58 ± 0.033		2018.734	2	0	
A 913	00364+5621	9.9	10.3	2008	90.2 ± 0.4	0.74 ± 0.002	0.7 ± 0.00	2018.734	3	0	
A 915	00378+3031	10.4	10.5	2008	129.5 ± 0.4	0.96 ± 0.002	0.3 ± 0.00	2018.734	3	2	
A 1507AB	00423+4015	10	10.4	2008	225.5 ± 0.5	0.7 ± 0.002	1.4 ± 0.10	2018.805	4	0	
A 1258	00544+5432	9.7	9.9	2008	202.3 ± 0.6	0.6 ± 0.012	1.1 ± 0.00	2018.734	3	0	
A 1510	00549+3827	10	10.3	2008	103.7 ± 0.0	0.62 ± 0.001	0.4 ± 0.00	2018.734	3	0	
A 656BC	01133+4426	10.1	12.4	2008	120.5 ± 0.4	0.72 ± 0.025	1.4 ± 0.50	2018.805	4	0	2
A 936	01172+5708	9.8	12.3	2008	241.3 ± 0.2	0.96 ± 0.007	2.2 ± 0.10	2018.805	4	1	
A 940	01280+5821	10.1	10.2	2008	86.1 ± 0.7	0.61 ± 0.013		2018.805	4	0	
A 943	01348+4656	9.6	11.9	1979	218.1 ± 0.9	0.56 ± 0.028	2.8 ± 0.10	2018.805	4	0	
A 2556	09181+0245	9.9	10.6	1991	353.7 ± 0.6	0.95 ± 0.023		2018.260	4	0	
A 344	09521+2916	9.6	9.9	1997	68.3 ± 1.3	0.67 ± 0.010		2018.260	4	0	
COU 169Aa.Ab	10140+2227	10.7	10.9	2014	321.7 ± 0.7	0.54 ± 0.006		2018.288	4	0	1
POP 117	10184+4346	8.3	9.6	2003	258.7 ± 1.8	0.77 ± 0.011	0 ± 0.00	2018.260	4	0	
STF1423	10192+2034	9.4	10	2010	308.3 ± 0.3	0.71 ± 0.002	1 ± 0.10	2018.288	4	0	1
STF1426AB	10205+0626	7.9	8.3	2015	313.4 ± 0.1	0.91 ± 0.001	0.4 ± 0.00	2018.288	4	0	1
A 2569	10261+0802	8.9	12.9	1987	305.4 ± 0.3	1.99 ± 0.077	5 ± 0.20	2018.296	4	0	
HU 1130	10262+6038	10.1	10.8	1991	137.8 ± 1.2	1.04 ± 0.052		2018.260	4	3	
COU2092	10382+4558	9.7	9.7	2003	279.5 ± 1.7	0.61 ± 0.020		2018.260	4	0	
STT 224AB	10397+0851	7.8	8.9	2014	127.5 ± 0.9	0.49 ± 0.019	1.5 ± 0.10	2018.288	4	0	1
A 2768	10426+0335	6.9	8.4	2015	240.9 ± 1.1	0.67 ± 0.006	1.4 ± 0.30	2018.288	4	0	1
A 2771	10446+0530	9.1	9.7	2013	111.7 ± 0.3	0.59 ± 0.009	0.9 ± 0.10	2018.288	4	0	1
A 2772AB	10520+0904	8.2	11.4	1991	97.4 ± 0.1	2.65 ± 0.009	3.5 ± 0.00	2018.296	4	2	
A 2375	10585+1711	10.4	10	2010	168.7 ± 0.7	0.54 ± 0.011		2018.288	4	0	1
A 2774	10596+0956	7.2	12	2003	109 ± 0.6	1.85 ± 0.015	4.5 ± 0.20	2018.296	4	1	
A 2775	11098+1009	8.5	9.8	2008	303 ± 1.8	0.62 ± 0.024	2 ± 0.20	2018.288	4	0	
A 2157	11162+3136	9.2	12.2	2008	2.9 ± 1.0	1.41 ± 0.001	4.4 ± 0.28	2018.301	2	0	1
A 3083	11189+1014	10	12.2	1988	249.8 ± 0.3	1.68 ± 0.006	2.4 ± 0.00	2018.301	2	2	
A 1846	11206+4324	8.8	11.8	1991	165.3 ± 0.5	1.88 ± 0.005	3.4 ± 0.00	2018.296	4	0	
A 2574	11244+0155	9.2	11.2	2010	66.2 ± 0.3	1.98 ± 0.025	3.3 ± 0.10	2018.301	4	3	
A 1354	11272+5513	7.8	11.2	1991	125.7 ± 0.2	1.28 ± 0.017	3.7 ± 0.10	2018.296	4	1	
A 1355	11282+5540	7.7	11.5	1999	359 ± 1.3	1.34 ± 0.024	4 ± 0.20	2018.296	4	0	
A 559	11312+2732	8.3	12.5	1987	152.5 ± 0.2	2.43 ± 0.020		2018.296	4	0	
A 678	11395+2518	7.9	11.1	1996	228.6 ± 0.5	1.19 ± 0.006	2.8 ± 0.10	2018.288	4	0	
A 2486	11574+1823	9.9	11.1	2010	240.9 ± 0.7	1.14 ± 0.023	1.6 ± 0.00	2018.301	4	1	
A 680	11579+2458	10.4	10.3	2008	322.1 ± 1.2	0.52 ± 0.019	2.3 ± 0.10	2018.288	4	0	
A 1779	12010+4347	9.8	11.4	2010	22.1 ± 0.5	0.6 ± 0.014	2 ± 0.10	2018.340	4	0	
A 1594	12050+5113	10.9	12.1	2010	129 ± 0.1	1.62 ± 0.009		2018.301	4	1	
A 2056	12093+1525	9.9	10.2	2010	306 ± 0.9	0.64 ± 0.010	2.2 ± 0.10	2018.288	4	0	
A 1596	12158+5351	9.2	12.4	1991	240.5 ± 0.2	2.81 ± 0.005	3.6 ± 0.10	2018.296	4	1	
A 2487	12171+0143	8.9	12.4	1991	176.8 ± 0.5	1.96 ± 0.022	3.9 ± 0.10	2018.296	4	2	
A 2059	12194+1744	8.3	10.2	2010	42.6 ± 1.5	0.49 ± 0.025	2.1 ± 0.10	2018.288	4	0	1
A 1597	12197+0533	9.2	11.9	1991	282.7 ± 0.8	1.43 ± 0.030	3.3 ± 0.00	2018.288	4	0	
A 1090	12281+0920	9.8	11.2	2001	92.4 ± 0.3	1.87 ± 0.003		2018.301	4	2	
STF1670AB	12417-0127	3.4	3.5	2016	0.5 ± 0.4	2.78 ± 0.016		2018.296	4	0	1
A 1602	12429+0516	8.7	10.1	2014	27.9 ± 0.8	0.68 ± 0.004	1.5 ± 0.00	2018.340	4	0	1
A 1603AB	12440+0356	9	11.6	1995	128.6 ± 0.8	1.22 ± 0.011	2.9 ± 0.00	2018.340	4	0	
A 2061	12461+1715	9.8	12.2	2007	194 ± 0.4	1.19 ± 0.050	2.7 ± 0.10	2018.340	4	0	
A 2000	12563+4300	9.7	10.2	2010	47.3 ± 0.2	1.03 ± 0.001	0.8 ± 0.00	2018.288	4	0	
A 564	13001+2343	9.4	11.3	2009	321.6 ± 0.3	1.73 ± 0.007	2.8 ± 0.00	2018.340	4	2	
A 1784	13041+0511	8.9	12.1	1991	314.2 ± 0.4	1.73 ± 0.028	3.8 ± 0.10	2018.296	4	0	

