



Estimation Of Transformation Coefficients Of Standard Star

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1 Introduction

1.1 Transformation to a standard system

A magnitude and colour system, such as the UVB system, is defined by a collection of standard stars detected with a certain detector and filter set. To enable observers at different observatories to compare observations, the instrumental system must be turned into a standard system. If M_λ is the standard magnitude, $m_{\lambda 0}$ is the observed extinction adjusted magnitude, and c is the standard colour index (e.g., MB - MV), they are connected by the equation. (Henden & Kaitchuck 1990)-

$$M_\lambda = m_{\lambda 0} + \alpha_\lambda \cdot c + \beta_\lambda \quad (1)$$

Where

α_λ = Color coefficient

β_λ = Zero point coefficient

Transformation relations for standard *UBVRI* system are given below-

$$V = v_0 + \alpha_v(B - V) + \beta_v \quad (2)$$

$$(B - V) = \alpha_{bv}(b - v)_0 + \beta_{bv} \quad (3)$$

$$(V - R) = \alpha_{vr}(v - r)_0 + \beta_{vr} \quad (4)$$

$$(R - I) = \alpha_{ri}(r - i)_0 + \beta_{ri} \quad (5)$$

$$(V - I) = \alpha_{vi}(v - i)_0 + \beta_{vi} \quad (6)$$

$$(U - B) = \alpha_{ub}(u - b)_0 + \beta_{ub} \quad (7)$$

$$(V - v)_0 = \alpha'_v(V - R) + \beta'_v \quad (8)$$

$$(B - b)_0 = \alpha_b(B - V) + \beta_b \quad (9)$$

$$(R - r)_0 = \alpha_r(V - R) + \beta_r \quad (10)$$

$$(I - i)_0 = \alpha'_i(V - I) + \beta_i \quad (11)$$

$$(I - i)_0 = \alpha'_i(R - I) + \beta'_i \quad (12)$$

$$(U - u)_0 = \alpha_u(U - B) + \beta_u \quad (13)$$

In the standard/instrumental system, capital and small letters signify magnitudes and colours, respectively. The above equations indicate a straight line with slope and intercept values of and, respectively. To acquire the coefficient values, we must fit straight lines into the transformation relations described above.

2 Observation, Data Reduction and Analysis

The data from the 2-meter Himalayan Chandra Telescope (HCT) at the Indian Astronomical Observatory (IAO1), Hanle, on May 14, 2016, is used in this study to determine transformation coefficients. To do this, the Himalaya Faint Object Spectrograph Camera (HFOSC), which is connected to the backend of HCT, was used to observe the standard star fields PG 1047 from Landolt (1992). The dimensions of the CCD chip utilised in HFOSC are $2K \times 4K$ pixels. The observation was conducted in the central $2K \times 2K$ pixels region. The CCD chip's gain and read-out noise are 4.87 electrons per pixel and 1.22 electrons ADU⁻¹, respectively. The HCT-HFOSC system was calibrated using PG1047 fields. Fig. 1 displays the finding chart for these fields.^{ss}

We have used IRAF² package for Reduction and Analysis of CCD Data. The process is given below-

1. The multiple bias frames obtained are median combined to get the master bias. This master bias is subtracted from all other frames.
2. A master flat for each filter is created by median combining and normalizing. All the bias-subtracted frames are divided by master flat in the same filter.
3. Aperture photometry was performed on eight field stars (marked in Fig. 1) to calculate their instrumental magnitude using *phot* task of *DAOPHOT* package within IRAF.
4. A plot between magnitude and airmass was made and a straight line was fit for each star in all bands. The slope gives the value of extinction coefficient.
5. After this we estimated color coefficients (α) and zero points (β) by fitting straight lines to the transformation relations mentioned above.

