UVLBI MEMO #022

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY

WESTFORD, MASSACHUSETTS 01886

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Telephone: 781-981-5407
Fax: 781-981-0590

To: UVLBI Group
From: Alan E.E. Rogers
Subject: The effect of a bandpass slope on quantized VLBI data.

Introduction

In order to simplify the data acquisition of wideband VLBI data at millimeter and sub-millimeter wavelength it has been suggested that the wideband IF data be sampled and directly quantized without splitting the band into many sub-channels prior to quantization using a polyphase filter bank. A potential problem with this suggestion is that an uncompensated slope in the bandpass will result in significant additional quantization loss.

Simulation

Using C-code 2 independent time sequences are generated to represent the noise at each antenna and a common scaled down time sequence is added to the signal. The time sequences are transformed to the frequency domain and a bandpass slop applied and then transformed back to the time domain. The time domain signals are quantized and correlated using the FX algorithm. The bandpass is then corrected by dividing by the slope function and the cross-spectral function is transformed to the complex delay function. The delay function is searched for a peak and the SNR Measured at the peak and if the correct delay is found the trial is marked as a detection. The relative performance is judged in 2 ways. First by looking at the number of detections and second from the average SNR for the detections. The full continuum sensitivity requires the bandpass correction to be made (from the autocorrelations) before deriving the delay function

The results of the simulations were as follows:

bandpass_slope_dB*	SNR_loss_percent (1_bit)	SNR_loss_percent (2_bit)
5	9	4
10	23	13
15	41	24
*Change from one end to the end of the band		

When 2 bits/sample are used with optimum state selection the loss due to a 5 dB slope across the full band end to end is only 4%. While the loss due the overall bandpass slope would be eliminated by separating the band into sub-bands with the polyphase filter there is some loss in the polyphase filter implementation due to the imperfect filter shape, aliasing and interpolation (see mk5 memos 28 and 29).