Post-Correlation Interference Mitigation

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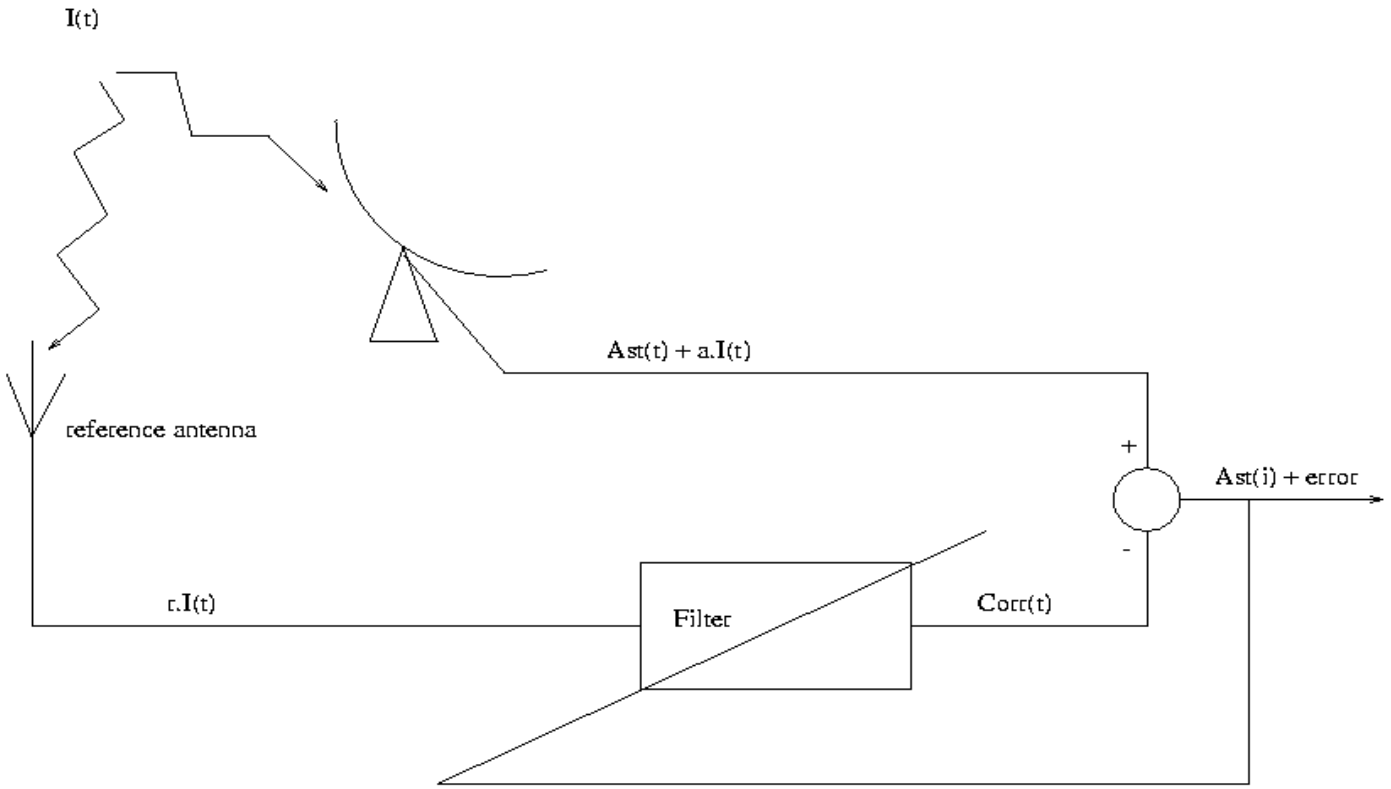
- **A Post-Correlation equivalent to an Adaptive Filter**
- **Applicable to Single Dish observations**
- **Applicable to Synthesis Array observations**
- **Performance comparable to the Adaptive Filter**
- **Can be implemented with current hardware**