Table 1 continues on the next page.

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Table 1 (continued). Measurements

NAME	WDS	M1	M2	DATE2	PA(°)	SEP (arcsec)	Δm	DATE	N	φ	NOTE
A 1605	13069+5200	10.7	10.7	2010	349.2 ± 0.4	1.1 ± 0.006		2018.301	4	1	
A 1360	13177+5845	8.2	10.8	1991	143.2 ± 1.4	0.78 ± 0.015	2.5 ± 0.10	2018.340	4	0	
A 2585AB	13189+0030	9.1	9.3	2012	215.8 ± 0.6	0.83 ± 0.006		2018.340	4	3	
A 1787	13196+0942	7.9	11.2	1944	354.7 ± 1.5	2.12 ± 0.102	4.9 ± 0.40	2018.296	4	3	
A 2489	13237-0043	9.4	9.8	2010	189.9 ± 0.2	0.99 ± 0.011	0.9 ± 0.00	2018.340	4	0	1
A 2490	13283+0214	7.5	10	1991	90.7 ± 0.9	1.26 ± 0.018	3.1 ± 0.20	2018.301	4	0	
A 567	13328+2421	6.2	9.7	2007	253.5 ± 0.4	1.39 ± 0.020		2018.296	4	0	
A 1611	13368+0650	8.9	9	2015	121.1 ± 0.2	0.88 ± 0.002	0.4 ± 0.00	2018.340	4	0	
A 1612	13455+0330	8.4	10.2	2015	344.8 ± 0.6	1.67 ± 0.008	2.4 ± 0.00	2018.340	4	0	
A 1795	14109+0424	8.5	11.4	1995	185.8 ± 0.5	1.37 ± 0.013	3.1 ± 0.10	2018.340	4	0	
A 147	14171+5100	8.7	10	2010	109 ± 1.3	0.65 ± 0.012	1.1 ± 0.20	2018.340	4	0	
A 148	14220+5107	8.3	8.9	2015	193.5 ± 0.4	0.52 ± 0.002	0.4 ± 0.00	2018.340	4	0	
A 1620AB	14288+5430	9.4	12.9	2010	226.3 ± 0.3	1.35 ± 0.008	2.8 ± 0.10	2018.340	4	2	
A 2075	15319+1623	9.3	10.1	2010	95.2 ± 0.5	0.48 ± 0.014	1.4 ± 0.10	2018.466	4	0	
A 2077	15468+1905	9.6	10.1	2010	222.7 ± 0.2	0.56 ± 0.005	1.2 ± 0.00	2018.466	4	0	
COU 192	15474+1851	8	14	1967	189.2	1.2	5.22	2018.466	1	3	3
A 1137	16192+5736	9.1	9.7	1997	203.7 ± 0.4	0.61 ± 0.006		2018.466	4	0	
A 1138	16311+5756	10.7	11.7	2010	172.9 ± 0.7	0.58 ± 0.004		2018.466	4	0	
A 1643	16376+4510	10.3	10.6	2008	150.7 ± 0.3	0.76 ± 0.002		2018.466	4	0	
A 349	16413+3006	10.6	10.9	2010	126.5 ± 0.3	0.7 ± 0.001	0.9 ± 0.00	2018.466	4	0	1
HDS2368	16414+3016	7.6	10.9	2010	156.9 ± 1.4	0.83 ± 0.020	3 ± 0.10	2018.466	4	0	
A 1149	17251+0716	9.6	10.3	2010	125.7 ± 0.2	1.03 ± 0.010	1.2 ± 0.00	2018.466	4	0	
A 2093	18054+1624	9	9.8	2008	230.7 ± 0.3	0.64 ± 0.004	0.8 ± 0.00	2018.526	4	0	
A 577	18173+4355	10.4	10.5	2008	303.7 ± 0.8	0.72 ± 0.005	2.1 ± 0.12	2018.479	3	1	
