Measurements of Aitken Visual Binary Stars: 2017 Report

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Abstract: This paper is a continuation of that published in [1]. It presents the measurements of 136 visual binary stars discovered by R.G. Aitken and listed in the WDS catalog. These measurements were obtained between January and December 2017 with an 11" reflector telescope and two types of cameras : an ASI 290MM CMOS-based camera and a Raptor Kite EM-CCD. Binaries with a secondary component up to magnitude 15 and separation between 0.4 and 5 arcsec have been measured. The selection also includes pairs exhibiting a large difference in magnitude between components (up to Δm=6). Measurements were mostly obtained using the auto-correlation technique described in [1] but also, and this is a innovative aspect of the paper, using the so-called bispectrum reduction technique supported by the latest version of the SpeckelToolBox software. As for [1], a significant part of the observed pairs had not been observed in the previous decades and show significant movements compared to their last measurement.

1. Instrumental Setup

The instrumental setup is the same as that described in [1]. The telescope is a 280 mm Schmidt-Cassegrain reflector (Celestron C11). Almost all measurements have been obtained with the ZWO ASI 290MM camera [2,3]. With a 2x Barlow and an Atmospheric Dispersion Corrector (ADC), the resulting plate scale is 0.095 arcsec/pixel. A few measurements were also obtained with the Raptor Kite camera described for example in [4]. In this configuration, plate scales between 0.10 and 0.35 arcsec/pixel were obtained by using a 3x Barlow or a 10 mm projecting eyepiece. In both configurations, an L-band (400-700 nm) filter was systematically used. As reported in [2], our ADC configuration allows a full correction for the 400-700 nm band up to z = 45° approximatively (decl = 0° at latitude = 45° N).

2. Image Acquisition and Analysis

Acquisition is carried out with the Genika Astro software [5] with the camera gain setting set at high values (550/600 for the ASI 290MM, 3100/3500 for the Raptor Kite). Exposure time for individual images range from 10 to 80 ms typically. For each target, and unless otherwise noted, four sequences of 1000 images are acquired and latter converted to FITS cubes for analysis.

Calibration is carried out using the sideral drift method using the dedicated module of the SpeckleToolBox software [6], the precise datation of each frame being performed by the Genika software. As reported in [2], this method provides very accurate and reproducible results both for plate scale and camera angle estimation.

Three distinct analysis (reduction) methods were used: auto-correlation, bispectrum analysis and lucky stacking.

Auto-correlation-based reduction (AC) is the method described in [2]. It consists in computing the power spectrum of individual images, summing these power spectrums and computing the inverse Fourier transform of the sum. The SEP and PA values of the measured pairs are then deduced from the position of the peaks on the resulting auto-correlogram. The AC-based results given in this paper were obtained by using the *Speckle Reduction* module provided by the Speckle-ToolBoox software [6] (version 1.08). In some cases, results have been improved by using deconvolution. Deconvolution consists in dividing the accumulated power spectrum by that obtained from a sequence of a single star† observed under the same conditions (typically as close as possible in time and celestial posi-

† *The so-called the* reference *star*

tion to the target star).

Bispectrum (BS) analysis – also known as triple-correlation – can be viewed as an extension of AC-based analysis aiming at recovering the final image phase in the Fourier domain, which is lost when using the classical AC-based technique. Compared to the latter, bispectrum-based analysis both solves the quadrant-ambiguity problem and allows a direct estimation of the difference of magnitude between components. As for simple AC techniques, bispectrum analysis is more effective when used with a reference star. The power spectrum and bispectrum are computed for the reference star and are then used to compensate the power spectrum and bispectrum of the target double star. We have started using the BS analysis module provided by SpeckleToolBox (version 1.13) in late 2017, after having checked that the astrometric results (SEP and PA) given by the method did not differ significantly from those obtained with the "classical" AC-based one [7].

Lucky stacking (LS) was here only used for pairs with relatively large separation (>3 arcsec) and large Δm, essentially to provide estimations of Δm to be compared to those obtained with BS-analysis method. The *n* best images of each acquisition sequence (n=10-30 typically) are selected and co-added and measurement is carried out on the composite image. For this, we used a dedicated surface fitting algorithm («Surface») provided by the Reduc software [8].

3. Results

The reported measurements have been obtained during 24 nights, between 2017-01-20 and 2017-11-22.

Figures 1, 2, 3, and 4 show the distribution of all measurements according to the magnitude of the primary and secondary component, their separation and their difference in magnitude. As in [1], Fig. 4 shows that pairs with large difference in magnitude Δm can be observed. For several of these pairs, an estimation of Δm could here be derived either from a lucky-stacked image or the bispectrum reconstructed image.

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 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 (2017-07-01)
- the final PA and SEP measurement (in degree and arcsec, resp.) with estimated error when available
- the estimated difference of magnitude, 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, 2017 by 366)
- the number of individual measurements,
- some notes, to be detailed after the table

When the given values have been obtained from several individual measurements, the standard error is here computed as

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

where the x_i are the individual measurements, μ the statistical mean computed from these values, N the total number of measurements (column 10 in Table 1) and f a correction factor introduced here to compensate the small size of the population from which the standard deviation is computed, here set, rather arbitrarily, to 2. When the standard error computed this way is smaller than 0.1° (resp. 0.01 arcsec), it is reported as 0.0 (resp. 0.00) in Table 1. Such cases are actually quite frequent, especially for the SEP value. We view it as an indication of the good internal precision of the corresponding measurement process.

A selection of reduced images from which the measures were obtained in given in Plate 1.

A few pairs were viewed as simple or perceived as binaries but cannot 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 [10]. Larger values are only observed for pairs having an orbit graded 4 or 5. The very small values obtained for pairs having an orbit graded 3 or less can be viewed as an indication of the good external precision of the measurement process.