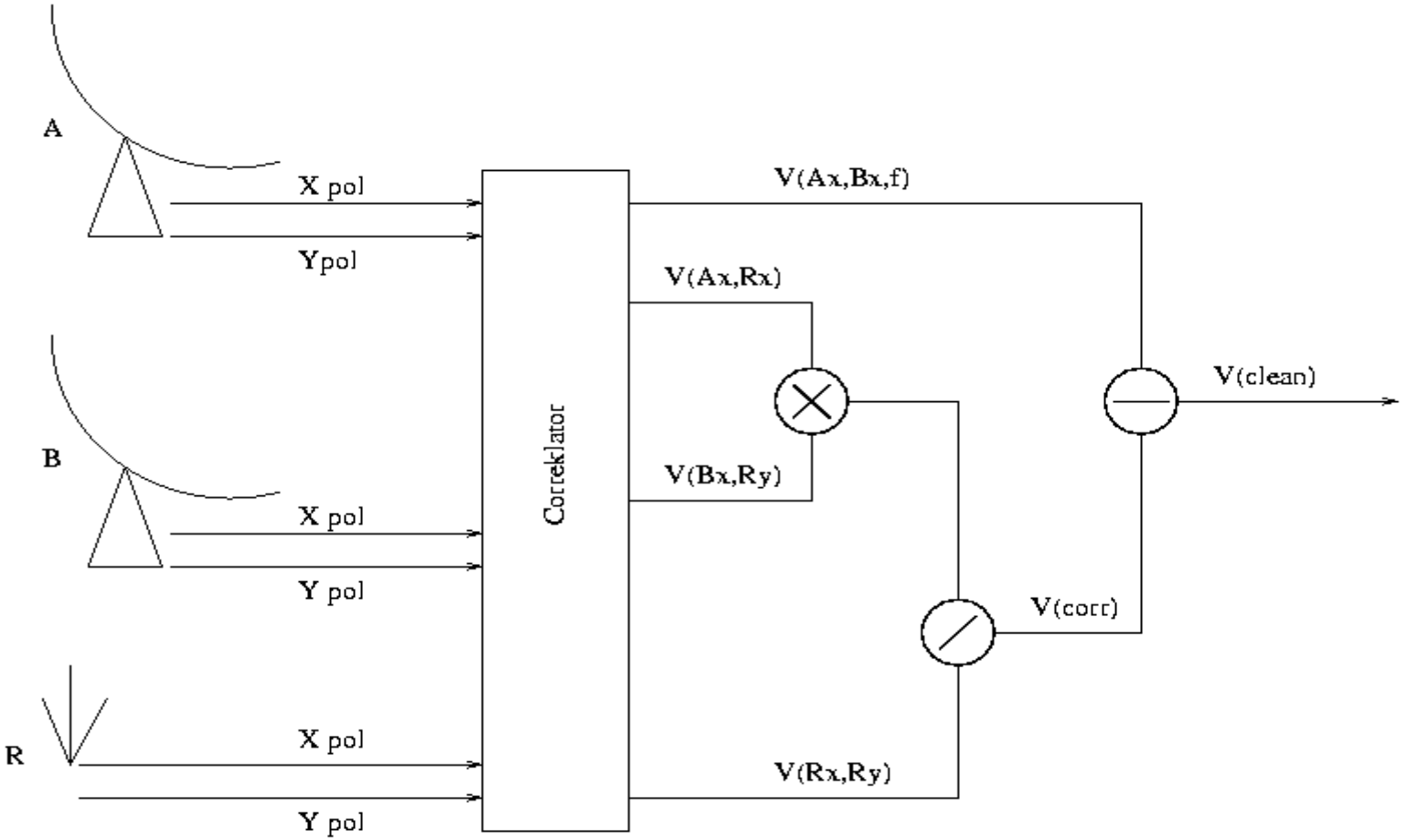
Adaptive Filter (schematic)



Post-Correlation - Features

- **Tolerant to small number of sampler bits**
- **Tolerant to multi-pathing interference**
- **Tolerant to significant delays between the reference and the astronomy antenna**
- **Tolerant to offset between the array tracking centre and the interference location**
- **Only one reference antenna required even for an array filter**

Post-Correlation Filter



Post-Correlation Filter

$$V_A(f) = g_A(f)I(f) + \sum V_{sky,A}(\theta, f)$$

$$V_R(f) = g_R(f)I(f)$$

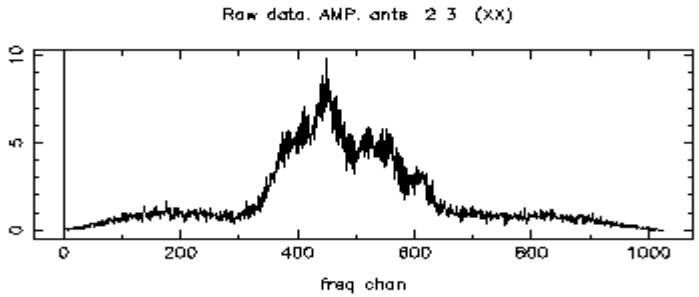
$$Corr(f) = \frac{Cross(A_x, R_x).Cross(B_x, R_y)^*}{Cross(R_x, R_y)^*}$$

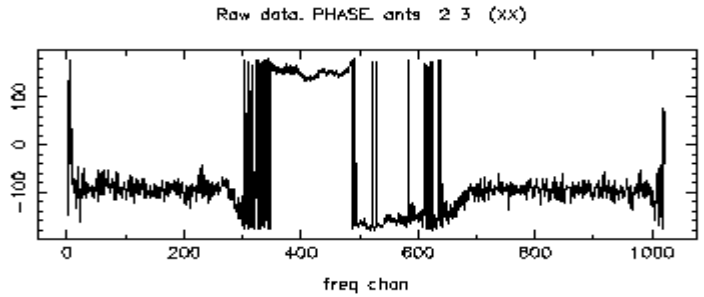
This requires:

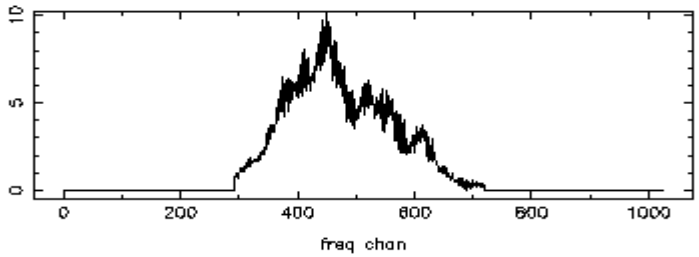
- slowly varying $\{g\}$ ... $< g(f)I(f) > \sim g(f) < I(f) >$

