REDDENING-FREE INDICES IN THE VISTA FILTER SYSTEM

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Reddening-free indices represent a powerful, and yet little used, approach to problems where reddening/extinction constitute a serious issue, without having to deal with the extinction of any individual star. Here we report on our progress in obtaining reddening-free indices, in the VISTA filter system.

Reddening-free indices are suitable, linear combinations of colors and magnitudes, so that the resulting "pseudo-magnitudes" and "pseudo-colors" are, by construction, insensitive to reddening. Such indices have a long history, and are perhaps most frequently used to derive distances to extragalactic Cepheids, by means of the so-called "Wesenheit indices" (e.g., Madore & Freedman 1991; Ngeow 2012; Inno et al. 2013, and references therein).

The Vista Variables in the Vía Láctea (VVV) ESO Public Survey (Minniti et al. 2010; Catelan et al. 2011, 2013; Saito et al. 2012) is a variability survey of the Galactic bulge and inner disk, using the Visible and Infrared Survey Telescope for Astronomy (VISTA) 4.1m telescope, and which includes the photometric bands $ZYJHK_S$. Many of the fields that are covered by VVV are subject to very large extinction levels, and thus the availability of reddening-free indices using the VISTA filter system could prove of great help for numerous scientific applications using the VVV data.

Consider a set of N photometric bandpasses, and the corresponding magnitudes $m_{1...N}$. Using the latter, it can be easily shown that a pseudo-magnitude

$$m_X = m_i - \alpha_X (m_j - m_k) \qquad (1)$$

will be reddening-free if

$$\alpha_X = \frac{(A_i/A_V)}{(A_j/A_V) - (A_k/A_V)}, \qquad (2)$$

where $i, j, k = 1 \ldots N$, with $j \neq k$. Naturally, the *relative* extinctions $A_{i,j,k}/A_V$ must be known a priori, but these come straightforwardly from an adopted reddening law. An important corollary is that

$$(m - M)_X = (m - M)_0, \qquad (3)$$

i.e., distances can be directly determined using m_X, without the need to know the reddening to any individual star (Catelan et al. 2013). Reddening-free pseudo-colors c_X can be defined in a completely analogous way, using a suitable coefficient β_X.

An initial such set of indices was defined by Catelan et al. (2011). We are now working to extend those definitions, by i) incorporating V and I bandpasses, so that the overlap with the ongoing OGLE-IV survey (e.g., Pietrukowicz et al. 2013) can be optimally explored; ii) investigating the dependence of the reddening-free colors and magnitudes (and, more specifically, α_X and β_X) on spectral type, luminosity class, and metallicity; iii) defining additional indices that maximize the visibility of evolutionary features in diagrams built using these indices. Full results will be presented elsewhere.

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