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VLB ARRAY MEMO No. 327

TO: Processor and Correlator Groups

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SUBJECT: Rejection of receiver images for various VLBI processing techniques

It is well known that the conventional VLBI processing method is extremely clean and free of images and spurious responses.

The interferometer response with imperfect receiver image rejection is given by

$$\langle e^{iw_L Tg} [1+\alpha e^{-2iw_L Tg} e^{-i2F_R t}] \rangle \qquad (1)$$

where

w_L = sum of local oscillator frequencies

Tg = geometric delay at "reference" epoch

F_R = total fringe rate in radians/sec

α = receiver image response - fractional units

in which the image term becomes zero if the integration is carried out over a integral number of fringe rate half cycles or many cycles. In other words the conventional VLBI processing strongly rejects receiver images, not that we plan poor receivers.

If on the other hand fringe rotation is done by offsetting the video converter local oscillators, as has been suggested, the response is

$$\langle e^{iw_L Tg} [1+\alpha e^{-2iw_L Tg}] \rangle$$

and now time averaging fails to eliminate the receiver image. If there is a residual fringe rate the image produces a spurious radio source with the opposite fringe rate residual. This is a very serious problem given the normally super high dynamic range of the conventional VLBI processing for sources separated by many "delay rate beams". If fact searches for weak compact components near strong quasars have already been made with a dynamic range in excess of several thousand. At very low fringe rate even the conventional VLBI processing runs into difficulties with D.C. offsets in the digitization and receiver image responses. Low fringe rates can however be eliminated by offsetting some of the stations by fixed amounts.

The digital SSB mixing method proposed for fringe rotation at the processor provides some rejection of receiver images, but virtually none at the high and low ends of the band. Furthermore if the digital SSB mixing is applied to both data stream there are images generated by the mixing (even with perfect receivers) which become a serious problem at low fringe rates.