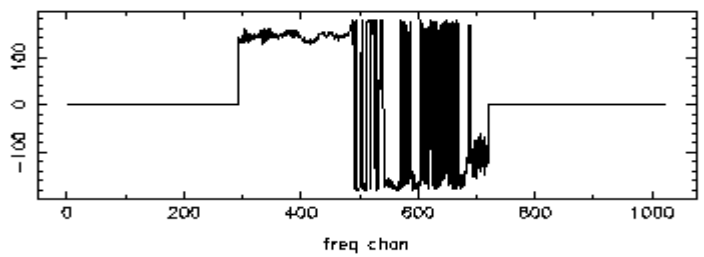
- closure... g(f) is an adequate description of the coupling;
  only one interferer in any (f) ... but multi - pathing is OK

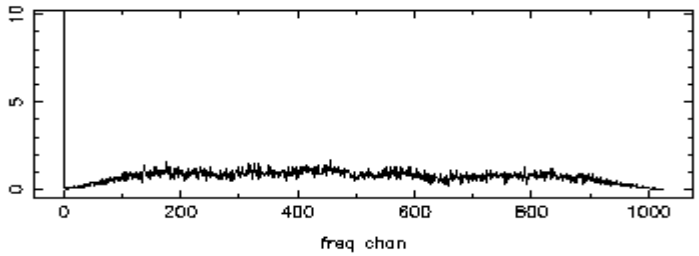
Synthesis Array Filtering

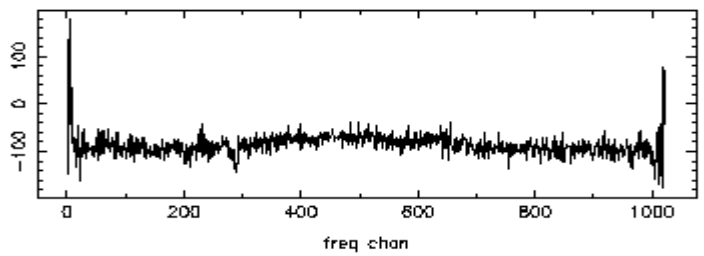




