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CORRGRAM: towards unifying correlation based triggered searches		
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Introduction

There are two fundamental free parameters in a triggered search based on an indicator of cross-correlation χ between pairs of (shifted) data streams,

1. The integration length, N, for constructing the cross-correlation indicator.
2. The offset δ of the N sample long segment pair from the start time of the trigger.

A third parameter is the cross-correlation lag, τ, which is completely fixed if the sky direction of the trigger is known exactly. We will neglect this parameter in the following. Thus χ is a functional of the data and is parametrized by N and δ. Let us denote this functional as $\chi(N,\delta)$.

Consider the matrix $\chi(a,b)$, with row index a and column index b corresponding to a discrete and finite set of values for N and δ respectively. Then, the most general triggered search boils down to the detection of an "event" in the $\chi(a,b)$ plane. In analogy with a *spectrogram*, we call $\chi(a,b)$ a *corrgram*.

Note: The notion of $\chi(a,b)$ has been introduced already in 1 where we defined a *modified cross-correlation*}. However, $\chi(a,b)$ is more general in the sense that it could also be the cross-correlation coefficient or some other indicator of correlation. Also, in 1, we proposed using the maximum of $\chi(N,\delta)$ over δ for a fixed N as our test statistic. Here, we consider the entire $\chi(a,b)$ plane.

CORRGRAM: MATLAB implementation

The corrgram has been implemented as a function in MATLAB 4.

```
>> help corrgram2

 CORRGRAM2(X,Y,INTLEN,OVRLP,Fs,Stat)
 Takes equal length data vectors X and Y
 and constructs a running cross-correlation (if Stat='cc') or
 running correlation coefficient (Stat='r') with segments of length
 INTLEN[i] sec with offsets starting from 0 samples
 from the beginning of each data vector incremented
 in steps of INTLEN[i]*OVRLP sec (0<=OVRLP<1).
 Fs is the sampling frequency (in Hz) of the data.
 The output is a two dimensional image with rows corresponding to INTLEN
 and columns corresponding to DELTA.

 B=CORRGRAM2(X,Y,INTLEN,OVRLP,Fs,Stat)
 returns the two dimensional output matrix.
```

Here is an example of usage.

```
x=randn(1,16384);
y=randn(1,16384);
fs=16384;
intlen=.01:.005:.1;
corrgram2(x,y,intlen,.5,fs,'r');
```

Results

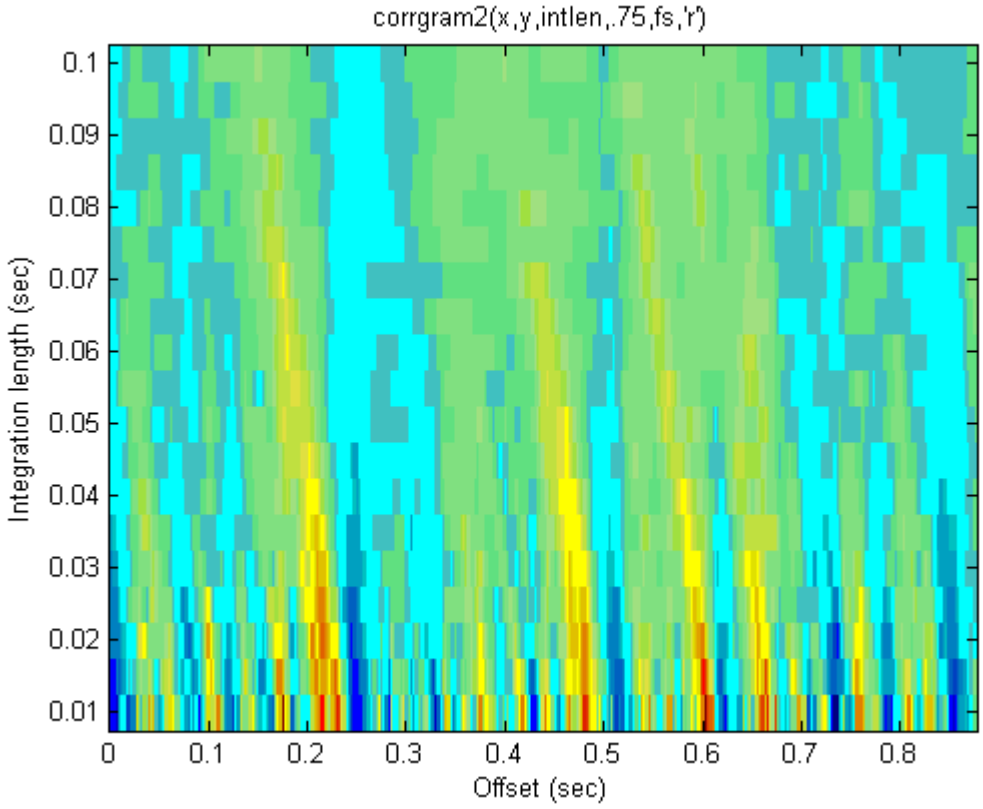
Fig. 1 shows the corrgram of two independent Gaussian white noise sequences. Fig. 2 shows the corrgram with the same noise type as in Fig. 1 but with an added signal (signal shown in Fig. 3). In Fig. 1 and 2, χ is the cross-correlation coefficient.