For several pairs our measurement shows a significant variation with respect to the latest one reported in the WDS catalog. Table 4 lists the pairs for which the variation in PA is greater than 10° and/or the variation in SEP is greater than 0.5 arcsec. The columns DATE2 and NOBS respectively gives the date of the last measurement and the total number of measurements reported in the WDS (2017-07-01). The variations δPA and δSEP are the difference between these values and ours. For most of the listed pairs, the variation can be explained by the relatively long period since the last recorded measurement. For three of them (A 1923, A

(Text continues on page 535)

Measurements of Aitken Visual Binary Stars: 2017 Report

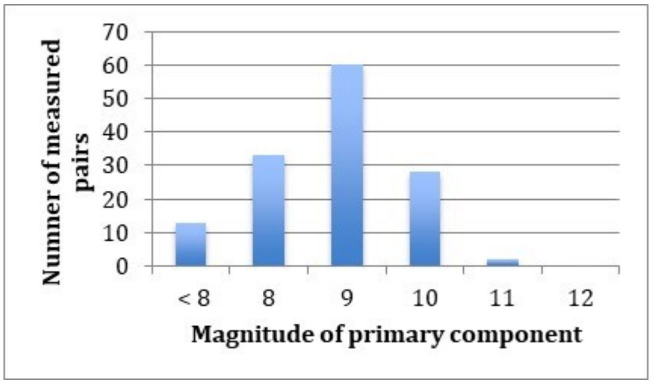

Figure 1. Distribution of measurements according to the magnitude of the primary component

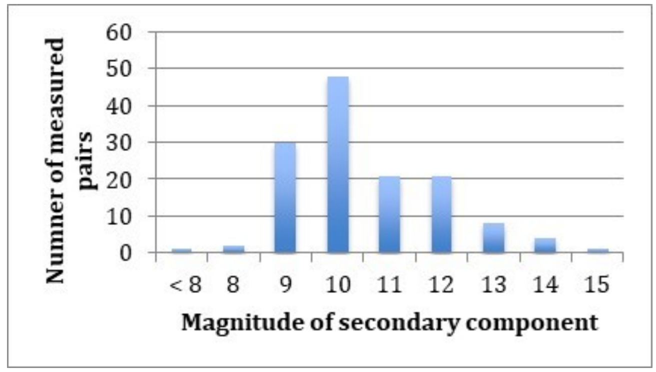

Figure 2. Distribution of measurements according to the magnitude of the secondary component

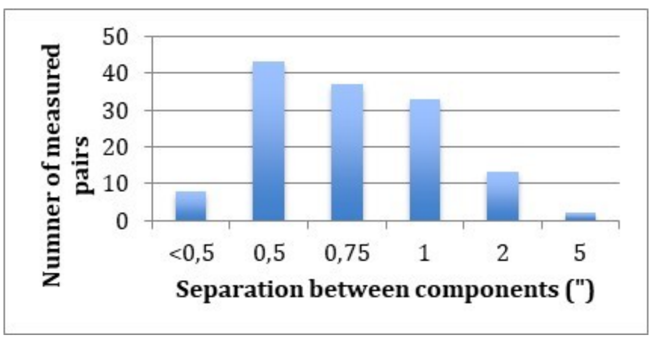

Figure 3. Distribution of measurements according to the separation of components

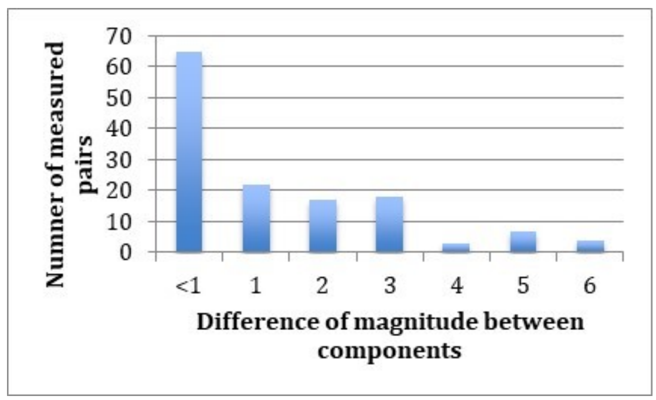

Figure 4. Distribution of measurements according to the difference in magnitude between the components

