495 Common Proper Motion Pairs so far not WDS Listed

Wilfried R.A. Knapp
Vienna, Austria
wilfried.knapp@gmail.com

Abstract: This report covers 495 common proper motion pairs so far (per end of February 2018) not WDS listed. The pairs come with a separation less than 5 arcseconds and are considered to be probably physical. For each pair an observation history covering 2MASS, UCAC4, UCAC5 and GAIA DR1 is given. Visual magnitudes are estimated using GAIA DR1 Gmags and 2MASS J/H/K-mags

Introduction

The number of GAIA DR1 stars with less than 5 arcseconds separation is estimated about 40 million – as GAIA DR1 provides proper motion data only for Tycho and Hipparcos stars, we have to wait for the next GAIA data release before we can base work on Gaia to differentiate between common proper motion stars and optical pairs and also for fainter stars. Despite some shortcomings (Knapp and Bryant 2018) UCAC5 is currently our most reliable comprehensive source of proper motion data. The number of UCAC5 stars with less than 5 arcseconds separation is about 3.5 million. Using the extended common proper motion assessment scheme presented in Knapp 2018 on this data set the number of pairs being probably physical is about 2,000.

Object list

To eliminate all objects with potentially suspect data a multi-step drill down process was applied:

- In a first step all objects already listed in WDS or WDSS were eliminated
- Next several hundred objects with a given UCAC5 proper motion error substantially larger than 2mas/yr were eliminated
- Next 2MASS and UCAC4 catalogs were counter-checked for corresponding objects to be able to deliver an observations history. The number of objects listed in all these catalogs got then down to about 1,000
- The availability of GAIA DR1 Gmags and 2MASS J/H/K-mags for all objects made it then possible to calculate an estimated visual magnitude for all objects. To avoid providing potentially suspect Vmag estimations the photometry quality flag of 2MASS was used to eliminate all objects with questionable J/H/K-mags. This reduced the number of objects by more than half

Finally I checked another recent catalog SDSS9 for matches to expand the observation history for at least a part of the objects.

The final result of these steps is provided in a spreadsheet available for download on the JDSO web site as “495_CPM_pairs”.

For the first 10 objects the data is given in Table 1.

Table 2 gives for the first 10 objects the rating results according to the Knapp 2018 CPM assessment scheme, the full spreadsheet is available for download on the JDSO web site as “CPM_Rating”.

Summary

The detection of the listed CPM pairs demonstrates the power of the CDS X-Match tool, not only for selecting interesting double stars out of very large star catalogs, but also for providing an observation history for such objects by cross-matching with different catalogs. The number of reported objects could have been far larger with less restrictive thresholds (larger separation, less complete observation history, less reliable estimations of visual magnitudes etc.), but I preferred to be on the rather safe side regarding data quality.

A potential follow up might be to take CCD images of these objects to provide my own astrometry and photometry measurements but this will take some time.

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Table 1. Data for First 10 of 495 Pairs so far not WDS Listed

