ESTIMATION AND DETECTION OF A PERIODIC SIGNAL

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Abstract

Detection and estimation of a periodic signal with an additive disturbance is considered. We study estimation of both the frequency and the shape of the waveform and develop a method based on Fourier series modelling. The method has an advantage over time domain methods such as epoch folding, in that the hypothesis space becomes continuous. Using uninformative priors, the noise variance and the signal shape can be marginalised analytically, and we show that this expression can be evaluated in real time when the data is evenly sampled and does not contain any low frequencies.

We compare our method with other frequency domain methods. Although derived in various different ways, most of these, including our method, have in common that the *cumulative periodogram* plays a central role in the estimation. But there are important differences. Most notable are the different penalty terms on the number of harmonic frequencies. In our case, these enter the equations automatically through the use of probability theory, while in previous methods they need to be introduced in an ad hoc manner. The Bayesian approach in combination with the chosen model structure also allow us to build in prior information about the waveform shape, improving the accuracy of the estimate when such knowledge is available.