Measurements of Aitken Visual Binary Stars: 2017 Report

Table 1. Measurements

NAME	WDS	M1	M2	DATE2	PA (°)	SEP (arcsec)	Δm	DATE	N	NOTE
A 429AB	00039+2759	9.3	9.4	2010	319.3 ± 0.7	0.6 ± 0.01	0.5 ± 0.1	2017.784	4	*2,12*
A 901	00113+5958	9	10.4	2008	100.4 ± 0.4	0.89 ± 0.01	2 ± 0.1	2017.792	4	*2*
A 806CD	00355+1150	10.9	13.9	1932	236.7	1.33	1.4	2017.781	1	*6*
A 807	00364+1213	9.5	10	2010	232.9 ± 0.2	0.83 ± 0.02	1.3	2017.781	3	*6*
A 434	00410+2458	10.3	10.6	2008	203 ± 0.3	0.88 ± 0.00	0.3 ± 0.0	2017.784	4	*2*
A 809	00421+1100	9.9	10.3	2007	315.6 ± 1.1	0.87 ± 0.03	2.4	2017.781	4	*6*
A 812	00518+4803	7.6	11.1	2009	326.9 ± 0.5	1.81 ± 0.02	3.7 ± 0.3	2017.789	4	*2*
A 923	00520+5934	9.7	11	1992	161.4 ± 0.8	1.11 ± 0.01	2 ± 0.1	2017.792	4	*2*
A 1905	01203+2122	9.6	11.2	2007	331.8 ± 0.3	0.95 ± 0.02	1.7	2017.781	4	*6*
A 1906	01216+2123	9.5	12.3	2004	38.0	4.84	2.9	2017.781	1	*9*
A 941AB	01286+4509	8.6	11.5	1991	241.9 ± 0.8	1.46 ± 0.00	3.6 ± 0.1	2017.89	2	*1,2*
A 953	01546+5956	9	9.1	2006	65.7 ± 0.3	0.83 ± 0.00	0.3	2017.83	4	*5*
A 955	01551+5958	8.2	11.8	2010	110.5 ± 1.3	1.09 ± 0.02	2.5	2017.83	4	*5*
A 1525	01564+4243	9.6	11.3	1991	209.3	1.24	2.6	2017.89	1	*1,2*
A 1923	02018+4040	8.8	9.9	2008	143.2	.66	2.7	2017.89	1	*1,2,12*
A 823	02332+6000	7.6	10.9	1991	289.2 ± 5.0	0.51 ± 0.02		2017.83	5	*7,12*
A 2219	02379+2003	9.4	9.3	2008	146.7 ± 1.9	0.41 ± 0.01		2017.052	4	*8,11*
A 2335	02383+1146	9	12.5	1999	321.7 ± 0.9	1.24 ± 0.02	3.3	2017.83	4	*5*
A 969	02426+6018	9.5	10	1991	92.8 ± 0.7	0.75 ± 0.01	1.5	2017.83	4	*5*
A 972	02501+5640	9.3	12.1	1986	103.2 ± 1.0	1 ± 0.02	2.1	2017.83	4	*5,12*
A 1281AB	02517+4559	8.9	10.7	2012	150.5 ± 0.6	0.67 ± 0.01		2017.052	3	*8,11*
A 2413	02572+0153	8.2	8.6	2012	165.6 ± 0.6	0.67 ± 0.01		2017.052	4	*8,11*
A 2028	03027+0704	9.9	12.7	1991	234.8 ± 3.9	0.81 ± 0.04	2.7	2017.83	4	*5,12*
A 1287	03247+4046	7.8	13.8	1931	94.875 ± 0.1	2.935 ± 0.01	4.2	2017.836	4	*5*
A 1826Aa,Ab	03444+2812	9	11.3	2007	221.5 ± 2.0	0.64 ± 0.02	2	2017.83	4	*5,12*
A 999	04147+4512	9.4	12.5	2008	73.25 ± 0.8	0.92 ± 0.02	1.9	2017.836	4	*5*
A 2641	05226+0236	7.9	10.7	2010	142.1 ± 1.7	0.81 ± 0.01		2017.052	4	*8,11*
A 2853	07164+1227	9.7	9.8	1991	312.2 ± 1.0	0.49 ± 0.01		2017.055	4	*8,12*
A 2856	07175+1324	9.9	10	1991	309.7 ± 0.7	0.52 ± 0.01		2017.055	3	*8*
A 2859AB	07185+0550	10.6	10.6	1996	107.6 ± 1.2	0.66 ± 0.02		2017.055	4	*8*
A 2862	07200+0347	8.3	9.5	1995	62.2 ± 1.1	0.75 ± 0.02		2017.055	4	*8*
A 2538	07558+2420	10.4	10.5	1991	309.3 ± 0.8	0.72 ± 0.01		2017.055	4	*8*
A 2129	08408+4148	10.2	10.5	1991	299.2 ± 0.3	0.94 ± 0.01		2017.203	4	*8*
A 2134	09085+2141	9.7	12.1	1984	19.4 ± 0.8	0.87 ± 0.01		2017.203	4	*8,12*
A 2138	09457+4104	9.1	14.5	2002	224.5	3.14	3.2	2017.2	1	*9*
A 1989	10106+2353	7.9	14.4	1974	284.7 ± 0.8	3.44 ± 0.08	4.9	2017.263	3	*6*
A 557	10417+2728	9.5	14.6	1998	127.2	5.14	3.3	2017.2	1	*9*
A 1769	10543+2607	10.4	10.5	2000	82 ± 1.2	0.74 ± 0.01		2017.236	4	*8*
A 2375	10585+1711	10.4	10	2007	169.3 ± 1.9	0.56 ± 0.02		2017.266	2	*8,11*
A 1995	11013+4542	11.4	11.4	1991	306.2 ± 2.2	0.67 ± 0.04		2017.236	4	*8,12*
A 1353	11136+5525	7.7	9.1	2010	207.8 ± 0.8	0.62 ± 0.00		2017.266	4	*8,11*
A 1848	11277+4410	9.9	9.9	1999	190.1 ± 0.6	0.61 ± 0.01		2017.236	4	*8*
A 2576AB	11330+0938	10.1	10.2	1991	260.2 ± 2.9	0.64 ± 0.03		2017.236	4	*8,12*
A 2225	13122+1608	7.5	13	1997	72.5 ± 0.6	3.01 ± 0.01	4.9	2017.395	2	*6,12*

Table 1 continues on next page.

