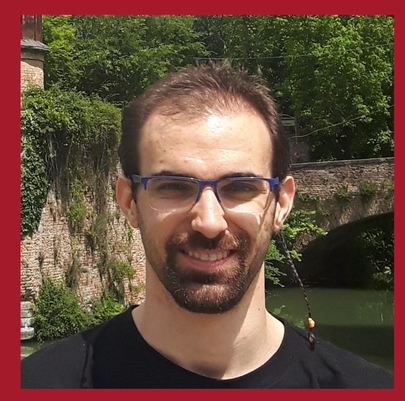
DELICE - DEtrending LIght Curves of Exoplanets

A new pipeline for light curve detrending



L. S. Colombo[1,2,*] (Exoplanets & Stellar Populations Group)

[1] Dipartimento di Fisica e Astronomia "Galileo Galilei" - Università degli Studi di Padova, Italy

[2] INAF - Osservatorio astronomico di Padova, Italy

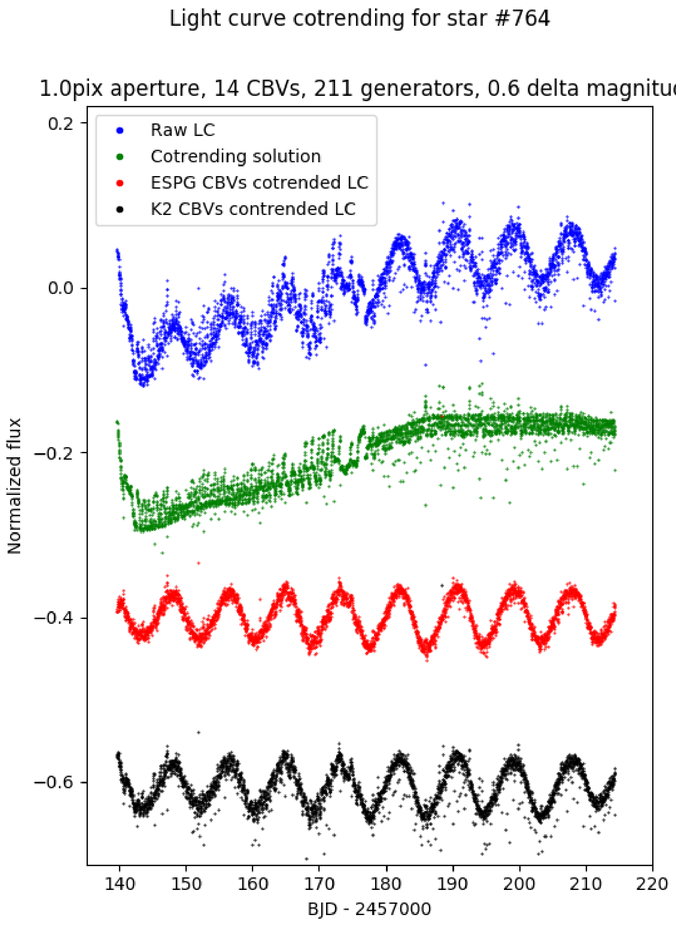
*lorenzo.colombo@phd.unipd.it

LIGHT CURVE COTRENDING

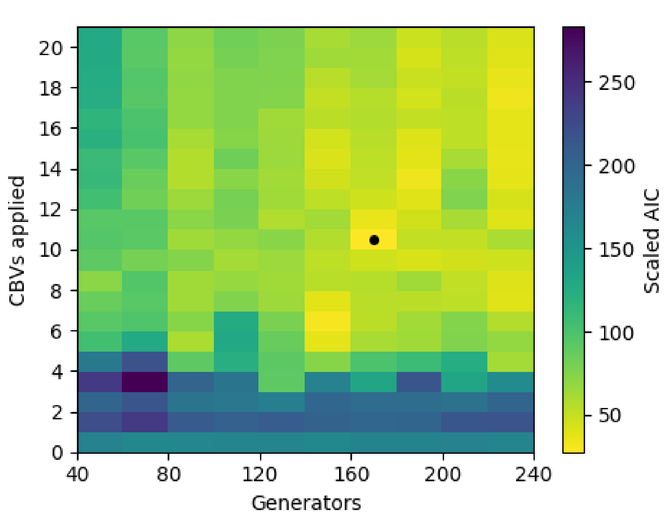
In crowded or wide fields of view, light curves may show **common trends** and **systematic effects** that vary across the field of view.

My approach relies on a Principal Component Analysis (**PCA**) to decompose a set of light curves (LCs) in a set of eigenvectors (also called Cotrending Basis Vectors or **CBVs**), associated to the systematic effects.