KPPn+	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	CPM score	Ap	Me	Date	N	Source/Notes
1	0.10349470	71.64577420	4.879	109.841	13.60	14.32	-0.70	-36.20	1.84	-2.00	-36.10	2.12	92	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	0.10356350	71.64592120	4.887	111.652			-15.70	-36.80	4.60					0.20	Eu	2003.623		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	0.10346300	71.64595000	4.904	109.960	13.23	13.71								1.30	E2	1999.789		2MASS. M1 and M2 estimated from J- and K-band
	0.10350110	71.64588720	4.894	109.801	13.28	14.14	-0.70	-36.20	1.84	-2.00	-36.10	2.12		0.20	Eu	2003.766		UCAC5. M1 and M2 are fmag values
	0.10349460	71.64577426	4.879	109.847	12.89	13.51								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
2	0.17726560	-14.16994860	3.401	75.006	14.05	14.11	15.70	-1.20	1.98	16.00	0.30	2.12	62	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	0.17719240	-14.16994480	3.407	75.480		13.31	0.00	0.00	70.71	13.10	-15.10	10.61		0.20	Eu	1999.540		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	0.17717800	-14.16992000	3.395	74.438	14.06	14.16								1.30	E2	1998.898		2MASS. M1 and M2 estimated from J- and K-band
	0.17719690	-14.16994330	3.390	75.379	14.15	14.27	15.70	-1.20	1.98	16.00	0.30	2.12		0.20	Eu	1999.717		UCAC5. M1 and M2 are fmag values
	0.17726555	-14.16994860	3.401	75.006	13.75	13.83								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
3	0.29269440	-30.60732330	3.352	47.514	13.85	13.92	28.00	-27.50	1.84	28.70	-27.30	1.84	100	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	0.29253950	-30.60721310	3.437	47.277	13.08		-16.80	-61.80	13.09	72.10	15.10	15.66		0.20	Eu	1990.450		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	0.29253800	-30.60720600	3.344	47.373	14.02	14.02								1.30	E2	1998.873		2MASS. M1 and M2 estimated from J- and K-band
	0.29254890	-30.60720030	3.341	47.399	13.88	13.89	28.00	-27.50	1.84	28.70	-27.30	1.84		0.20	Eu	1998.867		UCAC5. M1 and M2 are fmag values
	0.29269443	-30.60732333	3.352	47.510	13.45	13.51								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
4	1.98252640	2.72799330	4.886	125.853	12.77	14.51	15.40	1.00	1.91	15.40	1.20	2.76	63	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	1.98249210	2.72798730	4.812	126.348	12.48		4.80	1.00	10.29					0.20	Eu	1996.248		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	1.98241800	2.72800000	4.889	125.931	12.72	14.55								1.30	E2	2000.651		2MASS. M1 and M2 estimated from J- and K-band
	1.98246500	2.72798940	4.888	125.880	12.73	14.67	15.40	1.00	1.91	15.40	1.20	2.76		0.20	Eu	2000.648		UCAC5. M1 and M2 are fmag values
	1.98252645	2.72799323	4.886	125.856	12.41	14.15								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
	1.98248900	2.72799900	4.903	125.867	15.25	14.79								2.50	Es	2008.754		SDSS9. M1 and M2 are gmags

Table 1 continues on the next page.

Table 1 (continued). Data for First 10 of 495 Pairs so far not WDS Listed

KPPn+	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	CPM score	Ap	Me	Date	N	Source/Notes
5	2.71504110	-40.11615110	3.295	129.891	13.91	13.98	25.00	1.80	1.84	25.10	1.30	1.77	92	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	2.71488540	-40.11614500	3.338	130.107		13.16	-20.50	33.80	2.83					0.20	Eu	1996.715		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	2.71484800	-40.11615800	3.289	130.308	14.01	13.92								1.30	E2	1999.583		2MASS. M1 and M2 estimated from J- and K-band
	2.71489360	-40.11615920	3.288	129.805	13.99	13.81	25.00	1.80	1.84	25.10	1.30	1.77		0.20	Eu	1998.766		UCAC5. M1 and M2 are fmag values
	2.71504103	-40.11615120	3.295	129.885	13.66	13.66								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
6	2.87877670	25.35638890	3.862	176.929	13.50	15.42	-7.90	-19.20	1.84	-7.60	-19.40	5.52	78	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	2.87879860	25.35644950	3.871	177.225	13.33									0.20	Eu	2001.560		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	2.87881000	25.35650600	3.857	177.051	13.54	15.13								1.30	E2	1997.795		2MASS. M1 and M2 estimated from J- and K-band
	2.87880940	25.35646060	3.859	176.990	13.60	15.27	-7.90	-19.20	1.84	-7.60	-19.40	5.52		0.20	Eu	2001.559		UCAC5. M1 and M2 are fmag values
	2.87877668	25.35638895	3.862	176.923	13.26	14.93								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
	2.87879600	25.35645000	3.864	177.056	15.49	15.78	-11.00	0.00	2.83					2.50	Es	2004.729		SDSS9. M1 and M2 are gmags
7	2.94314330	-25.79168810	3.755	278.474	13.72	15.32	-6.30	-36.50	1.98	-6.00	-36.50	5.81	78	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	2.94316630	-25.79153700	3.796	278.684	13.47		7.00	-38.90	4.63	-102.50	-20.70	3.32		0.20	Eu	1981.198		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	2.94319500	-25.79152700	3.731	278.602	13.53	14.99								1.30	E2	1998.849		2MASS. M1 and M2 estimated from J- and K-band
	2.94317330	-25.79153140	3.759	278.458	13.72	15.21	-6.30	-36.50	1.98	-6.00	-36.50	5.81		0.20	Eu	1999.541		UCAC5. M1 and M2 are fmag values
	2.94314347	-25.79168795	3.756	278.467	13.29	14.62								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
8	3.53716810	-6.02624750	3.502	196.807	12.89	13.06	0.70	-15.80	2.27	1.30	-16.00	2.27	78	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	3.53716420	-6.02617280	3.496	196.990		12.20	7.70	11.80	2.70	-5.90	-9.60	9.29		0.20	Eu	1996.210		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	3.53716000	-6.02620100	3.502	198.599	13.06	13.09								1.30	E2	2000.807		2MASS. M1 and M2 estimated from J- and K-band
	3.53716500	-6.02618110	3.500	196.966	12.97	12.87	0.70	-15.80	2.27	1.30	-16.00	2.27		0.20	Eu	1999.861		UCAC5. M1 and M2 are fmag values
	3.53716795	-6.02624758	3.501	196.807	12.64	12.78								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
	3.53723500	-6.02626000	3.572	197.377	13.91	14.27								2.50	Es	2008.888		SDSS9. M1 and M2 are gmags

