1 Real Data

The initial Hertzsprung-Russell diagram for the measured Double Cluster is shown in figure 1 where the measured magnitude is offset to match up with the brightest star of the true data acquired from Aladin.

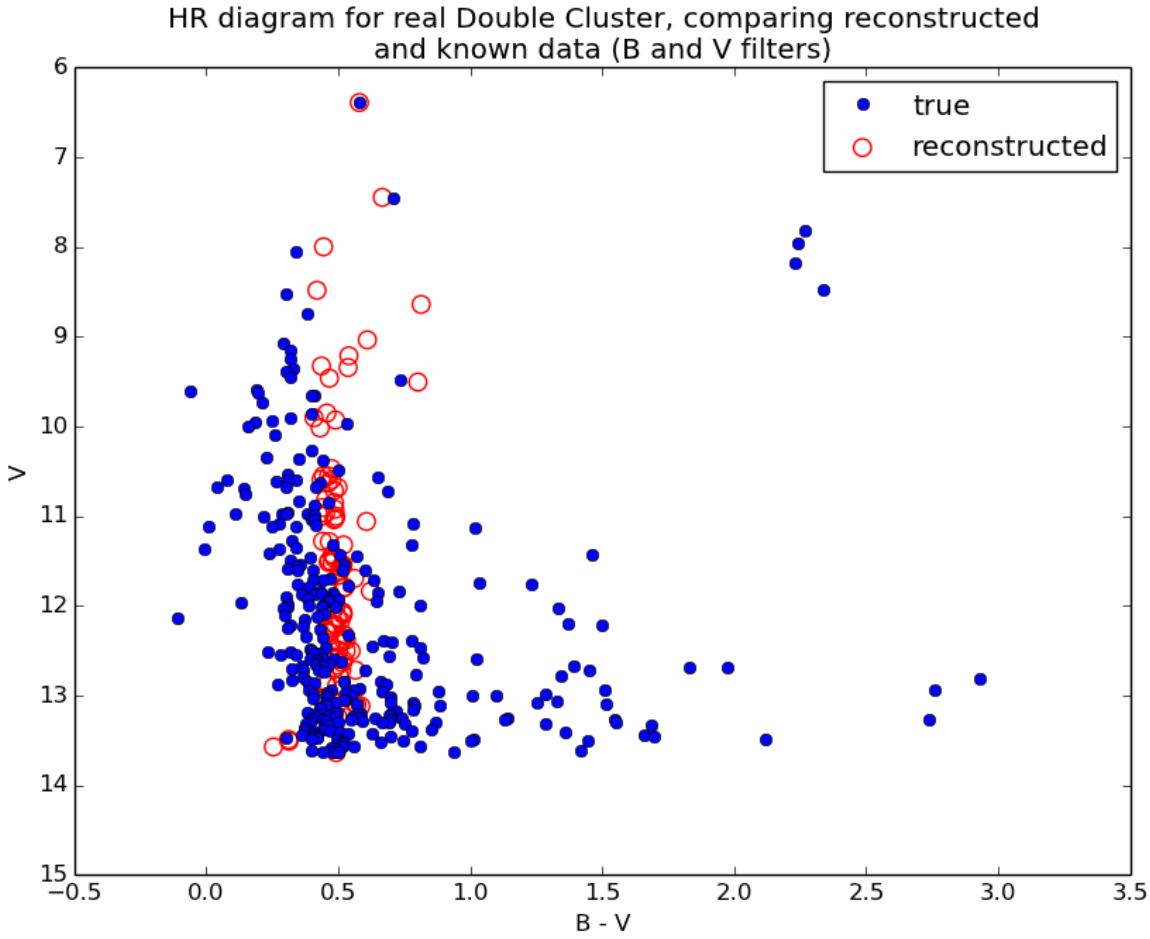

Figure 1: Initial Hertzsprung-Russell diagram of Double Cluster.

One can see from figure 1, the vertical scale is well measured in comparison to the true data acquired from Aladin. The horizontal scale, however, is compressed compared to the true data. This suggests that there is a scaling factor which must be worked out associated with the measured blue magnitude. To work out this scaling factor the measured blue and visual magnitudes of stars in a single frame need to be matched and compared to the blue and visual magnitudes of the stars in the true data. As the stars in Aladin have coordinates in degrees for RA/DEC and the stars in the frames taken have coordinates in pixels a coordinate transformation needs to be applied. A frame was uploaded to nova.astrometry.net where the wcs of the frame was calculated and a new fits file was

then available to download.

$$v'_{pix} = M^{-1}(v_{deg} - \delta_{deg}) + \delta_{pix}, \tag{1}$$

where v'_{pix} is the coordinate of a star in pixels of the frame, M is the transformation matrix in units deg/pixel from the header of the fits file therefore the inverse is applied to be in the form of pixel/deg, v_{deg} is the RA/DEC of the chosen star in degrees, δ_{deg} is the offset in degrees from the header of the fits file and δ_{pix} is the offset in pixels from the header of the fits file. Figure 2 shows how the transformation applied to the 3 brightest stars and 2 stars close to the edges of the frame.