HEI 565	18565+1020	10.8	11.2	1996	96 ± 0.5	0.86 ± 0.019		2018.526	4	5	
A 590	19107+4136	9.8	10	2008	164.9 ± 2.2	0.51 ± 0.022		2018.479	4	0	
A 265AB	19143+2840	10.8	10.8	2008	16.6 ± 0.2	0.93 ± 0.008		2018.479	3	4	
COU2200	19166+3903	11	11.5	1984	121.6 ± 1.9	0.61 ± 0.023		2018.526	4	0	
POP 33	19268+3457	10.6	10.9	1996	230.8 ± 0.4	0.85 ± 0.006		2018.526	3	1	
HEI 812	19272+0312	10	10.1	1995	72.2 ± 0.4	0.69 ± 0.006		2018.526	3	0	
A 715	19335+6002	10.1	10.2	2008	356.4 ± 1.3	0.51 ± 0.027	1.3 ± 0.30	2018.479	4	0	
COU2206	19355+3641	10	11.7	1996	317.4 ± 1.1	0.64 ± 0.009	2.2 ± 0.10	2018.526	4	0	
COU 210	19364+1938	9.7	12	1967	211.3 ± 5.5	0.68 ± 0.010		2018.668	4	1	
HEI 876	19421+0545	9.8	10.2	1996	145.7 ± 0.2	0.76 ± 0.003		2018.526	3	0	
DA 13AB	19447+4456	7.4	11.6	1946	273.8 ± 0.3	2.03 ± 0.002	3.7 ± 0.00	2018.674	3	1	
FOX 89	19456+4147	10.1	11	1991	208.5 ± 0.3	0.89 ± 0.009	1.4 ± 0.00	2018.668	4	0	
BU 1301BC	19464+0418	9.5	9.5	1983	334.6 ± 1.3	0.69 ± 0.023		2018.668	4	0	
MLR 606	19508+5633	10.5	10.6	1991	205.4 ± 0.6	0.57 ± 0.009		2018.526	4	0	
HDS2830	19516+3932	8.3	11.2	1991	204.3 ± 3.4	0.74 ± 0.019	2.9 ± 0.10	2018.668	4	0	
HU 351	19522+1951	8.2	12.4	1977	157.8 ± 0.1	2.04 ± 0.007	3.7 ± 0.12	2018.674	3	2	
A 1660AB.C	19529+1425	10.2	10.3	2008	203.3 ± 1.0	0.68 ± 0.005		2018.479	3	0	
MLR 587	19545+5727	10.7	10.7	1995	347.9 ± 0.4	1.02 ± 0.001		2018.526	3	3	
A 2791	19583+2218	9.5	12.5	2008	136.2 ± 2.3	0.52 ± 0.005	2.4 ± 0.10	2018.479	4	0	
A 276	19594+2636	9.6	11.8	2008	332.4 ± 1.0	0.94 ± 0.011	2.4 ± 0.10	2018.479	4	0	
HO 584	20003+2611	6.6	12.1	1975	226.9 ± 0.3	2.38 ± 0.001	5.3 ± 0.14	2018.674	2	2	
A 2278AB	20068+0157	10	10.5	1991	213.7 ± 0.6	0.93 ± 0.013	1 ± 0.12	2018.490	3	0	
BAR 11AB	20180+3311	7.9	9	2000	198.6 ± 4.8	0.47 ± 0.010	3 ± 0.20	2018.674	4	0	
HO 592AB.C	20180+3311	7.6	11.9	1991	254.6 ± 0.1	3.05 ± 0.007	4.5 ± 0.30	2018.674	4	0	
A 1674AB	20275+1454	9.8	13.1	1977	14.1 ± 1.2	0.92 ± 0.006	2.6 ± 0.10	2018.526	4	1	
A 1674CD	20275+1454	12.5	13.5	1932	171.2 ± 1.7	1.28 ± 0.015	0.7 ± 0.00	2018.668	3	0	
BU 987AB	20302+1925	6.8	11.1	1986	127.5 ± 0.1	2.52 ± 0.002	4 ± 0.10	2018.674	4	0	