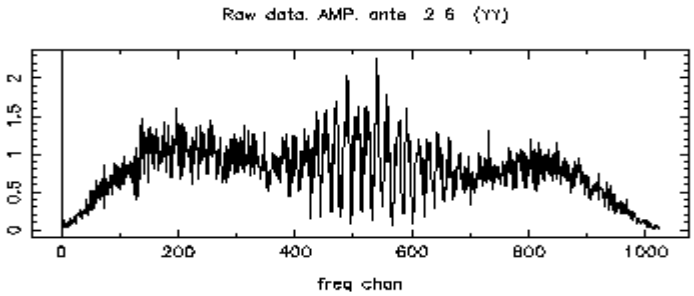


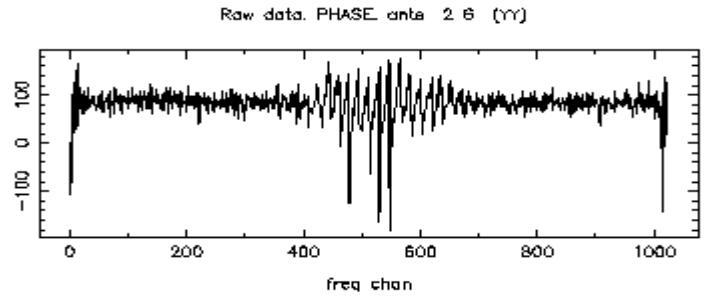


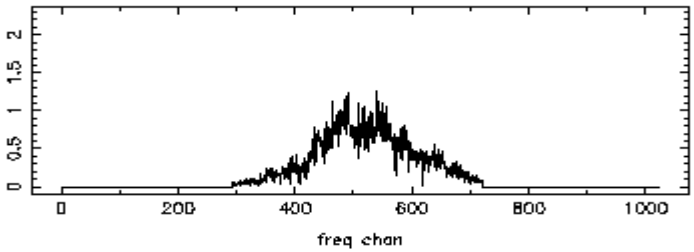


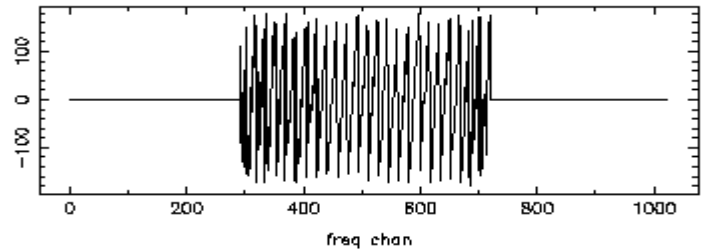


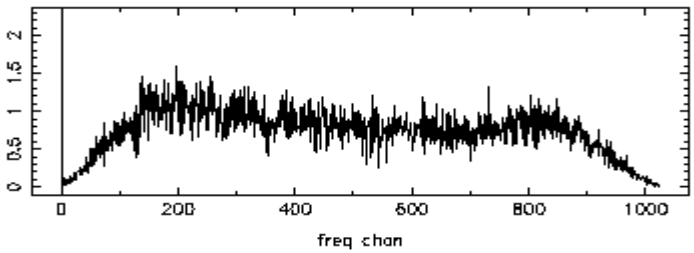
Synthesis Array Filtering

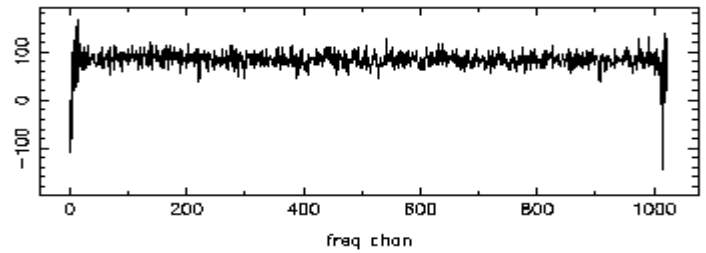




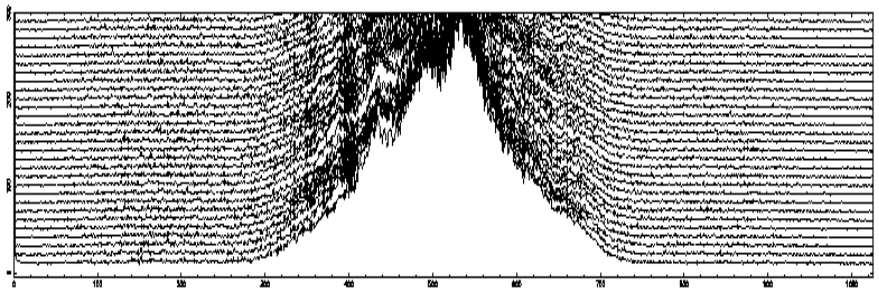


