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VARLET and PHALET two wavelet based filter methods to separate stellar variation, orbital disturbances and instrumental effects from transit events in stellar light curves.

S. Grziwa (1), J. Korth (1) and M. Pätzold (1)
(1) Rheinisches Institut für Umweltforschung, Planetenforschung, Cologne, Germany (grziwas@uni-koeln.de)

Abstract

The space telescopes CoRoT and Kepler provided a huge number of high-resolution stellar light curves. The light curves are searched for transit signals which may be produced by planets when passing in front of the stellar disc. Various flux variations by star spots, pulsation, flares, glitches, hot pixels etc., however, dominate the stellar light curves and mask faint transit signals in particular of small exoplanets, which may lead to missed candidates or a high rate of false detections. Full automated filtering and detection algorithms only make it possible to manage the huge number of stellar light curves to search for transits. This will become even more important in the future missions PLATO and TESS.

The Rheinisches Institut für Umweltforschung (RIU-PF) as one of the CoRoT detection teams has developed two model independent wavelet based filter techniques VARLET and PHALET to reduce the flux variability in light curves in order to improve the search for transits.

The VARLET filter separates faint transit signals from stellar variations without using a-priori information of the target star. VARLET distinguishes variations by frequency, amplitude and shape. VARLET separates the large-scale variations from the white noise. The transit feature, however, is not extracted and still contained in the noise time series which makes it now much easier to search for transits by the search routine EXOTRANS (Grziwa, S. et al. 2012 [1]).

The PHALET filter is used to separate periodic features with well-known periods independent of their shape. With PHALET it is possible to separate detected diluting binaries and other periodic effects (e.g. disturbances caused by the spacecraft motion in the Earth orbit). The main purpose, however, is to separate already detected transits to search for transits from additional planets in the stellar systems.

RIU-PF searched all Kepler light curves for planetary transits by including VARLET and PHALET in the processing pipeline.

The results of that search is compared with the public Kepler candidate list. About 93% of the 2232 included systems in the newest Kepler candidate list were confirmed. New planetary systems (more than 20) and additional candidates (more than 15) to already known multi-planet systems, however, could be added to the list and will be presented.

References

[1] Grziwa, S., Pätzold, M., Carone, L.: The needle in the haystack: searching for transiting extrasolar planets in CoRoT stellar light curves, Monthly Notices of the Royal Astronomical Society, Volume 420, Issue 2, pp. 1045-1052.