Table 1 concludes on the next page.

Table 1 (conclusion). Data for First 10 of 495 Pairs so far not WDS Listed

KPPn+	RA	Dec	Sep	PA	M1	M2	pmRA1	pmDec1	e_pm1	pmRA2	pmDec2	e_pm2	CPM score	Ap	Me	Date	N	Source/Notes
9	5.63974580	16.93811580	3.355	300.986	15.03	15.19	-49.30	-40.90	3.26	-50.00	-39.90	3.89	95	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	5.63994560	16.93826140	3.300	300.849	14.48					-8.00	30.10	9.62		0.20	Eu	2000.258		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	5.63997100	16.93827200	3.318	300.875	14.41	14.54								1.30	E2	1998.877		2MASS. M1 and M2 estimated from J- and K-band
	5.63994830	16.93827610	3.341	300.866	14.74	15.29	-49.30	-40.90	3.26	-50.00	-39.90	3.89		0.20	Eu	2000.875		UCAC5. M1 and M2 are fmag values
	5.63974595	16.93811578	3.356	300.986	14.20	14.32								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags
	5.63982700	16.93815600	3.373	301.174	15.80	16.47								2.50	Es	2008.754		SDSS9. M1 and M2 are gmags
10	6.47273500	62.76153640	4.755	222.988	15.26	15.91	-10.40	-4.10	3.89	-10.20	-4.30	4.53	63	0.96	Hg	2015.000	V	GAIA DR1/2MASS/UCAC5. M1 and M2 estimated from G/J/H/K-mag. PM data from UCAC5 catalog
	6.47278830	62.76153590	4.695	223.272	14.72	14.80	7.40	17.20	4.24					0.20	Eu	2002.730		UCAC4. Given magnitudes are Vmags. Central epochs averaged
	6.47281600	62.76157000	4.909	223.081	14.83	15.45								1.30	E2	2000.010		2MASS. M1 and M2 estimated from J- and K-band
	6.47280640	62.76154920	4.754	223.018	15.30	15.81	-10.40	-4.10	3.89	-10.20	-4.30	4.53		0.20	Eu	2003.699		UCAC5. M1 and M2 are fmag values
	6.47273491	62.76153627	4.754	222.988	14.78	15.04								0.96	Hg	2015.000		GAIA DR1. M1 and M2 are Gmags

Content Description:

The header line lists the data suggested for the WDS catalog entry, the other lines give the data from catalogs as indicated in the Source/Notes column. Given magnitudes in the header line are estimated Vmags according to Knapp and Nanson 2018 and given magnitudes in the 2MASS lines are estimated Vmags according to Caldwell et al. 1993.