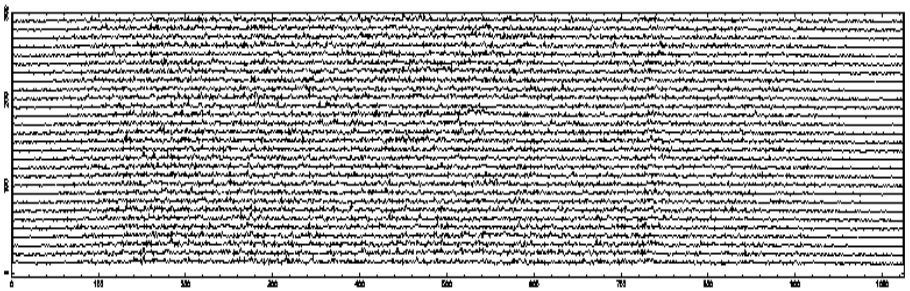


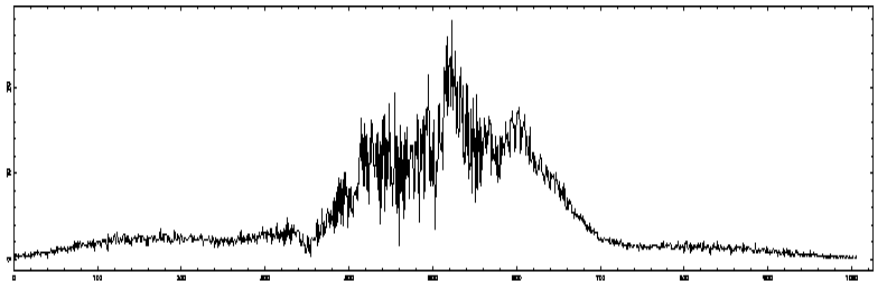


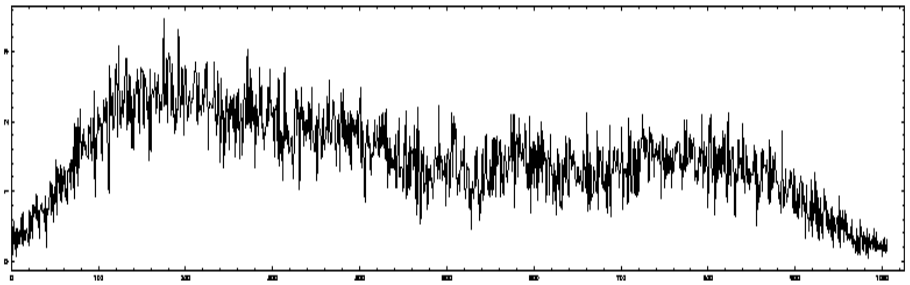


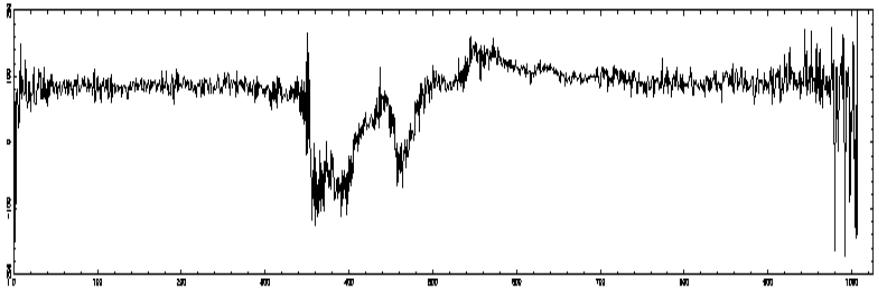
ATCA - 1503 MHz; 4 MHz BW

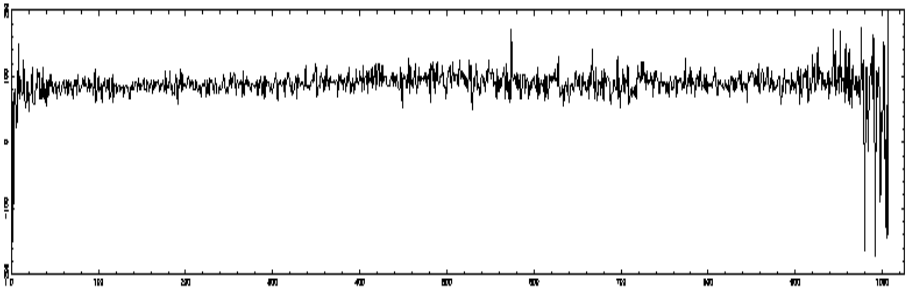








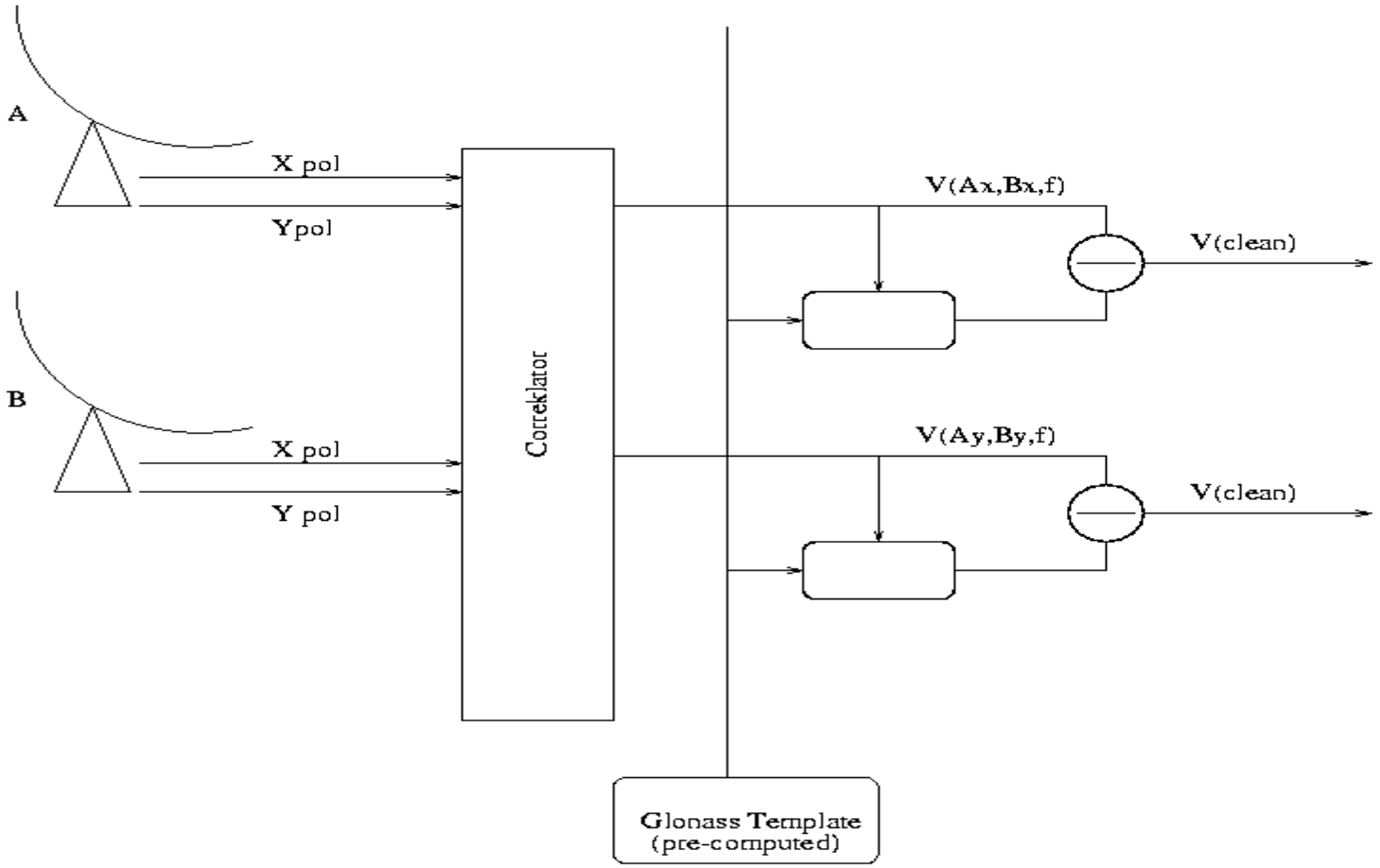