Table 1 concludes on the next page.

Measurements of Visual Binary Stars: 2018 Report

Table 1 (conclusion). Measurements

NAME	WDS	M1	M2	DATE2	PA(°)	SEP (arcsec)	Δm	DATE	N	φ	NOTE
A 395	20316+0530	10.1	11.9	1981	159.5 ± 1.5	0.69 ± 0.011	1.6 ± 0.10	2018.490	4	0	
BU 1302AB	20448+2311	8.8	12.9	1999	137.7 ± 0.1	2.28 ± 0.002	3.9 ± 0.00	2018.674	3	2	
A 876	20454+0023	10.1	10	1995	68.1 ± 1.0	0.58 ± 0.020		2018.490	4	0	
COU2431Aa.Ab	20599+4016	6.6	10.8	2012	205.4 ± 0.1	2.23 ± 0.008	4.1 ± 0.10	2018.674	4	0	
A 763	21202+6038	7.6	10.8	1994	214.4 ± 1.0	1.3 ± 0.044	3.7 ± 0.10	2018.674	4	0	
A 766	21249+5734	9.7	11.2	2008	225.1 ± 1.3	0.55 ± 0.031		2018.674	4	0	
A 891	21577-0038	9.5	9.5	2008	77.7 ± 0.3	0.65 ± 0.005	-0.2 ± 0.00	2018.668	4	0	
A 624	22107+5830	10.1	12.3	2008	10.6 ± 0.6	0.79 ± 0.007	1.6 ± 0.10	2018.668	4	0	
A 2495AB	22128+4048	8.4	10.5	2008	251.7 ± 1.8	0.69 ± 0.012	2.8 ± 0.10	2018.668	4	0	
A 1490	23335+5210	8.6	12.6	2008	192.6 ± 0.6	0.74 ± 0.008	2.6 ± 0.00	2018.734	4	0	