Measurements of Aitken Visual Binary Stars: 2017 Report

Table 1 (continued). Measurements

NAME	WDS	M1	M2	DATE2	PA (°)	SEP (arcsec)	Δm	DATE	N	NOTE
A 1637	15483+1400	9.6	14.9	1975	256.1	2.78	3.2	2017.395	1	9
A 2079	15536+1604	6.1	12.5	1991	61.35 ± 0.2	4.03 ± 0.04	6.4	2017.395	2	6
A 2179	16122-0007	8.2	9.2	2011	75.6 ± 1.7	0.78 ± 0.01		2017.512	4	7
A 2181	16169+0113	10.1	10.2	2007	87.8 ± 1.0	0.59 ± 0.01		2017.512	4	7,11
A 2232	16203+0151	10.6	11	1991	199.7 ± 1.1	0.7 ± 0.01		2017.512	4	7,12
A 2233	16269+0101	9.5	10.3	2000	28.1 ± 0.2	2.71 ± 0.01		2017.507	4	7
A 2084	16296+1635	10.2	10.2	2008	131.1 ± 1.0	0.43 ± 0.01		2017.512	4	7
A 2234	16330+0233	8.8	11.8	1991	119.2 ± 0.3	0.95 ± 0.00		2017.507	4	7
A 1865	16462+4649	9.8	12.6	2003	293.9 ± 0.2	4.45 ± 0.01		2017.507	5	7
A 1867	16510+4605	9.7	13.8	2004	263.7 ± 0.1	1.83 ± 0.02		2017.507	4	7,12
A 1869	16529+4608	9	15.1	1945	220.5 ± 1.6	2.145 ± 0.05		2017.392	2	7
A 1874AB	16579+4722	7.9	10.8	2007	63.45 ± 0.1	5.145 ± 0.01		2017.307	2	7,11
A 228	17063+2631	9.3	9.8	2009	6 ± 0.1	0.61 ± 0.00		2017.512	4	7
A 2237	17088+0002	9.5	10.5	1991	66.6 ± 0.3	0.9 ± 0.00		2017.512	4	7
A 2984	17166-0027	4.9	7.5	2009	22.3 ± 1.5	0.72 ± 0.01		2017.512	4	7,11
A 2183	17235+1654	7.6	10.6	1991	136.5 ± 0.3	1.21 ± 0.00		2017.507	4	7
A 1877	17339+1446	10.5	10.6	2010	61.6 ± 0.5	0.6 ± 0.01		2017.512	4	7
A 1879	17354+1322	8.3	10.2	1995	115.2 ± 0.6	0.61 ± 0.01		2017.512	4	7,12
A 2092	17457+1650	8.5	10.3	2008	336.6 ± 1.0	0.87 ± 0.01		2017.512	4	7
A 1161	17468+0534	8.5	9.9	2013	285.8 ± 1.1	0.81 ± 0.01		2017.512	4	7
A 2185	17481+0135	9.8	11.5	1995	176.5 ± 0.5	0.73 ± 0.01		2017.507	4	7,12
A 2187	17501+0214	8.8	9.7	1998	321.8 ± 0.4	0.59 ± 0.00		2017.507	4	7
A 1883	17516+4555	10.3	10.4	1996	41 ± 0.4	0.59 ± 0.00		2017.512	4	7
A 2190	18022+0302	8.9	14	1930	75 ± 0.3	3.6 ± 0.01		2017.507	4	7
A 1165	18034+0447	9.6	10.7	1991	32.8 ± 0.7	1.18 ± 0.01		2017.633	4	7
A 1166	18054-0019	10.2	13.7	1925	89.6 ± 0.9	0.59 ± 0.02		2017.633	4	7,12
A 579	18181+4334	9.3	11.2	1997	339.8 ± 0.2	1.54 ± 0.01	1.9	2017.633	4	6
A 243	18215+2603	9.9	11.5	2002	68.6 ± 0.2	2.17 ± 0.00		2017.507	4	8
A 582	18295+0722	7.7	13.5	1962	28.7 ± 0.3	2.88 ± 0.01		2017.507	3	7,12
A 355	18363+0516	9.4	10.9	1996	142.6 ± 0.3	1.26 ± 0.01		2017.507	4	8
A 356	18380+0800	9.2	10.2	2005	223.5 ± 0.3	1.02 ± 0.02	0.9	2017.625	4	6
A 357	18436+0444	9.5	9.6	1995	71 ± 0.1	0.62 ± 0.00		2017.512	3	7
A 858AB	18437-0014	9.1	14	1986	244.9 ± 0.5	0.91 ± 0.01		2017.633	3	7,12
A 2262	18456+0142	10.1	10.8	1991	325 ± 0.3	1.16 ± 0.01	0.9	2017.633	4	6
A 257AB	18528+3125	8.4	13.5	1929	93.7 ± 0.6	0.86 ± 0.01		2017.512	3	7,12
A 257CD	18528+3125	11.8	12.1	1980	79.6 ± 0.7	0.73 ± 0.01		2017.512	4	7,12
A 2193	18559+0323	8.7	9.1	2011	356.7 ± 0.5	0.96 ± 0.01		2017.512	4	7
A 1171AB	18563-0048	8.2	11.5	1991	80.2 ± 1.6	0.93 ± 0.02		2017.512	4	7
A 2194	18586+0237	8.9	12	1987	325.2 ± 0.4	1.45 ± 0.01		2017.625	4	7
A 2195	19028+0146	7.8	11.6	1980	39 ± 0.3	2 ± 0.01		2017.633	4	7
A 589	19030+4233	9.5	10.1	2010	6.3 ± 0.4	0.69 ± 0.01		2017.534	4	7
A 360	19034+0718	10.2	10.2	2001	284.6 ± 0.4	0.67 ± 0.02		2017.534	4	7
A 363	19170+0724	8.7	11.9	1991	170.9 ± 0.2	2 ± 0.01	3.2	2017.633	4	6
A 1176	19177+1015	9.9	10.8	1999	105.3 ± 0.2	1.31 ± 0.00	1.3	2017.625	4	6
A 2268	19178+0317	9.3	9.7	1993	188.6 ± 2.0	0.6 ± 0.03		2017.534	4	7,12

Table 1 concludes on next page.