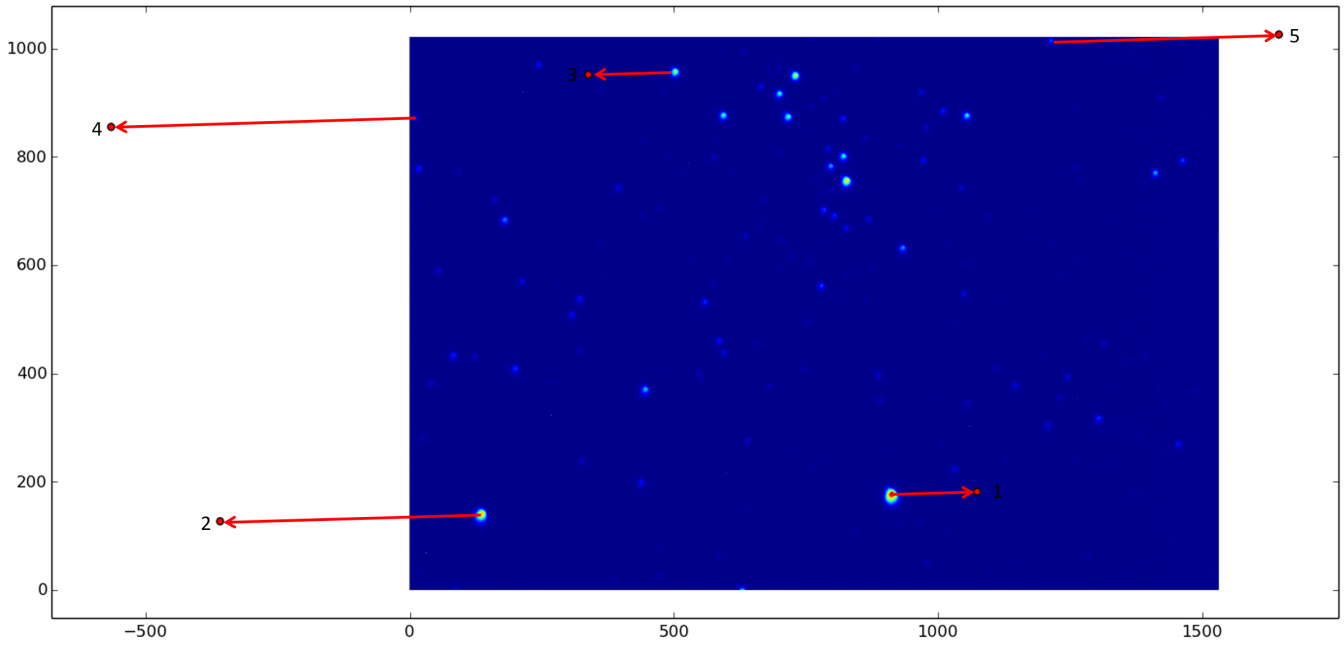

Figure 2: transformation of 5 stars using matrix.

One can see that that the vertical transformation is accurate however there is some factor n which needs to multiplied to the horizontal elements of the transformation matrix 2 to match up the stars in perfectly.

$$M = \begin{pmatrix} m_{11} \times n & m_{12} \times n \\ m_{21} & m_{22} \end{pmatrix} \tag{2}$$

Using trial and error, it was found that the stars match up perfectly shown in figure 3, when $n = 1.85$.

Using the transformation 1 where the matrix is 2 where $n = 1.85$ stars can be matched between the measured data obtained from the star-finder and the true data from Aladin.