Notes for Table 1

1. Pair with an entry in 6th Catalog of Orbits. See Table 3 for O-C
2. AB=HJ2027
3. Only one measurement. Hence no estimation of standard errors

Table 2 – Pairs observed but for which no measure was obtained

NAME	WDS	M1	M2	DATE	NOTE
A 1523	01472+4212	10	9.3	2018.805	2
A 2770	10446+0402	8.7	11.8	2018.260	2
A 1104	14231+0729	9.8	9.4	2018.340	2
HU 252	18477+0916	9.2	9.7	2018.526	1
MLR 540	19393+5802	10	12.4	2018.668	1
COU1804DE	19466+3253	9.6	11.1	2018.674	1
HO 114AB	19466+3253	6.3	11.8	2018.674	1
A 866Ba,Bb	20055+5800	9.9	10.3	2018.490	1
A 1491	23363+5428	8.8	10.3	2018.734	1

Notes for Table 2

1. Viewed as simple
2. Viewed as elongated but too close to be measured.

Table 3 – O-C residuals for pairs having a known orbit

NAME	WDS	DATE	O-C PA(°)	O-C SEP (arcsec)	GRADE	REF
COU 169Aa,Ab	10140+2227	2018.288	-7.1	0.05	5	Cou1999b
STF1423	10192+2034	2018.288	3.7	0.11	3	WSI2004a
STF1426AB	10205+0626	2018.288	-0.1	0.01	4	Nov2006
STT 224AB	10397+0851	2018.288	-2.9	0.01	3	Hrt2010a
A 2768	10426+0335	2018.288	0.4	0.05	3	Tok2015c
A 2771	10446+0530	2018.288	-1.2	0.06	4	Tok2014a
A 2375	10585+1711	2018.288	1.3	0.04	3	Doc2009g
A 2157	11162+3136	2018.301	-229.3	0.34	5	Pop1996b
A 2059	12194+1744	2018.288	-0.3	0.06	5	Lin2017a
STF1670AB	12417-0127	2018.296	1.5	0.05	2	Sca2007c
A 1602	12429+0516	2018.340	1.5	0.06	5	Doc2015d
A 2489	13237-0043	2018.340	-1.5	0.01	5	WSI2004a
A 349	16413+3006	2018.466	-1.9	0.04	3	Hrt2014b

Table 4 – Binaries not observed since 1988

NAME	WDS	DATE2	NOBS	ΔPA	ΔSEP
A 943	01348+4656	1979	6	0.1	0.06
A 2569	10261+0802	1987	4	4.6	0.11
A 3083	11189+1014	1988	12	2.8	0.22
A 559	11312+2732	1987	4	0.5	0.03
A 1787	13196+0942	1944	4	3.3	0.42
COU 192	15474+1851	1967	1	4.2	0.31
COU2200	19166+3903	1984	1	9.4	0.11
COU 210	19364+1938	1967	1	9.7	0.02
DA 13AB	19447+4456	1946	13	1.8	0.23
BU 1301BC	19464+0418	1983	5	5.4	0.19
HU 351	19522+1951	1977	7	2.8	0.24
HO 584	20003+2611	1975	5	0.1	0.02
A 1674CD	20275+1454	1932	3	0.8	0.28
A 1674AB	20275+1454	1977	7	3.1	0.22
BU 987AB	20302+1925	1986	11	1.5	0.08
A 395	20316+0530	1981	7	8.5	0.01

(Continued from page 317)

This paper is dedicated to the memory of the great double star observer René Gili (d. 2018).

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