Measurements of Aitken Visual Binary Stars: 2017 Report

Table 1 (conclusion). Measurements

NAME	WDS	M1	M2	DATE2	PA (°)	SEP (arcsec)	Δm	DATE	N	NOTE
A 364	19253+0739	8.9	10.6	2001	50 ± 0.3	1.33 ± 0.01	1.9	2017.625	4	6
A 365	19256+0758	9	12.7	1995	155.9 ± 0.1	1.4 ± 0.01	2.5	2017.625	4	6
A 159AB	19273+2040	8.5	10.4	2007	336.2 ± 0.1	0.77 ± 0.02		2017.534	4	7,10
A 1182	19275+0910	9.5	9.8	1996	291.6 ± 0.2	0.74 ± 0.01	1	2017.625	4	6
A 1649	19283+1232	9.3	12.5	1991	27 ± 1.1	1.48 ± 0.02		2017.633	4	7
A 367	19330+0546	8.7	9.8	2005	304.9 ± 0.2	1.02 ± 0.00	1.1	2017.625	4	6
A 270Aa,Ab	19344+2535	8.8	12.3	1970	106.3 ± 0.4	1.41 ± 0.00	3	2017.633	4	6
A 2789	19415+2319	9.7	10	2007	277.7 ± 0.5	0.74 ± 0.00		2017.534	4	7
A 599AB	19435+4130	9.9	10	2007	201.2 ± 1.5	0.49 ± 0.00		2017.534	4	7
A 2389	19446+0350	9	11.3	1986	126.5 ± 1.0	0.86 ± 0.01	2.3	2017.633	4	6
A 1408	19564+3750	9.3	12.3	1932	182.6 ± 0.3	1.46 ± 0.01	2.7	2017.633	4	6
A 606	19580+0456	9.5	9.3	2008	344.4 ± 0.7	0.6 ± 0.02	0.6	2017.63	4	6,11
A 1197	20058+2946	9.8	10	2007	330.6 ± 0.2	0.77 ± 0.03		2017.616	4	7,12
A 390	20155+4030	9	10.3	2005	327.5 ± 1.4	0.8 ± 0.01		2017.625	4	7
A 391AB	20192+2441	9.8	10.4	2007	278.1 ± 0.6	0.89 ± 0.00	0.7	2017.625	4	6
A 610	20290+0710	9.5	9.9	2007	90.6 ± 0.5	0.5 ± 0.01	0.9	2017.636	4	2,11
A 613	20519+0544	9.1	9	2007	326.6 ± 0.8	0.75 ± 0.03		2017.616	4	7,11
A 877	20546-0042	9.7	9.9	1997	9.1 ± 1.3	0.55 ± 0.01		2017.625	4	7,12
A 1690BC	21050+1243	10.4	11.4	1991	112.6 ± 5.0	0.37 ± 0.02		2017.718	4	7
A 767	21297+4732	9.1	12.2	1928	169.4	1.29	2.7 ± 0.0	2017.784	1	2
A 888	21307+0005	9.8	9.8	2001	35.7 ± 1.7	0.57 ± 0.00	0.4	2017.625	4	6
A 770AB,C	21308+4827	8.7	11.9	2008	317.4	1.13	3.1 ± 0.0	2017.784	1	2
A 1446	21399+3941	10.7	11.3	2002	40.3 ± 0.3	1.3 ± 0.00	0.9	2017.633	4	6
A 2098	21440+0335	9.2	12.1	1991	222.1 ± 0.5	1.1 ± 0.02		2017.633	4	7
A 1800	21550+5442	10.3	11	2001	27.3 ± 0.9	1.27 ± 0.02	0.7	2017.633	4	6
A 1458	22131+3653	10	10.6	2000	340.4 ± 0.2	0.77 ± 0.01	0.7 ± 0.0	2017.789	4	2,3
A 2496	22138+4237	9.1	12.4	1997	255.7 ± 0.1	1.72 ± 0.02	2.8 ± 0.2	2017.786	3	1,2
A 627	22190+6012	10.7	10.9	2001	136.4 ± 0.6	1.03 ± 0.01	1.1	2017.625	4	6
A 186AB	22205+4817	9.6	10.2	1991	11 ± 0.3	0.98 ± 0.01	1.3 ± 0.0	2017.789	4	2
A 630	22237+1107	8.1	12.9	1915	304.8	1.4	3.6 ± 0.0	2017.784	1	2
A 1465	22278+5258	8.6	12.1	2008	157.4 ± 1.7	0.86 ± 0.03	2.6 ± 0.2	2017.789	4	2
A 1466	22307+3923	10.8	11	2009	161.1 ± 0.5	0.77 ± 0.00	0.6 ± 0.0	2017.789	4	2,3
A 631	22515+5726	9.9	10.2	2008	290.1 ± 1.3	0.59 ± 0.03	1.2 ± 0.1	2017.792	4	2
A 633AB	22560+5702	9.1	11.2	2008	231.9 ± 0.9	0.75 ± 0.00	2.6 ± 0.1	2017.792	4	2
A 1236	22585-0001	10.8	12.3	1986	1.6 ± 0.5	0.69 ± 0.01	1.4 ± 0.0	2017.789	4	2,3,12
A 2296	22587+0401	9.5	10.5	2000	45.4 ± 0.5	0.83 ± 0.01	1.1	2017.781	4	6
A 198	23131+4622	10	10.1	2008	344.1 ± 0.6	0.63 ± 0.01	0.2 ± 0.0	2017.789	4	2
A 2299BC	23137+0212	10.9	11.1	1994	76.5 ± 0.1	1.32 ± 0.01	0.9	2017.781	4	6,12
A 639	23190+4726	10.6	10.8	2009	103.4 ± 0.2	0.82 ± 0.01	0.9 ± 0.0	2017.789	4	2,3
A 1485	23268+5434	9.3	9.9	2005	208.6 ± 0.3	0.58 ± 0.01	0.9	2017.781	4	6
A 1486	23285+5524	9.4	10.6	2009	261.8 ± 0.8	0.85 ± 0.01	1.6 ± 0.1	2017.789	4	2
A 109	23291+4324	10.1	10.3	2009	311.7 ± 0.1	0.9 ± 0.00	0.6 ± 0.1	2017.789	4	2,3
A 1489	23326+4949	10.2	10.3	2008	40.7 ± 0.7	0.48 ± 0.01	1.2 ± 0.1	2017.789	4	2,4
A 1495	23425+5436	9.1	9.6	1995	186.4 ± 0.6	0.49 ± 0.01	1.2	2017.781	4	6,12
A 645	23492+5838	10.2	10.9	2008	96.4 ± 0.3	0.88 ± 0.01	1.2 ± 0.0	2017.792	4	2
A 1246	23511+3147	9.1	12.2	1999	93.2 ± 0.4	0.91 ± 0.02	2.5 ± 0.1	2017.789	4	2
A 2200	23550+0428	10.8	10.9	1994	54 ± 0.2	0.81 ± 0.00	0.5	2017.781	4	6

Notes for Table 1.

