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The WFCAM multiwavelength Variable Star Catalog *(Corrigendum)*

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The multiplicative expression on the $I_{\rm pfc}^{(s)}$ (see Sect. 3.1, Eq. (6)) variability indices does not properly correct for different numbers of epochs in different filters. The expression can be written in the following form:

$$\sqrt{\frac{(n_s-s)!}{n_s!}} = \sqrt{\frac{1}{\prod_{j=1}^{s-2}[n_s-(s-j)]}}\cdot\sqrt{\frac{n_s}{(n_s-1)}}\cdot\frac{1}{n_s}, \quad (1)$$

where $s > j$. $\sqrt{n_s/(n_s-1)}$ is the Bessel correction while $1/n_s$ is the factor for the mean value. The first parameter (right side) is incorrect and introduces a bias related to n_s values when $s > 2$. Additionally the Bessel correction needs to be repeated for each additional correlation term, as we show below. Indeed, the weight of this bias must increase with both s and n_s. Therefore these indices must be replaced by following,

$$I_{\rm pfc}^{(s)'} = \frac{1}{n_s}\sum_{i=1}^{n}\left[\sum_{j_1=1}^{m-(s-1)}\cdots\left(\sum_{j_s=j_{(s-1)}+1}^{m}\Lambda_{ij_1\cdots j_s}^{(s)}\sqrt[s]{|\Gamma u_{ij_1}\cdots\Gamma u_{ij_s}|}\right)\right], \quad (2)$$

where Γ is given by,

$$\Gamma u_{ij} = \sqrt{\frac{n_{u_{j_s}}}{n_{u_{j_s}}-1}}\times\left(\frac{u_{ij_s}-\bar{u}_{j_s}}{\sigma_{u_{ij_s}}}\right), \quad (3)$$

where u_{ij_s} is the ith epoch of filter j_s. This new index is the mean value of the correlations and it is not biased for n_s; additionally it reduces to $I_{\rm pfc}^{(s)'} = J_{WS}$ for $s = 2$.

As discussed above, the analysis of $I_{\rm pfc}^{(s)}$ for $s > 2$ in Fig. 5 is incorrect since the index is biased by the extra first term such that the index is relatively reduced in value at larger values of n_s. A corrected version is shown in Fig. 1, which shows the distribution of the unbiased variability indices ($I_{\rm pfc}^{(s)'}$) as a function of K magnitude. These $I_{\rm pfc}^{(s)'}$ indices present a similar range of values for different values of s. Additionally, we can observe that the centre of the distribution (m) decreases with increasing s, whilst the full-width at half maximum increases. This is caused by an asymmetry in the number of combinations that produce negative values compared to positive values with increasing s. Real correlated variations return positive values, whereas random or semi-correlated noise is much more likely to return negative values. This leads to a better discrimination between variable and non-variable stars as s increases. For instance, we can select about 90% of the WFCAM Variable Stars Catalog in a sample 2.2 times smaller when $s = 4$ than that when $s = 2$.

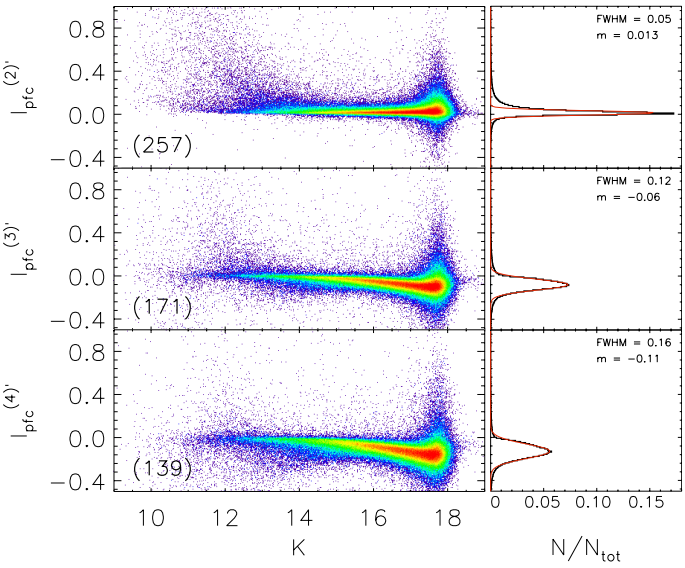

Fig. 1. $I_{\rm pfc}^{(s)'}$ variability indices versus the K-band magnitude for the initial database, for three values of s: $s = 2$ (*upper panel*), $s = 3$ (*middle panel*), and $s = 4$ (*lower panel*) on the *left-hand side*, with histograms of each distribution on the *right-hand side*. The red line marks a Gaussian fit and we record the full-width half maximum and centre in each *right-hand panel*.