¹<http://www.iiap.res.in/centers/iao>

²IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

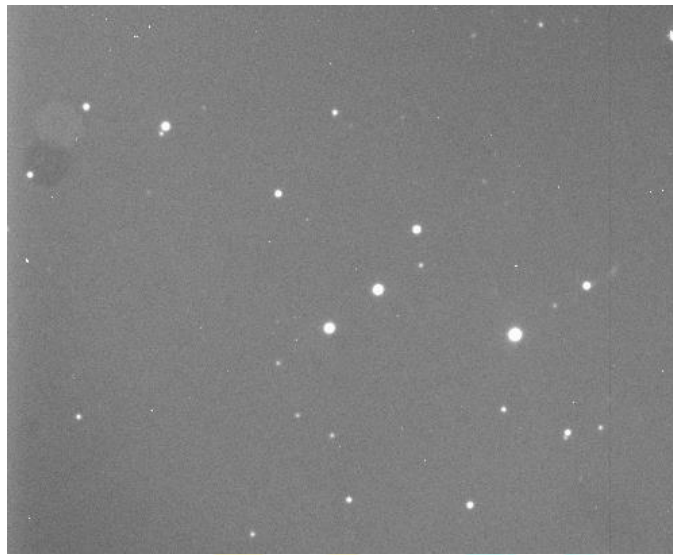
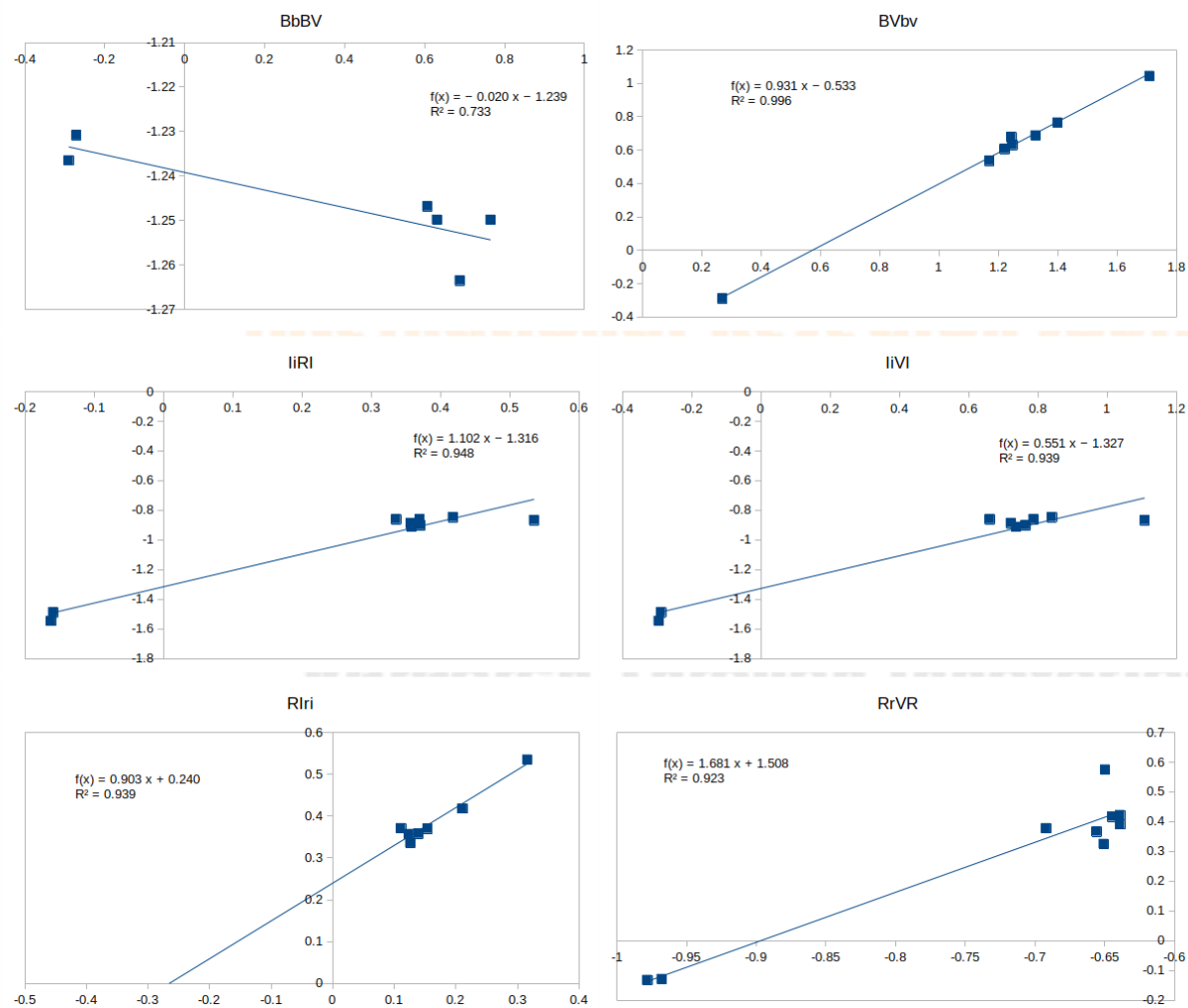


Figure 1: Identification chart for PG1047.

3 Results

Plots for various Transformation Relations are shown in Fig. 2 . Estimated values of transformation coefficients are listed in Table 1.