1. Acquisition with a G filter (Astronomik type IIc)
2. SEP, PA and Δm computed using bispectrum with SpeckleToolbox (v 1.13)
3. Imperfect bispectrum-reconstructed image (secondary peak). Estimated Δm may be biased.
5. SEP, PA computed using N auto-correlations and Δm from a single bispectrum, both with SpeckleToolbox
6. SEP, PA computed using N auto-correlations with SpeckleToolbox and Δm from a single LS image with Reduc
7. SEP, PA computed using N auto-correlations with SpeckleToolbox
8. SEP, PA computed using N auto-correlations with Reduc
9. SEP, PA and Δm computed from a single LS image with Reduc
10. AC=STF2527
11. Pair with an entry in 6th Catalog of Orbits. See Table 3 for O-C
12. Pair showing a significant displacement since last measure published in WDS. See Table 4

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

NAME	WDS	M1	M2	DATE	NOTE
A 806AB	00355+1150	8.4	11.8	2017.781	*1*
A 1816	02291+3720	6.6	11.3	2017.83	*1*
A 1290	03480+5503	8.6	12.7	2017.83	*2*
A 2521	06448+3848	9.5	13.2	2017.055	*2*
A 2143	10095+4126	10.5	10.3	2017.236	*2*
A 1385AB	18554+3556	9	11	2017.512	*2,3*
A 2192	18558+0327	7.7	8	2017.512	*1*
A 2990AB	18585+2515	7.9	14.5	2017.507	*1*
A 2994BC	19503+0713	10.2	10.2	2017.534	*2*
A 1445AB	21399+3931	6.8	12.8	2017.633	*1*
A 890	21547+4729	9.9	14	2017.633	*1*

Notes for Table 2

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

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

NAME	WDS	DATE	O-C PA(°)	O-C SEP (arcsec)	GRADE	REF
A 2219	02379+2003	2017.052	5.3	0.03	5	Hei1997
A 1281AB	02517+4559	2017.052	6.1	0.01	4	Hrt2014a
A 2413	02572+0153	2017.052	-0.4	0.07	3	Hrt2010a
A 2641	05226+0236	2017.052	-4.1	-0.13	4	Sod1999
A 2375	10585+1711	2017.266	1	0.06	3	Doc2009g
A 1353	11136+5525	2017.266	-0.3	0.07	3	Doc2015f
A 2181	16169+0113	2017.512	-18.8	0.17	5	Pop1995d
A 1874AB	16579+4722	2017.307	-0.2	0.12	5	Kis2009b
A 2984	17166-0027	2017.512	1.1	0	4	Tok2015c
A 606	19580+0456	2017.63	-3.5	0.17	4	Zae1982
A 610	20290+0710	2017.636	-0.9	0.05	3	Cot2002
A 613	20519+0544	2017.616	8.8	0.14	5	USN2002

Measurements of Aitken Visual Binary Stars: 2017 Report

Table 4. Pairs with showing a significant displacement wrt. their last measurement as reported in the WDS

NAME	WDS	DATE2	NOBS	δ PA	δ SEP	NOTES
A 429AB	00039+2759	2010	34	-11.7	0.1	
A 1923	02018+4040	2008	8	-181.8	0.06	*4*
A 823	02332+6000	1991	5	15.2	-0.09	
A 972	02501+5640	1986	5	-13.8	0	
A 2028	03027+0704	1991	5	11.6	0.01	
A 1826Aa,Ab	03444+2812	2007	7	11.5	0.14	
A 2856	07175+1324	1991	12	10.7	0.02	
A 2134	09085+2141	1984	5	-11.6	-0.13	
A 1995	11013+4542	1991	5	20.2	-0.13	
A 2576AB	11330+0938	1991	11	22.2	0.14	
A 2225	13122+1608	1997	7	-1.1	0.52	*2*
A 2079	15536+1604	1991	6	2.2	0.6	*5*
A 2232	16203+0151	1991	10	19.7	-0.1	
A 1867	16510+4605	2004	5	-11.3	-0.07	
A 1879	17354+1322	1995	18	11.2	0.11	
A 2185	17481+0135	1995	8	-13.5	0.03	
A 1166	18054-0019	1925	3	-25.5	0.09	
A 582	18295+0722	1962	5	-10.3	-0.02	
A 858AB	18437-0014	1986	5	-29.1	-0.49	
A 257AB	18528+3125	1929	3	-13.3	-0.14	
A 257CD	18528+3125	1980	4	-180.4	0.23	*1*
A 2268	19178+0317	1993	29	-20.4	0.1	
A 1197	20058+2946	2007	24	10.6	0.07	
A 877	20546-0042	1997	8	-11.9	0.03	
A 1236	22585-0001	1986	8	-14.4	-0.31	*2*
A 2299BC	23137+0212	1994	11	-9.5	0.52	*2*
A 1489	23326+4949	2008	10	-175.3	-0.02	*3*

Notes for Table 4

1. Possible quadrant inversion
2. See Plate 2
3. Our observation definitely shows B in Q1 (like the first 8 recorded in the WDS)
4. Our observation definitely shows B in Q2 (like almost all the others in the WDS)
5. Large Δm pair. Sep may be overestimated. See Plate 2.