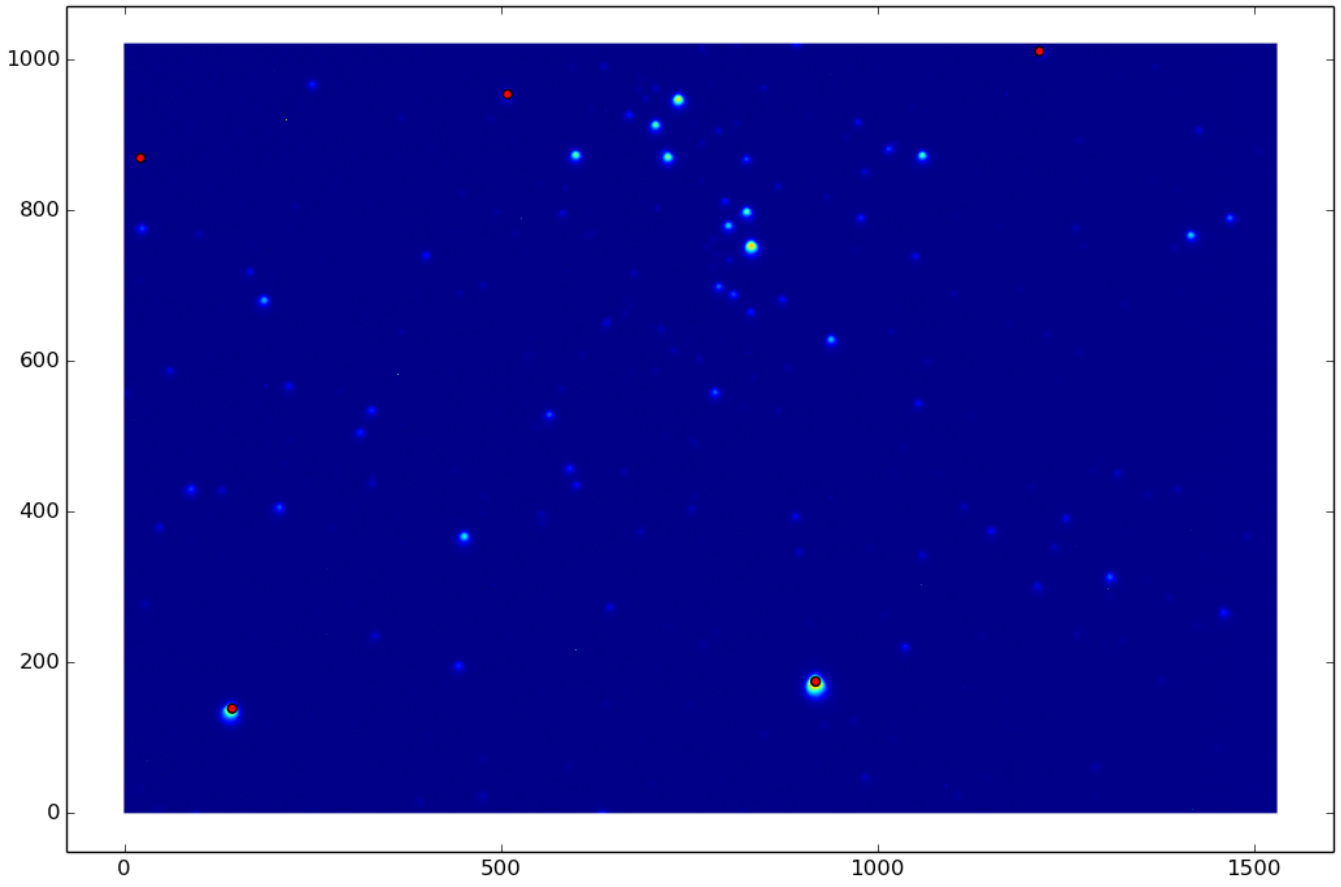

Figure 3: matched 5 stars using matrix.

The plots in figure 4 show the visual and blue magnitudes for 81 matched stars between the measured and true data. Both are visibly linear as expected. By plotting a line of best fit, the scaling factor can be obtained from the gradient and the translation can be obtained from the intercept for both, blue and visual magnitudes shown in table 1.

