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Periodicity detection in irregularly sampled light curves by robust regression and outlier detection. (English) Zbl 07260353
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Summary: An important task in astroparticle physics is the detection of periodicities in irregularly sampled time series, called light curves. Many periodogram methods for light curves may be characterized as fitting periodic models using least squares regression. We generalize this approach and allow robust regression and weighted regression. This gives a unified concept which includes further methods proposed in the literature, allows to create new methods and take additional information about measurement accuracies into account. We compare all these methods using simulated data. We observe that if the quality of the measurement accuracies is dubious, they should be ignored, and that robust methods can be helpful if the light curve contains outliers. Finally, we propose a new way to determine valid periods by robust fitting of a distribution to the periodogram and outlier detection. In our simulations, this leads to better detection rates for periodic fluctuations with unexpected shape and less wrong detections in light curves of pure red and white noise.

MSC:

62-XX Statistics
68-XX Computer science

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Keywords:

time series; periodogram; epoch folding; phase dispersion minimization; lomb scargle; cramér von Mises distance; m-regression

Software:

robustbase; MASS (R); quantreg; R

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