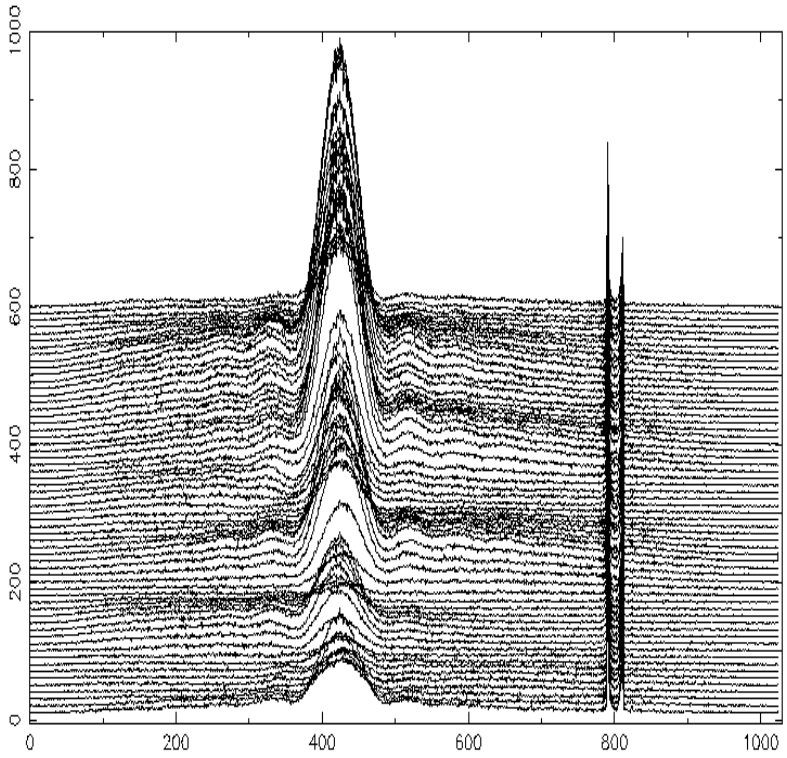
Hardware

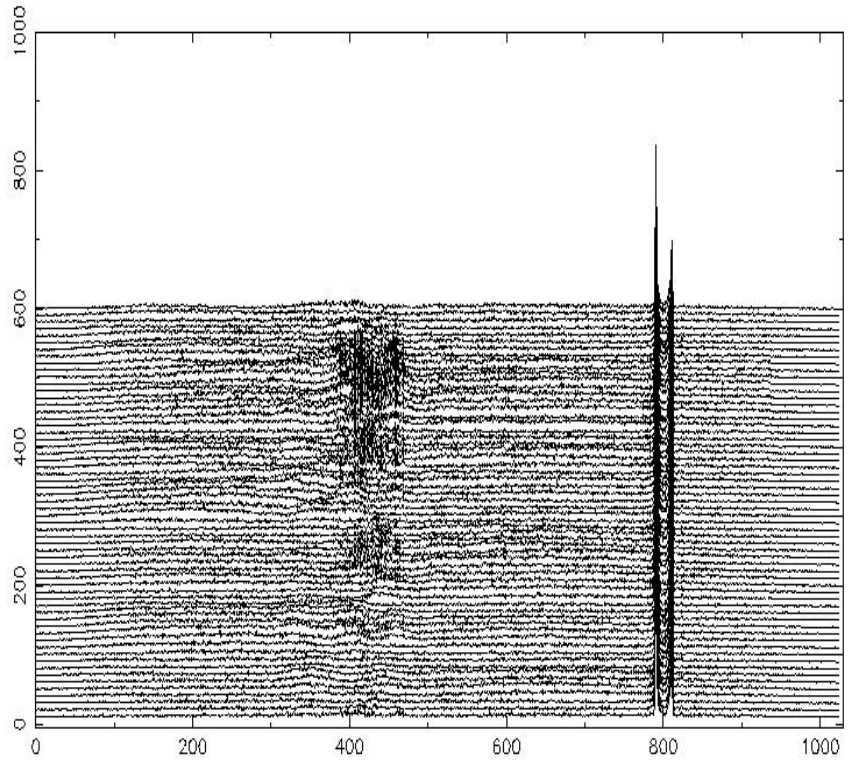
- **Reference Antenna + conversion chain**
- **Additional Correlator resources. Equivalent to adding one extra antenna to the array.**
- **Enjoys all the flexibility of the observatory correlator**

