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# SPECTRAL LINE MEASUREMENTS IN EXCEPTIONALLY LOW SNR BY THE KLT

**Abstract**

A little-known tool for spectral line measurements is the KLT (acronym for Karhunen-Loève Transform). This mathematical algorithm is superior to the classical FFT in many regards:1) The KLT can filter signals out of the background noise over both wide and narrow bands. That is in sharp contrast to the FFT that rigorously applies to narrow-band signals only.2) The KLT can be applied to random functions that are non-stationary in time, i.e. whose autocorrelation is a function of the two independent variables t1 and t2 separately. Again, this is a sheer advantage of the KLT over the FFT, inasmuch as the FFT rigorously applies to stationary processes only, i.e. processes whose autocorrelation is a function of the absolute value of the difference of t1 and t2 only.3) It can detect signals embedded in noise to unbelievably small values of the Signal-to-Noise Ratio (SNR), like 10e-4 or so. This particular feature of the KLT is studied in detail in this paper. As a practical application, we show the case of a 43 GHz line emission produced by SiO and detected experimentally in R Cassiopeae by virtue of the KLT already available at the IRA-INAF Noto radiotelescope in Sicily, Italy.