Detrending the long-term stellar activity and the systematics of the Kepler data with a non-parametric approach.

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The NASA Kepler mission is delivering groundbreaking results, with an increasing number of Earth-sized and moon-sized objects been discovered. A high photometric precision can be reached only through a thorough removal of the stellar activity and the instrumental systematics. We have explored the possibility of using non-parametric methods to analyse the Simple Aperture Photometry data observed by the Kepler mission. We focused on a sample of stellar light curves with different effective temperatures and flux modulations, and we found that Gaussian Processes-based techniques can very effectively correct the instrumental systematics along with the long-term stellar activity. Our method can disentangle astrophysical features, such as planetary transits, flares or general sudden variations in the intensity, from the star signal and it is very efficient as it requires only a few training iterations of the Gaussian Process model. The results obtained show the potential of our method to isolate the main temporal events in the light curves for both Kepler long cadence and short cadence data. We tested our approach on the star KIC 2571238 (Kepler-19), finding that the transit depth of its planetary companion is consistent at 1 sigma- with the one published in the literature.