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Title:	Unleashing Kepler's astrophysical potential: robust discovery and correction of systematic effects in Kepler data
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Abstract:

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The Kepler data are a gold mine for studies of astrophysical variability, from stellar rotation and activity to AGN and other extra-galactic objects, but the full exploitation of this rich potential remains limited by our ability to correct systematic instrumental effects without affecting the "true" underlying astrophysical signals. The various incarnations of the pre-search data conditioning (PDC) pipeline are optimised for transit searches, and while the PDC-MAP data can be - and is being - used for variability studies, there is strong demand for a more "astrophysically robust" correction.

Over the past few years, we have been working towards such a correction, using approximate Bayesian methods to achieve a combination of robustness and scaleability. In Roberts, McQuillan, Reece and Aigrain (2013, arXiv:1308.3644), we introduced the "ARC" method to discover and correct common-mode trends, using a statistical entropy criterion and shrinkage priors to ensure that the trends are indeed common to many light curves, and to avoid over-fitting. At that point, the ARC method was optimised and tested using quarter 1 data only. We have now improved some of the key steps and extended the method, enabling us to address effects seen in later quarters. In particular, we have implemented a fast Gaussian Process method to correct for the discontinuities and decays associated with quarter boundaries and data download events, and to detect and correct pixel sensitivity dropouts. Our current research uses GPs as part of the smoothing of the common-mode trends discovered by ARC, which significantly improves our ability to correct trends associated with periodic reaction wheel momentum dumping manoeuvres was well as longer term, pointing-related effects.

We demonstrate the performance of the method by injecting artificial stellar variability into real Kepler light curve and testing our ability to recover the key statistical properties of the injected signals, showing that the method we have developed offers a clear advantage for variability studies over existing, widely available versions of the Kepler data. By the time of the conference, we hope to have fully processed at least 1 year of data. In the medium term, we intend to process the full dataset and make it publicly available, along with the associated code.

NB: I have submitted this abstract under the topic "Galactic and extragalactic astrophysics" but it is relevant to all forms of astrophysical variability on timescales longer than transits, so it could also go in the "Stellar activity, rotation, ages, metallicity session".