(Continued from page 528)

257CD and A 1489), it may be explained by a quadrant inversion, either in our measurement or in the recorded data (for A 1923 and A 1489, for example, most of the historical measurements are noted as having their PA value been quadrant flipped). In two cases (A 1236 and A 2225) the variation is likely to be caused by a deviation in the last WDS data, as shown in Plate 2.

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 developed and maintained by D. Rowe and the Reduc software (v 5.1) developed and maintained by F. Losse. History of measurements for some pairs listed in Table 4 have been kindly provided by B. Mason. Figures in Plate 2 have been obtained using software kindly provided by R. Harshaw.

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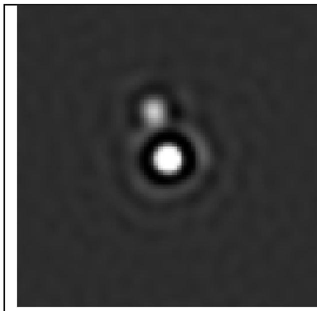
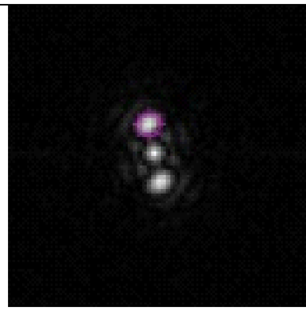
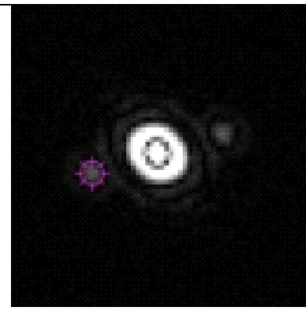
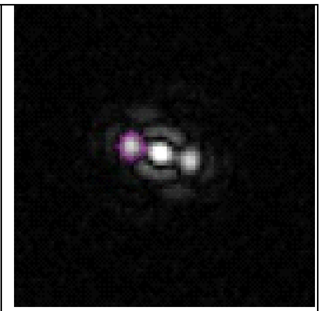
Measurements of Aitken Visual Binary Stars: 2017 Report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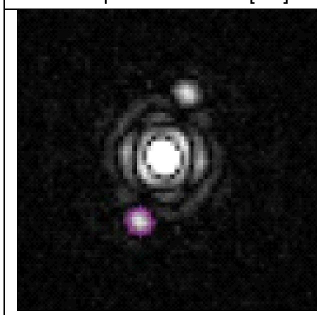
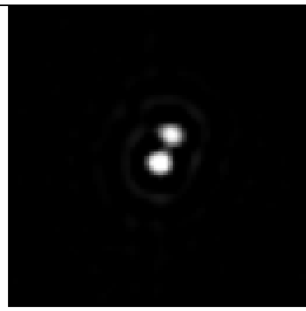
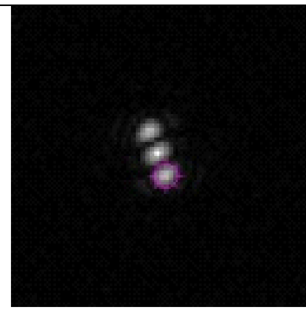
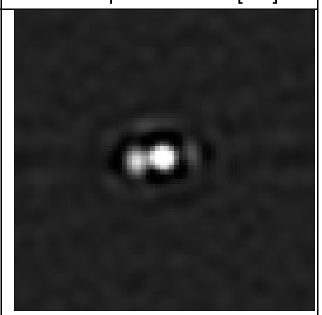
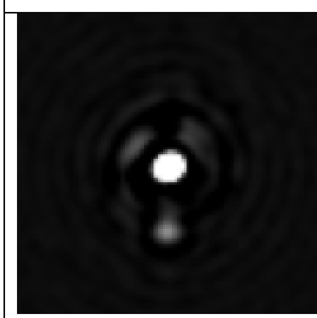
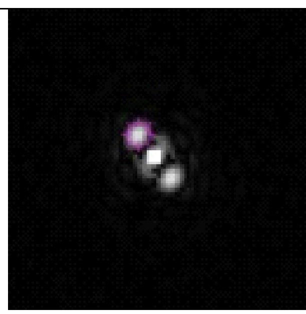
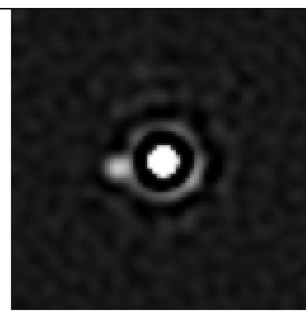
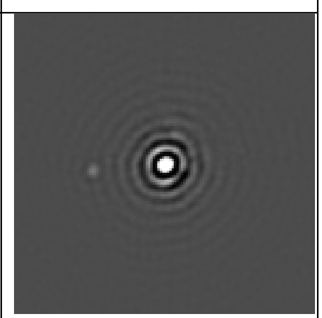
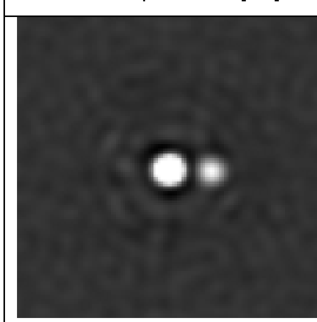
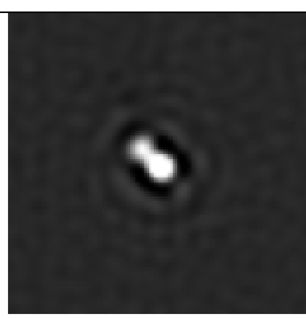
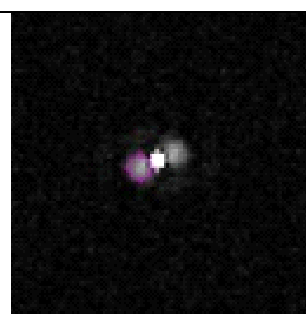
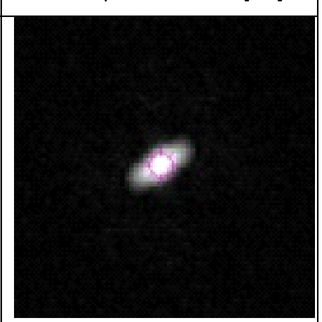
			
