Reference Antenna Techniques for Cancelling RFI due to Moving Sources

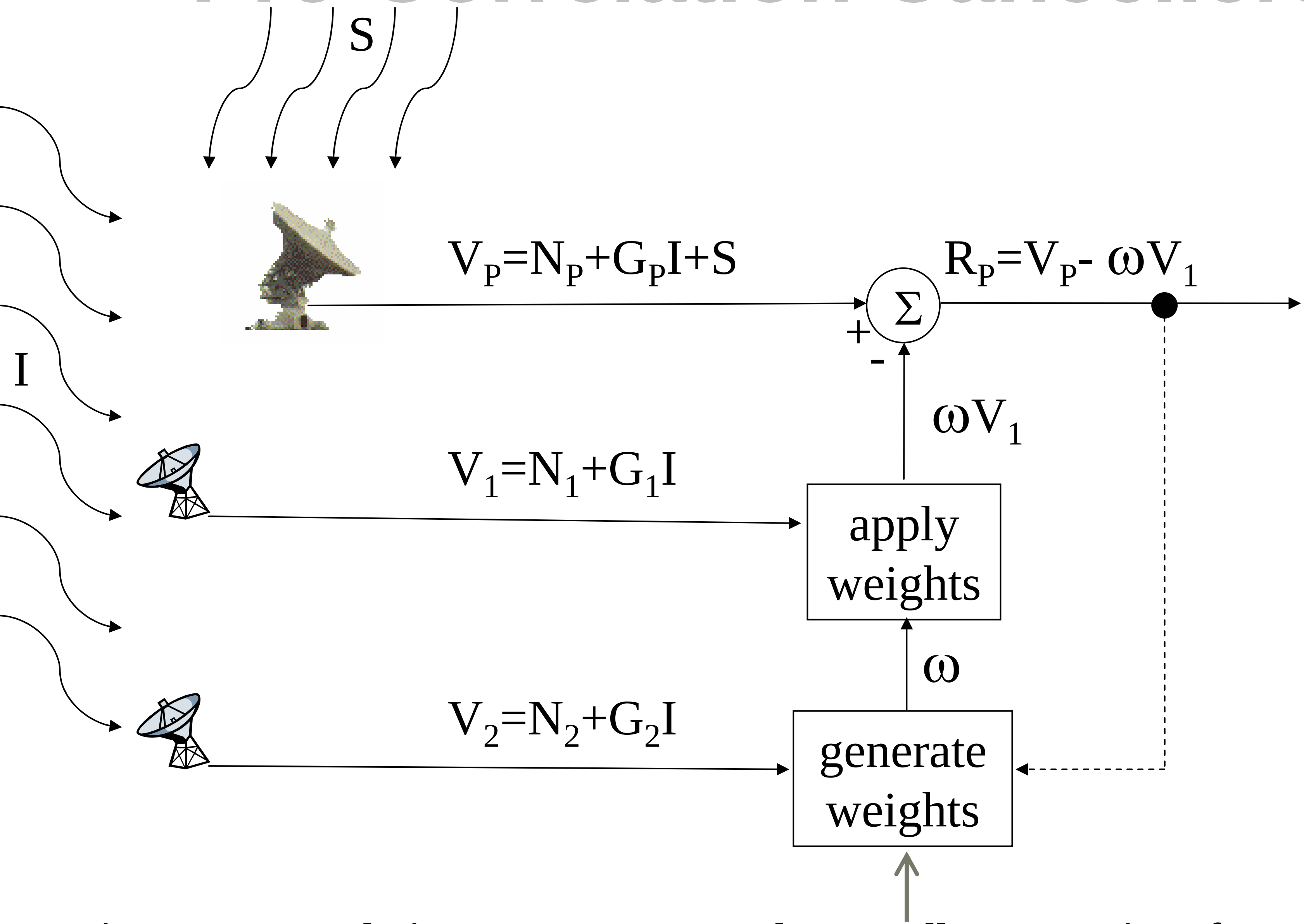
Daniel Mitchell,
Gordon Robertson

Sydney University

Overview

