Notes on DSLR Archive Data

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Tom Calderwood

In the course of preparing our fall meeting presentation on observer consistency, Jim Kay and I had occasion to look at recent DSLR data in the AID. A number of problems were found, and this note is a summary of the findings. I am not trying to “pick” on DSLR—there are PEP observers committing some similar sins—but the sheer volume of DSLR data coming into the archive means that problematic observations are being submitted in large quantities.

1. Observers with systematic errors.

Below are light curves with data from PGD, experienced PEP observer (blue crosses), and DSLR observer Sam.
Sam shows a definite habit of being too faint, but not always. Below, he is the blue crosses:
And sometimes he does reasonably well (blue crosses):

Here is a nice curve from Dick, apparently using the wrong comp star or comp star magnitude (PGD crosses):
Here is observer Mike on UU Aur. Blue crosses are Hilda, who appears to be reliable; Mike data are the rather dim points below her (I trimmed out one howler at $V \approx 14.3$). The overly-bright data points are Sam, again.

On eps Aur, Walter is questionable:
Andy (blue crosses) on U Del is very questionable:

Below, a bright outlier (blue cross) from Eddie on XY Lyr: Larry (large error bars), Fran (small error bars), and Sam (no error bars) are responsible for the dim points.
In these examples, the DSLR observers are mostly operating unfiltered with V zeropoint, or as TG, so one would not expect exact agreement with transformed V PEP data (but see item #11, below). However, the range of deviation is so great that it is hard to believe that serious problems are not involved.

2. Observers reporting unrealistic errors.

Below is a time series for alf Com, an apparent dry run for the abortive eclipse campaign of 2014-5:

The mean of these magnitudes is pretty close to the expected value for alf Com. However, the median error reported is 3 mmag, while the RMS for a constant-line fit of all the points is 18 mmag.

Some observers report no errors at all. Bruce has submitted 20,000+ observations the last two years with no uncertainties. Some observers are reporting time series with suspiciously constant errors (eg:
Betty, B Per, March 2016. Errors of 0 are being submitted (Randy, mu Cep, 12 July 2012). Note that the WebObs observation editor will reject error values of 0. If the observer had to modify such an observation record, the editor would force him/her to change the 0 error to a positive value.

3. Extinction problems

Returning to the alf Com light curve, it is seen that the data have a brightening trend:

During the series, the star is rising towards the meridian. Differential extinction between the variable and comparison decreases, so the variable, which is east of the comparison, appears to get brighter. The field-of-view for a DSLR is large enough to require correction for first-order extinction.

4. Chart problems

Various practices render it difficult to determine the comparison star or its magnitude. Some observers are submitting BAAVSS chart identifiers (Liz Sep 2016). Some are listing comp stars that are not on the specified AAVSO chart (Victor, R Lyr, JD=2457611). Sometimes no comp or check is even specified (Sarah, RZ Cas, 2457537). There are numerous examples of what I presume are ensemble comparisons where the comparison is listed as blank or “NA.” Andy gives comp/check magnitudes instead of identifiers for U Del on 1 Nov 2015.

5. Incorrect classification of observations

DSLR observer Mike has data classified as CCD during 2014-2016. I suppose it is possible that Mike is using a non-DSLR color camera to take TG data, but from the observation record it is impossible to tell. Victor DSLR data is also classified as CCD (2016).
6. Fainter-than data

Hal is reporting fainter-than observations with uncertainties. How is this possible? Fainter-than means you can't detect the star.

2456556.41774, <12.352, 0.248, V, Hal , 86, 107, 12584AWX, 0 , Z , -10.057, -7.948, RU AUR
2456558.36061, <12.666, 0.222, V, Hal , 86, 107, 12584AWX, 0.2759, Z, -10.688, -8.498, RU AUR

7. Missing airmass

Hal on RU Aur, again. Field before “Z” is empty.

2456528.49407, 14.647, 0.205, V, Hal, ENSEMBLE, 105, 12584AWX, 0, Z, 10.540, RU AUR

8. Inappropriate targets for unfiltered observations

Unfiltered data is useful for monitoring CVs, for establishing periods, in cases where comparisons with matching B-V are available, or when operating near the instrumentation sensitivity limit. But observers are shooting large fields and reporting data for multiple stars at once. In principle, the ensembles used could be made up of stars with matching B-V for each variable, but far more likely that the observer is using a single ensemble for all of them, which is not appropriate. In any case, the observer is using a single check star for all variables, which cannot possibly match the different variable colors. Eg: Fran on 1 Apr 2016. Y CVn, TU CVn, NSV 19560, BZ CVn, CE CVn, CE CVn, BY CVn, BQ CVn, CD CVn, TW CVn, and NSV 5976, all on chart 13353RG. Observer Liz seems to be doing this on a more limited scale in Sep 2015 with V Aql, R Sct.

9. Large errors

There are observations reported with uncertainties north of 0.2. These are no better than visual data—do we really want them in the archive? Perhaps in addition to the “discrepant” category, we need a “low quality” category. It might also apply to data taken at excessive airmass.

10. Missing metadata

Observers often do not identify the equipment they used. There is no requirement that they do so, so I can't say this is an omission, but it can be placed in the COMMENTS and would be a big help. It would also be nice to know the software used for reduction. [In PEP, we are looking at standardized information for the comment field to convey this and other information.]

11. Wrong filter identifier

Do Victor and Liz really have Johnson V filters for their DSLRs? On 20 Sep 2016, Liz, if we believe her filter specification, is switching rapidly between Johnson V and unfiltered, which seems unlikely. Observer Pete specified filter “N/A” for AE UMa on 12 Mar 2015. Surely he means unfiltered.

12. Conclusion
It should be noted that assembling this sample of anomalies was a very laborious process—we don't have tools to efficiently evaluate the archive contents. Also, CCD data were not considered, and we can reasonably assume that similar problems exist in that domain. Finally, I will pick on DSLR. Here is a five year light curve of rho Cas from the heyday of PEP observing in the 1980s. 268 data points by fourteen observers. Top five observer totals were 45, 43, 41, 37, and 36. Median uncertainty is 3 mmag.

Fairly good-looking curve. Now, here are the last five years of data from DSLR observers. 532 data points from eleven observers, top five totals: 243, 214, 31, 24, 5. Same vertical scale. Victor, the most prolific and reliable observer, had a median uncertainty of 26 mmag. Liz, the other major contributor, did not even supply uncertainties.

It is not unreasonable to conclude that data quality declined as DSLR supplanted PEP.