Reference

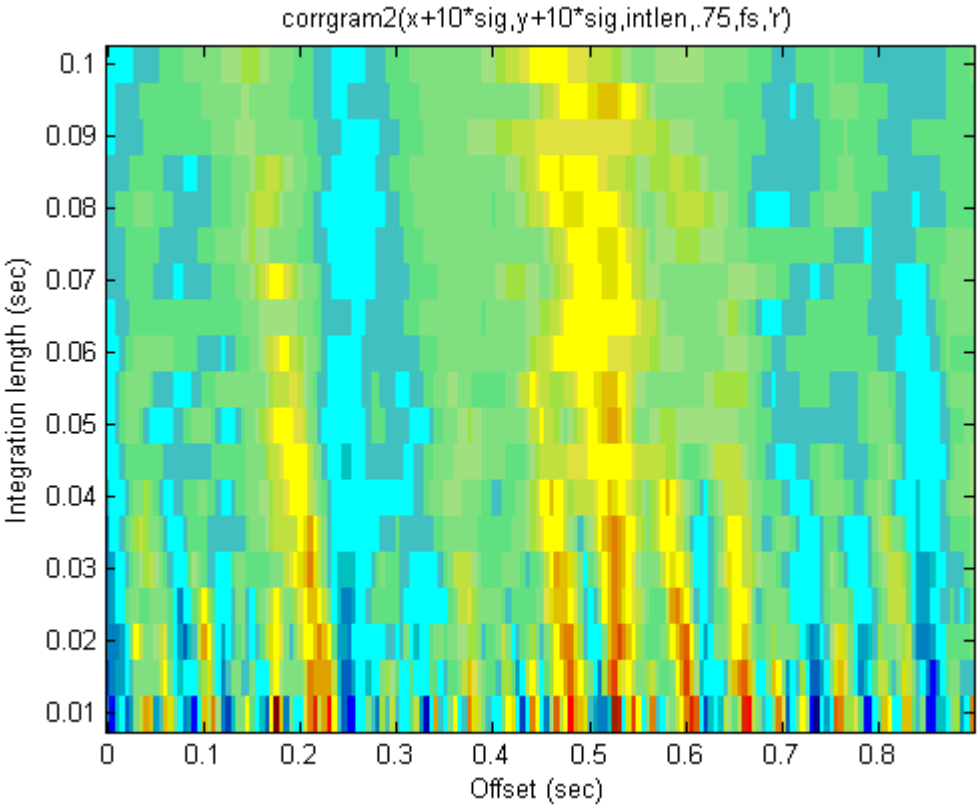
1. Soumya D. Mohanty *et al*, "Confidence interval estimation of root mean square strain amplitude using a maximized cross-correlation statistic", LIGO-T030108-00-D.
2. Available from the external triggers CVS archive (http://www.ligo.caltech.edu/~sn).
3. http://www.mpa-garching.mpg.de/Hydro/RGRAV/index.html
4. MATLAB, http://www.mathworks.com

Figures

1. CORRGRAM of two white Gaussian random sequences. Note how chance correlations (both positve and negative) propagate across integration lengths.



2. CORRGRAM of two white Gaussian random sequences with added signal (scaled such that its matched filtering SNR is 10). The noise sequences are identical to those used in Fig,1



3. The signal used for producing Fig.2. It is picked from the Dimmelmeir, Font, Mueller catalog 3.