Paper ID: 27454
oral

44th SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps (A4)
SETI 1: SETI Science and Technology (1)

Author: Dr. Claudio Maccone
International Academy of Astronautics (IAA) and Istituto Nazionale di Astrofisica (INAF), Italy

SETI TRANSIENT SIGNALS FROM ET SPACESHIPS DETECTED BY THE RELATIVISTIC KLT

Abstract

SETI, the Search for ExtraTerrestrial Intelligence, nowadays is mainly the search for ET radio signals. Two types of such ET signals possibly exist:

1) Stationary, intentional signals suitable to be analyzed by the Fast Fourier Transform (FFT) (and that is "Classical SETI"), and

2) Transients, i.e. non-stationary leakage signals that might be emitted by moving ET sources like spaceships possibly flying around even at relativistic speeds. For such signals the FFT won't work, and it will be necessary to resort to the KLT instead.

The KLT (acronym for Karhunen-Loève Transform) is a mathematical algorithm superior to the classical FFT in many regards:

1) The KLT can filter signals out of background coloured 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 non-stationary in time, i.e. whose autocorrelation is a function of the two independent variables t1 and t2 separately. These are transient signals.

3) The KLT can detect signals embedded in noise to unbelievably small values of the Signal-to-Noise Ratio (SNR), like 10 raised to (-3) or so.

An excellent filtering algorithm such as the KLT, however, comes with a cost that one must be ready to pay for especially in SETI: its computational burden is much higher than for the FFT. In fact, for an autocorrelation matrix of size N, the calculations must be of the order of N square or even higher, rather than N*log(N) as typical of the FFT. Nevertheless, the unbelievable recent progress in programmable cards, capable of doing TERAFLOP calculations at moderate prices, make us believe that the KLT no longer is a dream, but rather a technological reality already at work.

In this paper we study KLT filtering even for signals emitted by relativistic sources, as described by this author in Ref. [1].

REFERENCE

[1] Maccone, C., "Mathematical SETI", a 724-pages book published by Praxis-Springer in the fall of 2012. ISBN, ISBN-10: 3642274366 — ISBN-13: 978-3642274367 — Edition: 2012. See, in particular, Chapters 17 through 28.