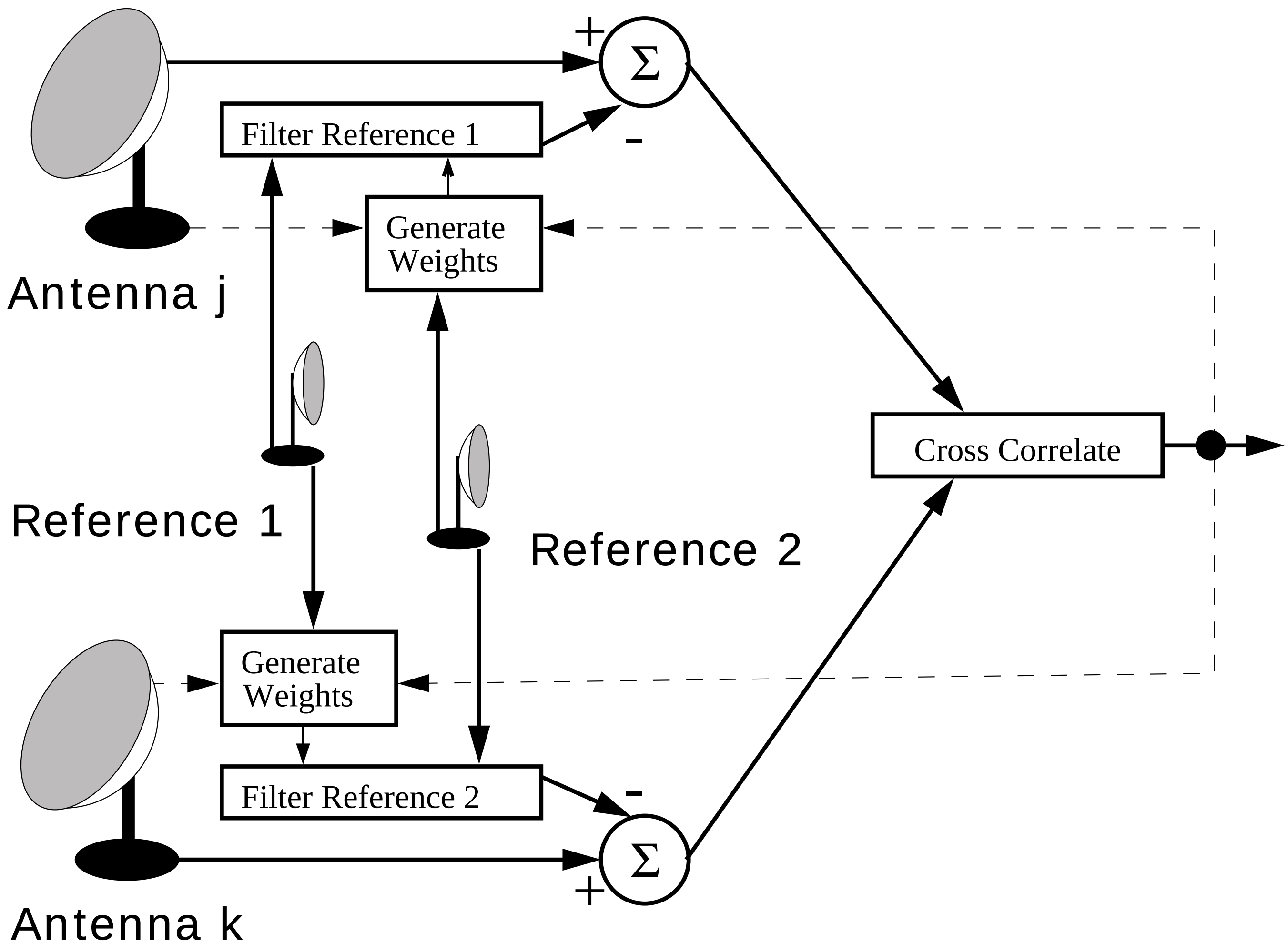
- Reference Antenna Techniques
  - A quick review of the techniques.
- Varying Delays
  - How do the algorithms deal with moving transmitters.
- Examples
- Summary