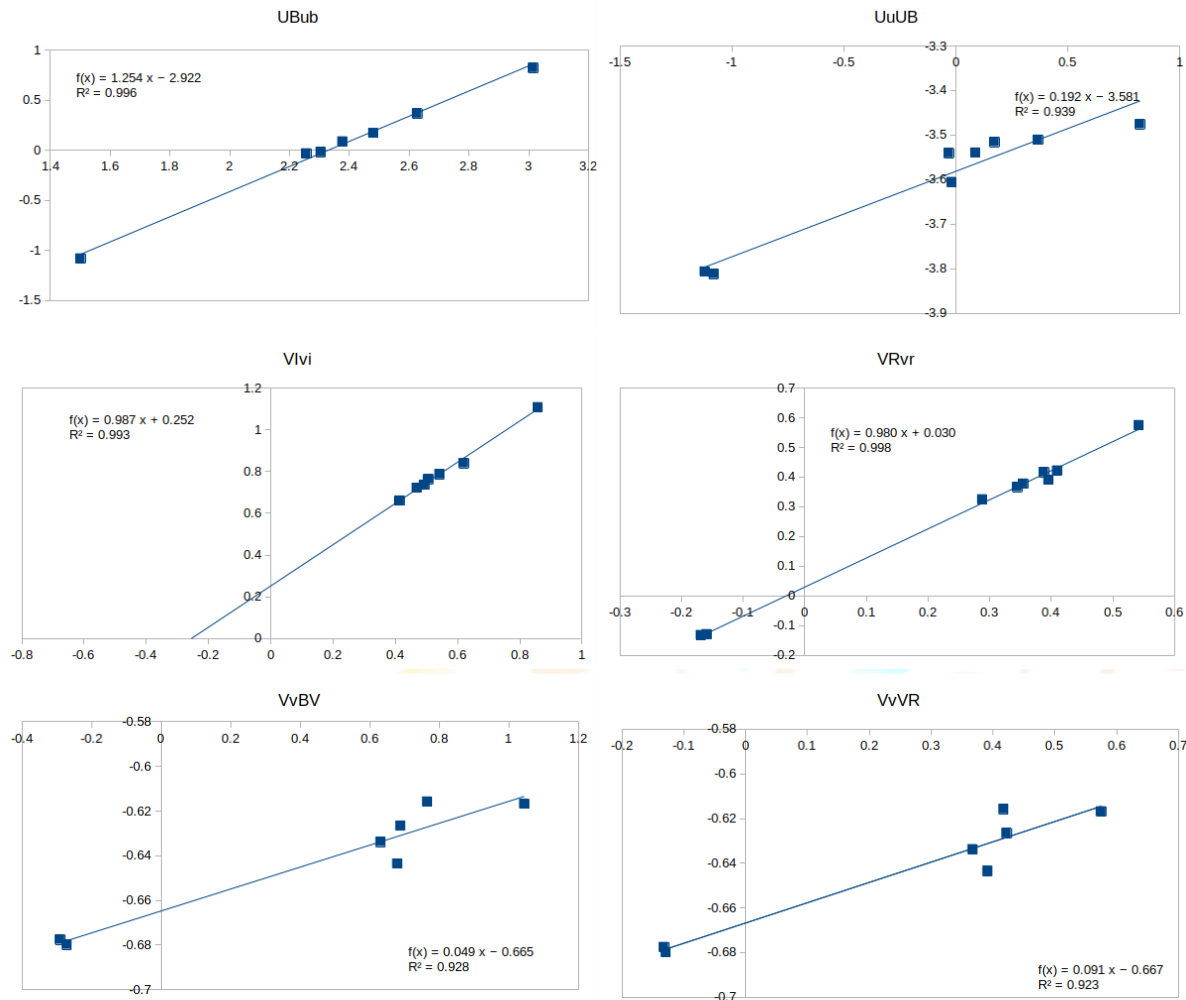


Figure 2: Plot for various Transformation Relations. Values of transformation coefficient are shown.

Table 1: Details of Transformation coefficients Estimation

S.No.	Relation	α	β	Corrl. coeff.
1	$(B - V) = \alpha_{bv}(b - v)_0 + \beta_{bv}$	0.031	-0.533	0.99
2	$(V - R) = \alpha_{vr}(v - r)_0 + \beta_{vr}$	0.980	0.030	0.99
3	$(R - I) = \alpha_{ri}(r - i)_0 + \beta_{ri}$	0.903	0.240	0.93
4	$(V - I) = \alpha_{vi}(v - i)_0 + \beta_{vi}$	0.987	0.252	0.99
5	$(U - B) = \alpha_{ub}(u - b)_0 + \beta_{ub}$	1.254	-2.922	0.99
6	$(V - v)_0 = \alpha_{vBV}(B - V) + \beta_{vBV}$	0.049	-0.665	0.92
7	$(V - v)_0 = \alpha_{vVR}(V - R) + \beta_{vVR}$	0.091	-0.667	0.92
8	$(B - b)_0 = \alpha_{bBV}(B - V) + \beta_{bBV}$	-0.020	-1.239	0.73
9	$(R - r)_0 = \alpha_{rVR}(V - R) + \beta_{rVR}$	1.681	1.508	0.92
10	$(I - i)_0 = \alpha_{iVI}(V - I) + \beta_{iVI}$	0.551	-1.327	0.93
11	$(I - i)_0 = \alpha_{iRI}(R - I) + \beta_{iRI}$	1.102	-1.316	0.94
12	$(U - u)_0 = \alpha_{uUB}(U - B) + \beta_{uUB}$	0.192	-3.581	0.93

References

Henden A., Kaitchuck R., 1990, Astronomical photometry. Willmann-Bell

Landolt A. U., 1992, AJ, 104, 340