A 365 m1=9 .0 m2=12.7 θ=155.9° ρ=1.4'' [AC]	**A 429AB** m1=9.3 m2=9.4 θ=319.3° ρ=0.6'' [BS]	**A 599AB** m1=9.9 m2=10.0 θ=201.2° ρ=0.49'' [AC]	**A 610** m1=9.5 m2=9.9 θ=90.6° ρ=0.5'' [BS]
			
A 767 m1=9.1 m2=12.2 θ=169.4° ρ=1.29'' [BS]	**A 888** m1=9.8 m2=9.8 θ=35.7° ρ=0.57'' [AC]	**A 1246** m1=9.1 m2=12.2 θ=93.2° ρ=0.91'' [BS]	**A 1287** m1=7.8 m2=13.8 θ=95° ρ=2.92'' [BS]
			
A 1486 m1=9.4 m2=10.6 θ=261.8° ρ=0.85'' [BS]	**A 1498** m1=10.2 m2=10.3 θ=40.7° ρ=0.48'' [BS]	**A 1690BC** m1=10.4 m2=11.4 θ=112.6° ρ=0.37'' [AC]	**A 1385** m1=9 m2=11 N/A [AC]

Plate 1 – Examples of images after reduction
(AC : auto-correlogram computed on 1000 frames. BS: bispectrum computed on 1000 frames. N up, E left)

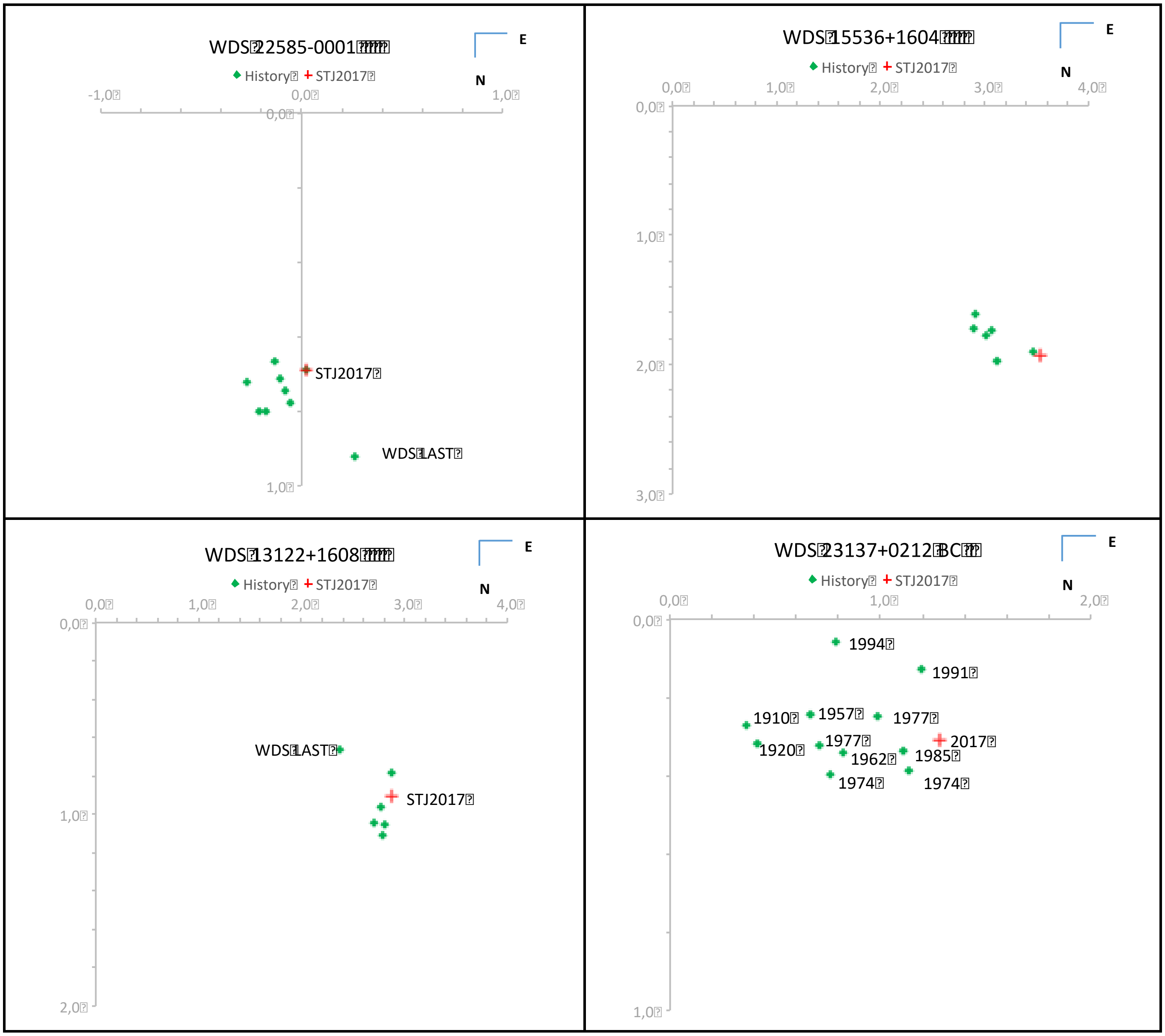


Plate 2. Some image of pairs with showing a significant displacement wrt. the measurement recorded in the WDS