These CBVs are tailored for each star in a local approach. The cotrending is performed by finding the best combination of CBVs and their generation criteria.



Cotrending example: star in M67 (K2-C05, Nardiello+2016).



Upper panel: comparison between cotrending using our ESPG CBVs and using the K2 data products.

Left panel: the correction quality map related to the chosen example. The generators are selected in magnitude bins.

LIGHT CURVE DETRENDING

Spacecraft pointing drift introduces **systematic effects** due to the target stars falling in areas of different intra- and inter-pixel sensitivity.

Approach in case of missing flat field: iterative self flat-fielding using precise star positions reconstruction.

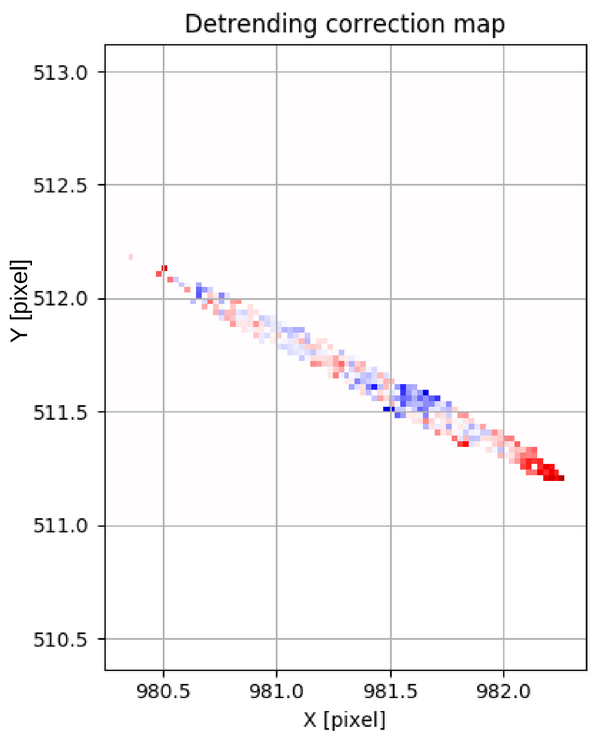
The correction is summarized as follows:

1) Naive estimator model of the LC;

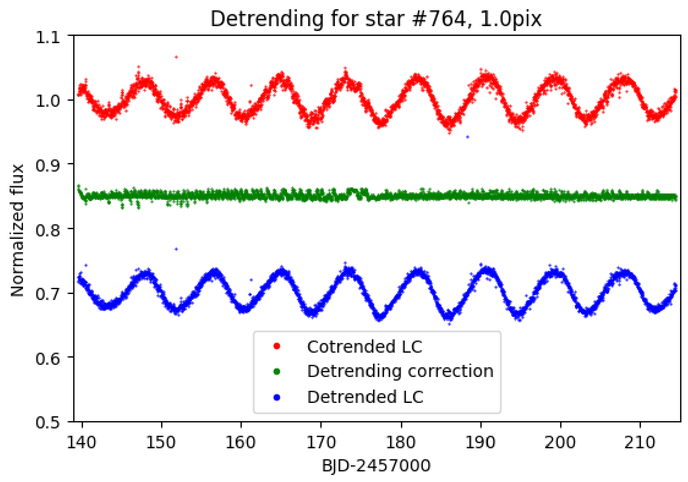
2) Sub-pixel binning of the model residuals and cubic spline interpolation of the 3.5σ-clipped medians of the residuals in each sub-pixel;

3) Each photometric point divided by the interpolated spline value;

4) Iteration of the procedure with a new model on the detrended LC.



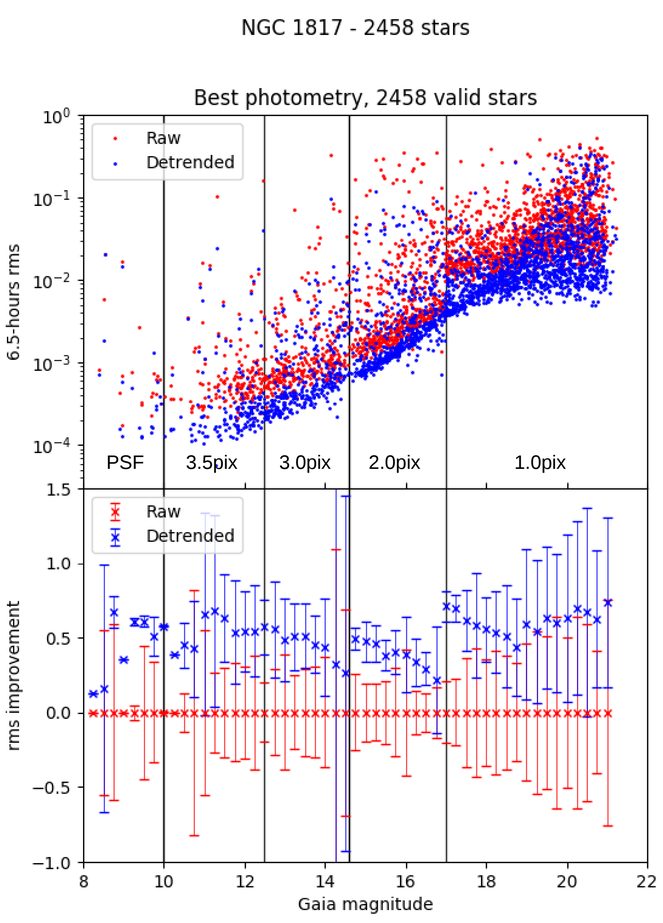
Example of detrending for the same star in M67.