Glonass Excision

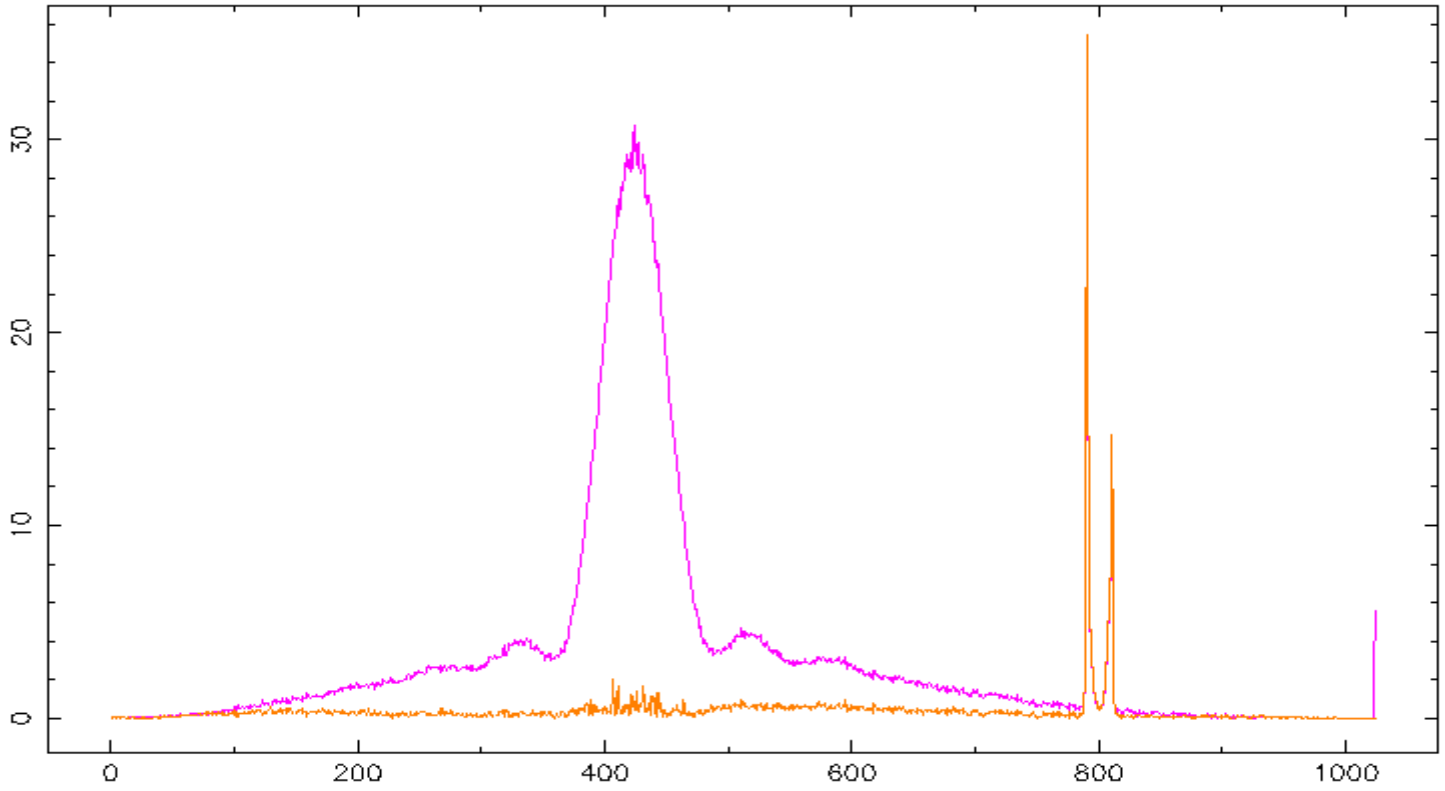


Glonass Excision





Glonass excision



SKA ?

In a tied - array (eg, an SKA station), we have :

$$V_{tied\ -\ array}(f) = \sum V_{elements}(f) = I(f).\sum g_{element}(f)$$

Post - Correlator filtering is therefore applicable in this case.

Conclusions

- **The Post-Correlation Interference cancellation works well.**
- **The hardware requirements are realistic (but non-trivial)**
- **The additional computing requirements are modest**
- **The system is flexible.**

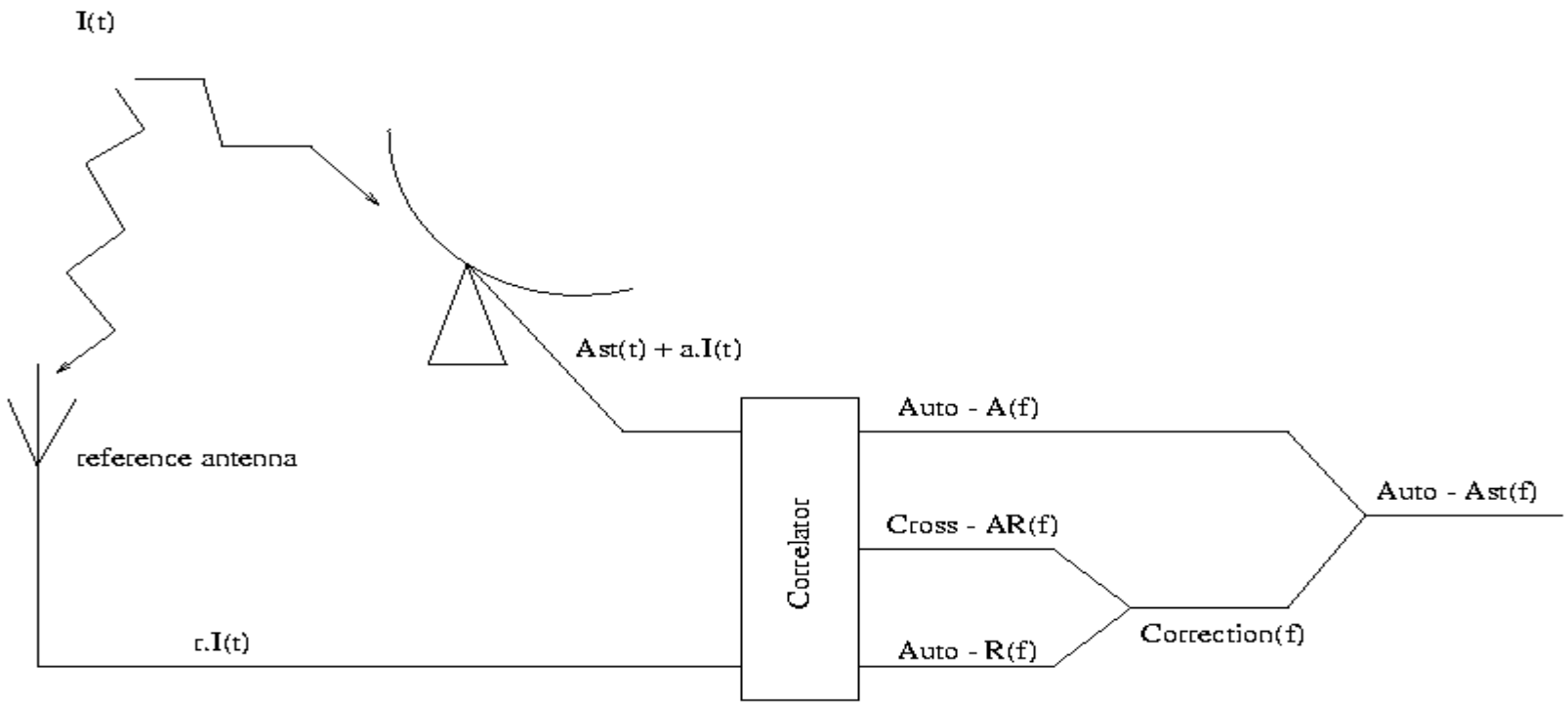
Post-Correlation RFI excision

- **Overview of the scheme**
- **Application 1 - Single Dish**
- **Application 2 - Synthesis Array**
- **Parametric Filter - Glonass Excision**
- **Extension to SKA**