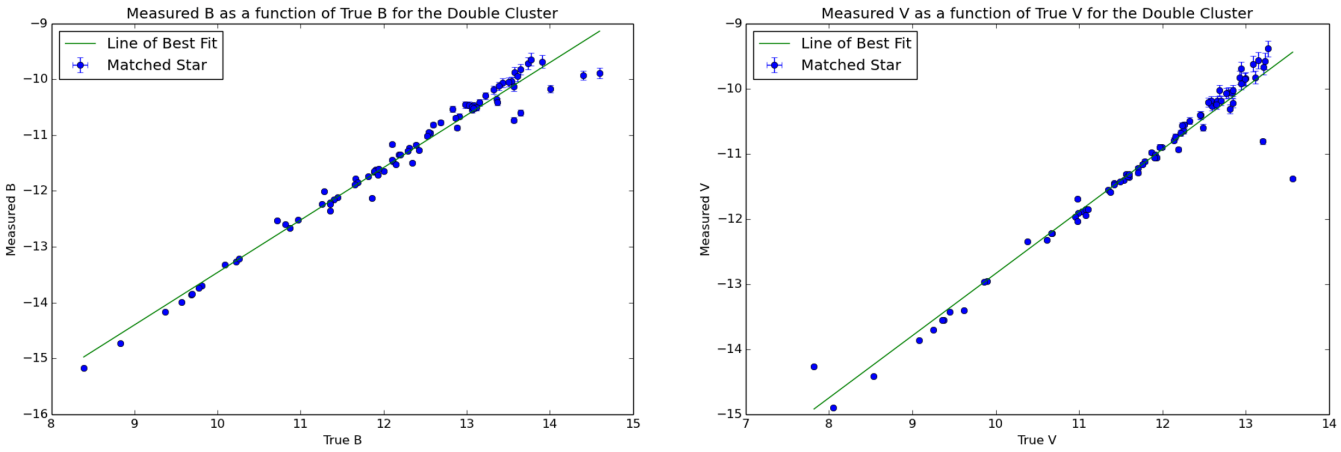

Figure 4: True magnitudes a function of measured magnitudes of Double Cluster.

	Visual	**Blue**
Gradient	0.954001934919 ±0.0248615873329	0.939952626716 ±0.0167685621144
Intercept	-22.380825879 ±0.29274281072	-22.8611259547 ±0.205248671913

Table 1: table of parameters

Using the parameters obtained from the linear fits, the Hertzsprung-Russell diagram was then scaled using (V_M-intercept)/gradient by rearranging the line for the best fit. The stars that are matched between the blue and visual filters are then plotted and scaled as shown in the HR diagram in Figure 6.