KPPn+	Discoverer ID + running number
RA	RA in degrees
Dec	Dec in degrees
Sep	Sep in arcseconds
PA	PA in degrees
M1	Magnitude for the primary
M2	Magnitude for the secondary
pmRA1	RA proper motion in mas/yr for the primary
pmDec1	Dec proper motion in mas/yr for the primary
e_pm1	Proper motion error vector in mas/yr for the primary
pmRA2	RA proper motion in mas/yr for the secondary
pmDec2	Dec proper motion in mas/yr for the secondary
e_pm2	Proper motion error vector in mas/yr for the secondary
CPM score	Estimated probability for being physical
Ap	Aperture
Me	Observation method
Date	Observation date
N	Note code
Source/Notes	Used source plus comments as required

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Table 2: CPM Rating of the Listed Objects

Disc	PMVD° A	PMVD° B	PMVL A	PMVL B	CPM Rat	CPM Score	Verbal
KPPn+1	181.1077914	183.1710397	36.20676732	36.15535922	AABB	92	Almost certainly physical
KPPn+2	94.37079704	88.92583	15.74579309	16.00281225	BACB	62	Probably physical
KPPn+3	134.4838358	133.5679038	39.24601891	39.61035218	AAAA	100	Most certainly physical
KPPn+4	86.28471089	85.54439717	15.43243338	15.44668249	AADB	63	Probably physical
KPPn+5	85.8818103	87.03513869	25.06471624	25.13364279	AABB	92	Almost certainly physical
KPPn+6	202.3651244	201.3928904	20.76174366	20.83554655	AACB	78	Most probably physical
KPPn+7	189.79292	189.3349985	37.03970842	36.98986348	AACB	78	Most probably physical
KPPn+8	177.4632383	175.3549216	15.81549873	16.05272563	AACB	78	Most probably physical
KPPn+9	230.3204038	231.4101328	64.05700586	63.96882053	AABA	95	Almost certainly physical
KPPn+10	248.4841153	247.1412381	11.17899817	11.06932699	AADB	63	Probably physical

Content Description:

Disc	Discoverer code
PMVD° A	Proper motion vector direction primary
PMVD° B	Proper motion vector direction secondary
PMVL A	Proper motion vector length primary in mas/yr
PMVL B	Proper motion vector length secondary in mas/yr
CPM Rat	Overall common proper motion rating for direction, speed, error range and angular separation in relation to speed
CPM Score	Estimated probability for being physical in percent
Verbal	Verbal estimated probability for being physical

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Acknowledgements

The following tools and resources have been used for this research:

- Washington Double Star catalog
- 2MASS All Sky catalog
- GAIA DR1 catalog
- UCAC5 catalog
- URAT1 catalog
- SDSS9 catalog
- CDS X-Match
- CDS VizieR
- Aladin Sky Atlas v9/10

References

Caldwell, John A.R., Cousins, A.W.J., Ahlers, C.C., van Wamelen, P. and Maritz, E.J., 1993, "Statistical Relationships Between the Photometric Colours of Common Types of Stars in the UBV(RI)c, JHK and uvby Systems", *South African Astronomical Observatory Circulars*, No 15.

Knapp, Wilfried R.A. and Bryant, Tom, 2018, "Reliability of UCAC5 Proper Motion Data for Common Proper Motion Assessment of Double Stars", *JDSO*, **14** (3), 577-586. (this issue)

Knapp, Wilfried R.A. and Nanson, John, 2018, "Estimating Visual Magnitudes for Wide Double Stars", *JDSO*, **14** (3), 496-502.

Knapp, Wilfried R.A., 2018, "A New Concept for Counter-Checking of Assumed Binaries", *JDSO*, **14** (3), 487-491. (this issue)