On the application of a new nonparametric estimator for the off-pulse interval of a light curve using a computer package

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The launch of the *Fermi Gamma-ray Space Telescope* in 2008 resulted in a dramatic increase in the number of known γ-ray pulsars. The opportunity to study a large number of these high-energy objects suddenly arose. In order to study the surroundings of the pulsars, such as their associated Pulsar Wind Nebula (PWN), requires the observer to focus only on those γ-ray emissions where the pulsed emission beam is not in the line of sight of the observational instrument. It is therefore mandatory to establish the off-pulse window of the pulsar before any research can proceed into the surrounding stellar structure of a pulsar. From several papers published in astrophysical journals, it is evident that some analyses performed on histogram-type estimated light curves are done with the "eye-ball" technique or visual inspection of the histogram, in order to identify the off-peak phase interval. In contrast to this *subjective* approach to identify the off-pulse interval visually, an *objective* technique was developed to estimate the off-pulse interval nonparametrically. The estimation technique was implemented in a package developed for the statistical software, R. Broadly speaking, it is based on a sequential application of P-values obtained from goodness-of-fit tests for the uniform distribution. To be more specific, the well-known Kolmogorov-Smirnov, Cramér-von Mises, Anderson-Darling and Rayleigh test statistics are applied sequentially on subintervals of $[0, 1]$. An extensive simulation study was conducted to evaluate the performance of the objective technique on different classes of distributions for an array of different parameters. It was found that the technique provides an accurate estimation of the off-pulse interval. Furthermore, the new method was also applied to several sets of real pulsar data, which resulted in satisfactory estimated off-pulse intervals.

Keywords: sequential estimation; circular kernel density estimation; pulsar; R.