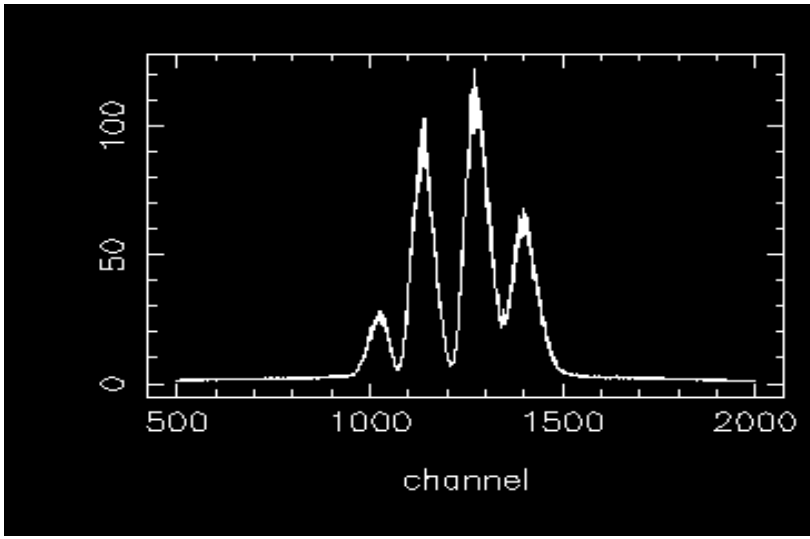
Pre- and Post-Correlation filters Different Philosophies

- **Adaptive filter operates at the sampling rate to recover the message**
- **Time scale is Nyquist rate (sub-μseconds)**
- **There is no “message” in astronomy - we want average spectra**
- **Time scale is long (seconds)**

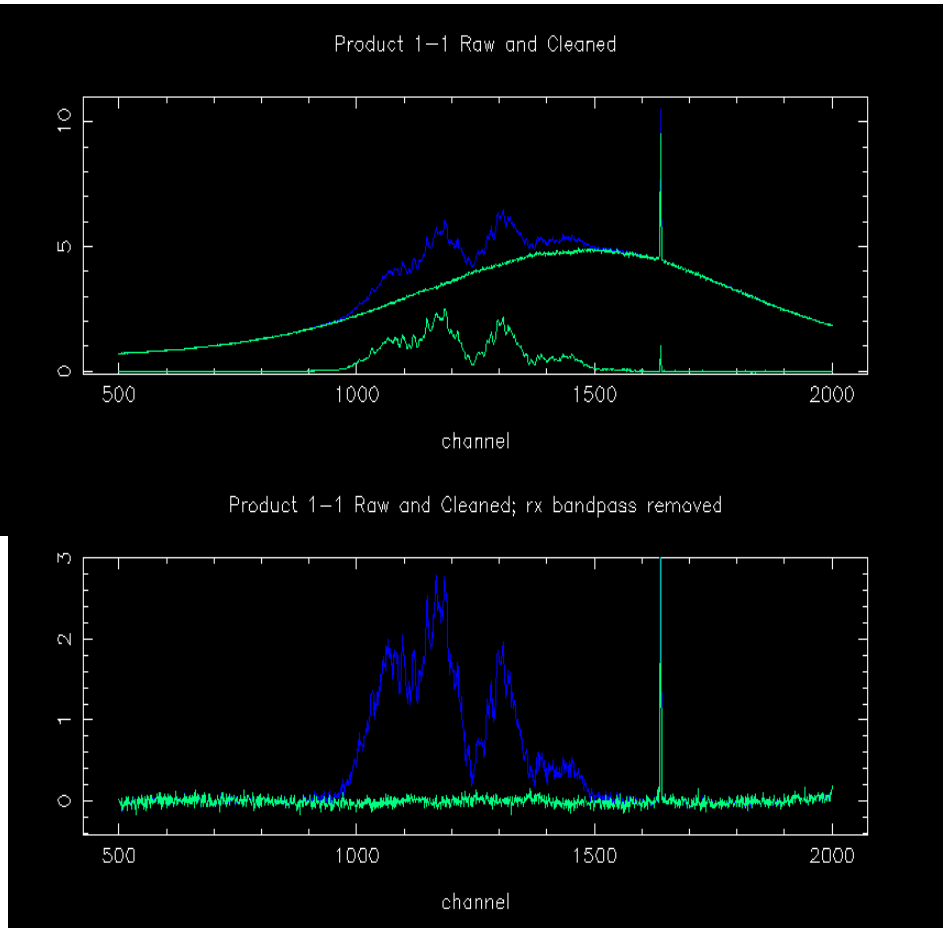
Post-Correlation Filter



Single Dish - Autocorrelation



Reference antenna



Parkes 64m