Upper panel: map showing the medians of the residuals in each sub-pixel for one of the iterations. Correlation is clear.
Left panel: comparison between the cotrended LC (red) and subsequently detrended LC (blue) of the star in consideration.

RESULTS: Four clusters from K2-C13

NGC1647 - NGC1750 - NGC1758 - NGC1817

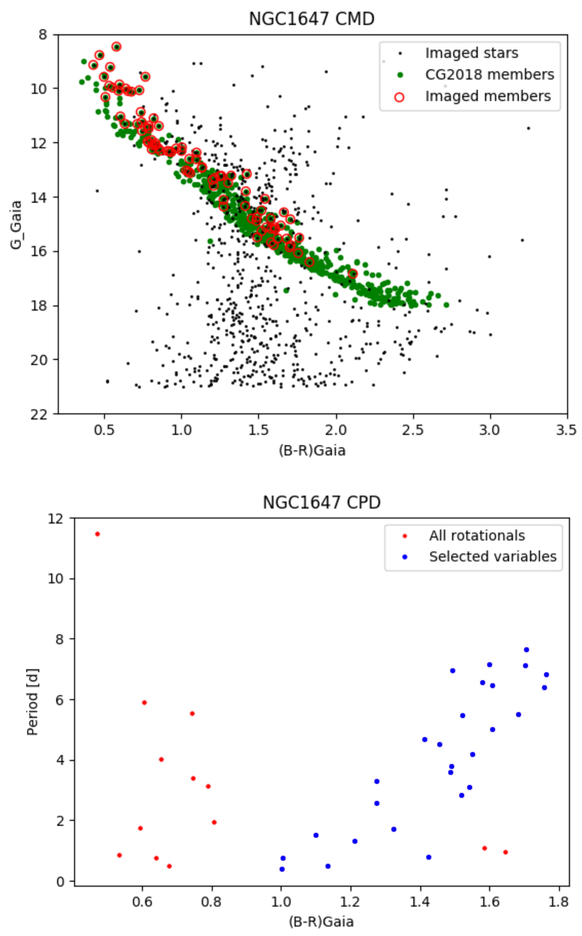


I applied DELICE to LCs of 4 open clusters observed during K2-C13. The raw LCs were produced as in Libralato+2016. The photometric rms shows a 40%-70% improvement. I then searched for planets and variables using BLS (Kovács+2002) and GLS (Zechmeister+2009) tools.

No transiting candidate exoplanets were identified. The rotational variable stars were selected for a gyrochronological study of the clusters.

Cluster	Observed stars	Members (CG+2018)	Rotational variables
NGC1647	871	88	40
NGC1750	3342	92	30
NGC1758		76	19
NGC1817	3944	319	26

Left panels: rms improvement for the LCs in the NGC1817 field. We chose the best photometric method in different magnitude intervals (see labels).
Top right panel: Color-Magnitude Diagram for members of NGC1647.
Bottom right panel: Color-Period Diagram for members variable stars of NGC1647.



References

Nardiello et al. 2015, MNRAS, 447, 3536

Nardiello et al. 2016, MNRAS, 455, 2337

Libralato et al. 2016, MNRAS, 456, 1137

Libralato et al. 2016 MNRAS, 463, 1780

Nardiello et al. 2016 MNRAS, 463, 1831

Stumpe et al. 2012, PASP, 124, 985

Smith et al. 2012, PASP, 124, 1000

Cantat-Gaudin et al. 2018 A&A, 618, A93

Kovács et al. 2002 A&A, 391, 369

Zechmeister et al. 2009 A&A, 496, 577

Hartman et al. 2016 A&C, 17, 1

Exoplanets & **S**tellar **P**opulations **G**roup

http://groups.dfa.unipd.it/ESPG