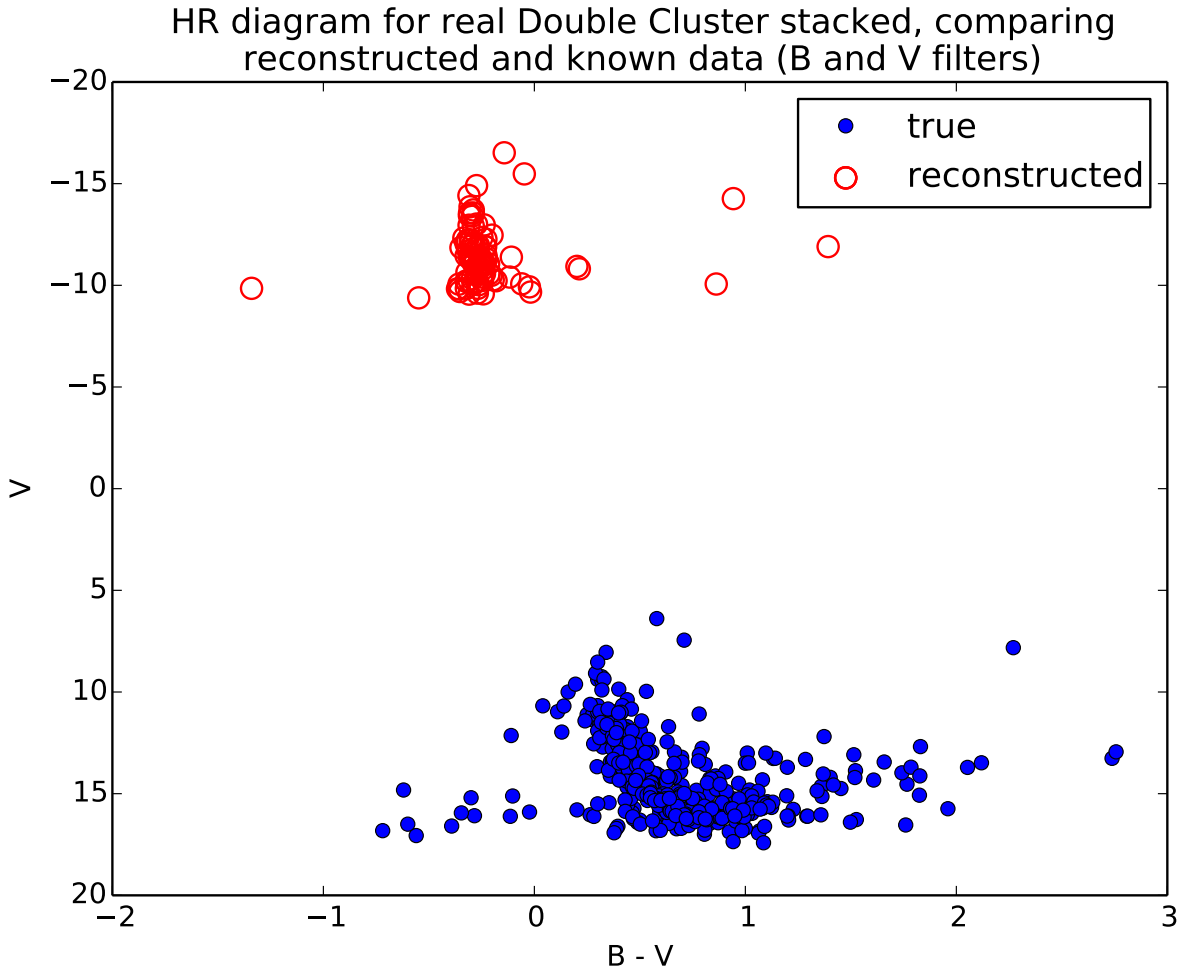

Figure 5: hr pre scaled.

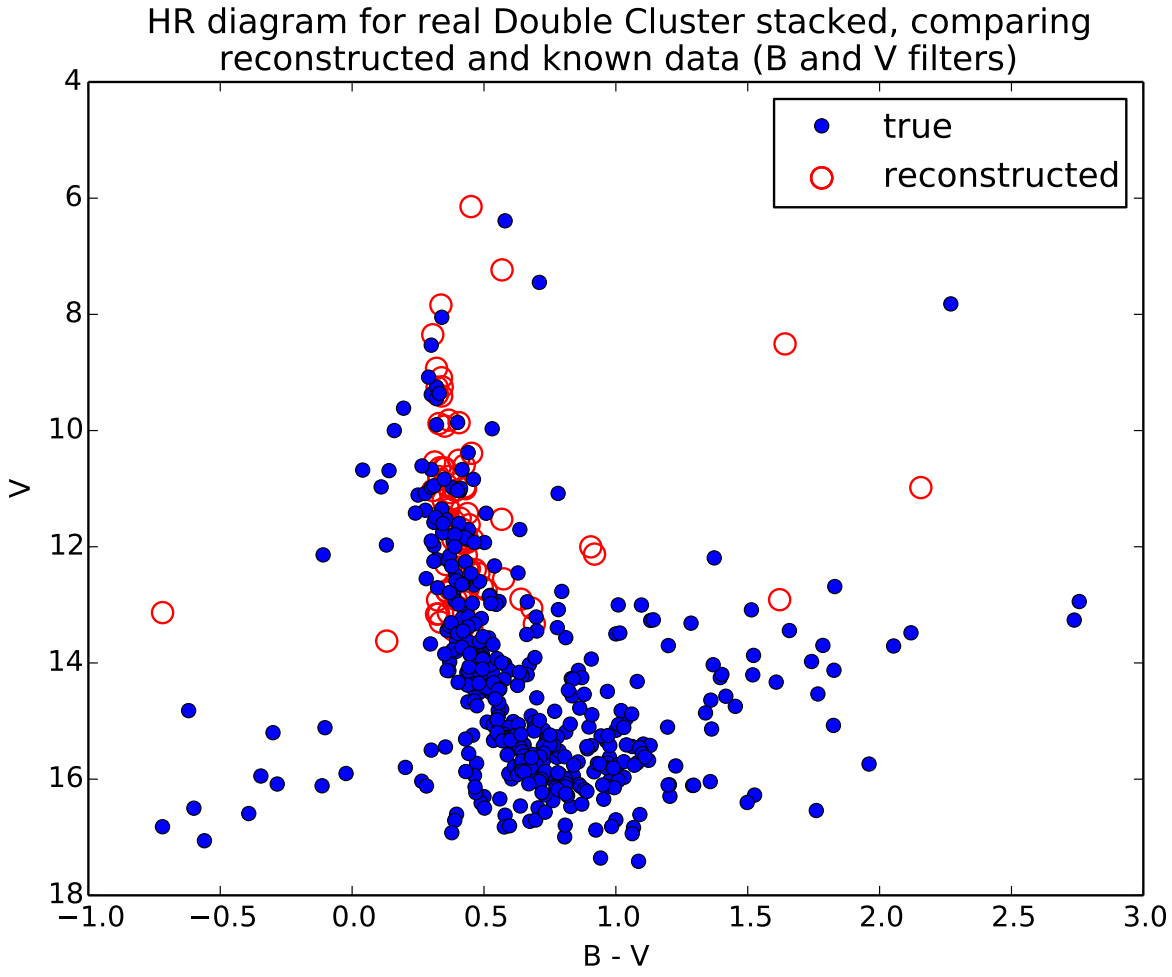

Figure 6: match hr.