The shape of the cut-off surfaces in Fig. 6 for $I_{\rm pfc}^{(3)}$ is unbiased in the magnitude dimension, but the n_s dimension is biased by $\sqrt{1/(n_s-2)}$. The selections of variable star candidates were

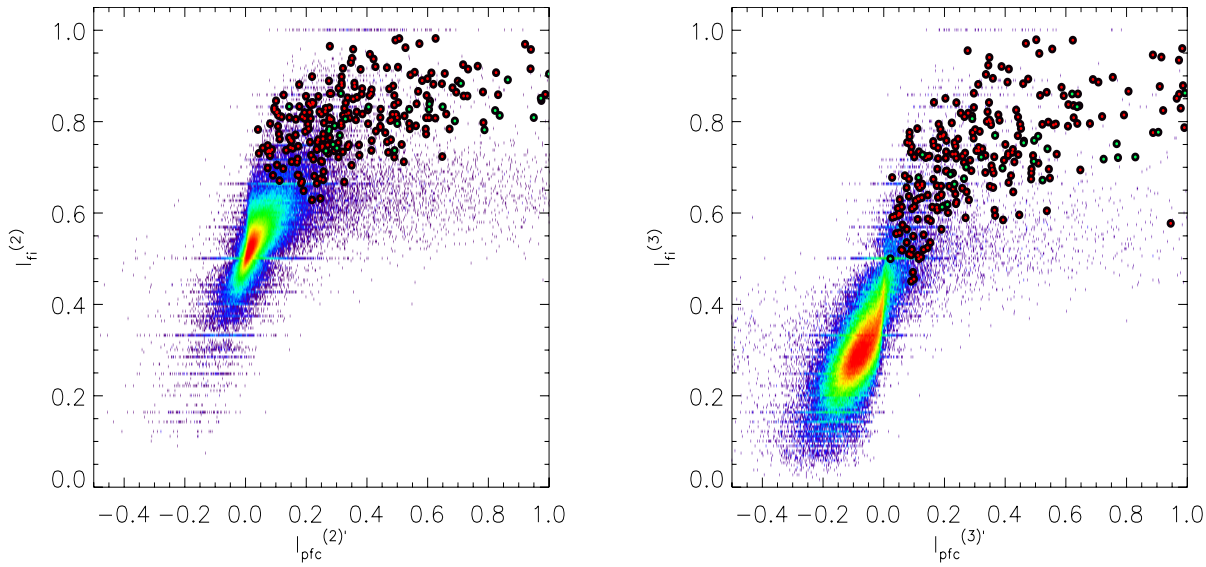

Fig. 2. Distribution of $I_{\rm fi}^{(s)}$ versus $I_{\rm pfc}^{(s)'}$ variability indices, for orders 2 (*left*) and 3 (*right*). The C1 and C2 sources are indicated by red and green circles, respectively.

performed for $I_{\rm pfc}^{(s)}$ as well as $I_{\rm fi}^{(s)}$. $I_{\rm pfc}^{(2)}$ and $I_{\rm fi}^{(s)}$ are unbiased and they may provide a complete selection of variable stars candidates. Meanwhile, the incorrect factor in $I_{\rm pfc}^{(s)}$ for $s > 2$ does not provide a strong bias in our selection because the selection is performed using the cut-off surfaces which are modified to take the mean effect of the bias into account. However, $I_{\rm pfc}^{(s)}$ indices should be replaced by $I_{\rm pfc}^{(s)'}$ indices, since the surfaces can correct for the average bias factor but there is be an increased variance in $I_{\rm pfc}^{(s)}$ that could be reduced by using $I_{\rm pfc}^{(s)'}$.

Figure 2 shows the corrected plot of panchromatic variability indices $I_{\rm pfc}^{(s)}$ versus flux independent $I_{\rm fi}^{(s)}$ (see Fig. 8). As expected, the overlap at large values of $I_{\rm fi}^{(s)}$ remains.