HOMEWORK 8
An algorithm based on Mutual Information

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Robust Period Estimation Using Mutual Information for Multiband Light Curves in the Synoptic Survey Era

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Abstract

The Large Synoptic Survey Telescope (LSST) will produce an unprecedented amount of light curves using six optical bands. Robust and efficient methods that can aggregate data from multidimensional sparsely sampled time-series are needed. In this paper we present a new method for light curve period estimation based on quadratic mutual information (QMI). The proposed method does not assume a particular model for the light curve nor its underlying probability density and it is robust to non-Gaussian noise and outliers. By combining the QMI from several bands the true period can be estimated even when no single-band QMI yields the period. Period recovery performance as a function of average magnitude and sample size is measured using 30,000 synthetic multiband light curves of RR Lyrae and Cepheid variables generated by the LSST Operations and Catalog simulators. The results show that aggregating information from several bands is highly beneficial in LSST sparsely sampled time-series, obtaining an absolute increase in period recovery rate up to 50%. We also show that the QMI is more robust to noise and light curve length (sample size) than the multiband generalizations of the Lomb–Scargle and AoV periodograms, recovering the true period in 10%–30% more cases than its competitors. A python package containing efficient Cython implementations of the QMI and other methods is provided.

Key words: methods: data analysis – methods: statistical – stars: variables: general

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