Pre-Correlation Cancellers



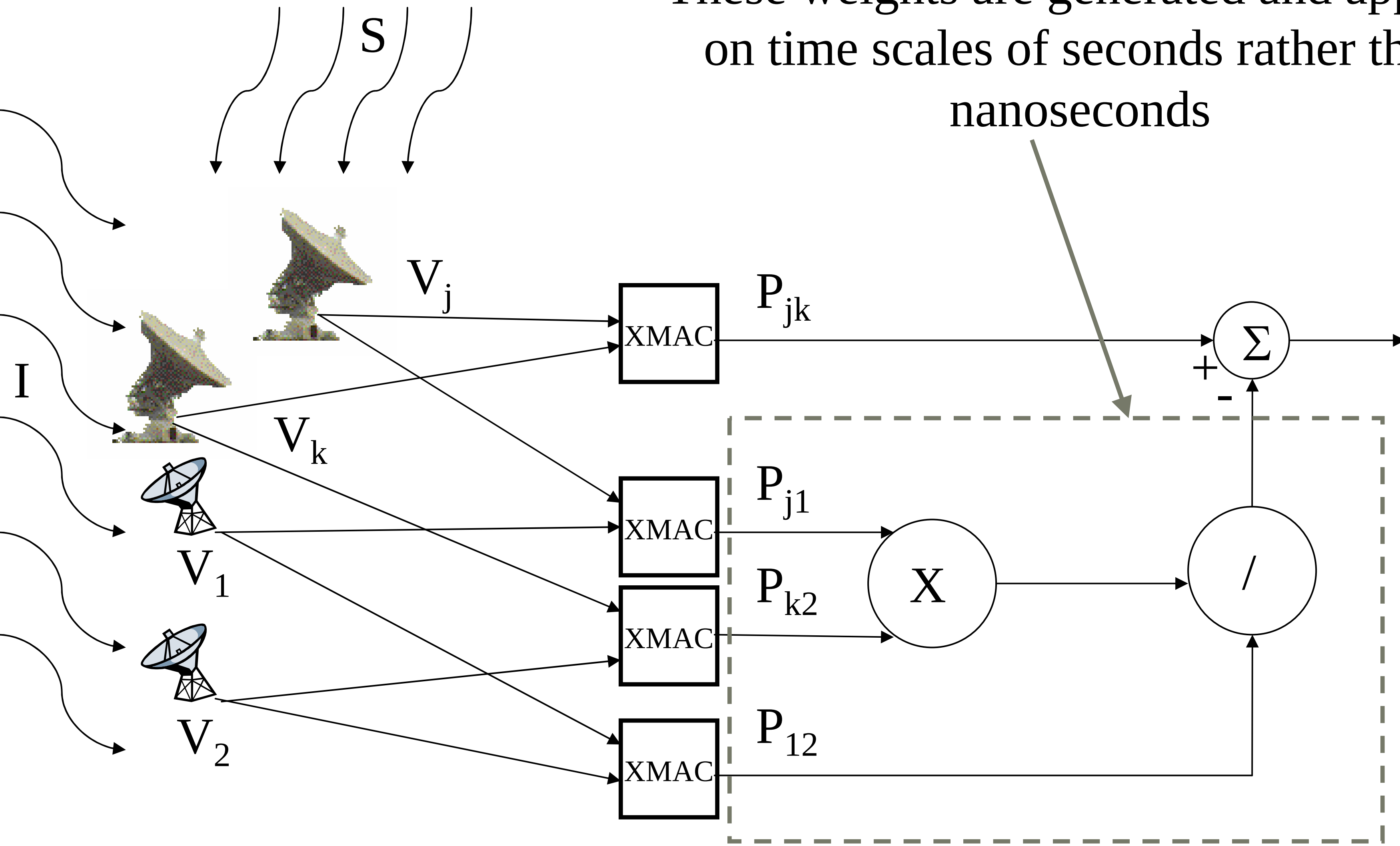
Setting cross-correlation to zero must set the canceller output interference to zero

Use two filters to average down reference receiver noise



Post-Correlation Cancellers

These weights are generated and applied on time scales of seconds rather than nanoseconds



Moving Sources

- Antennas are tracking the sky, so even fixed interferers will move through fringes

  -> decorrelated cross-power measurements

- **Pre-Correlation**: Vary weights at the RF sample rate (ns)
- **Post-Correlation**: Need to modify the algorithms (s)

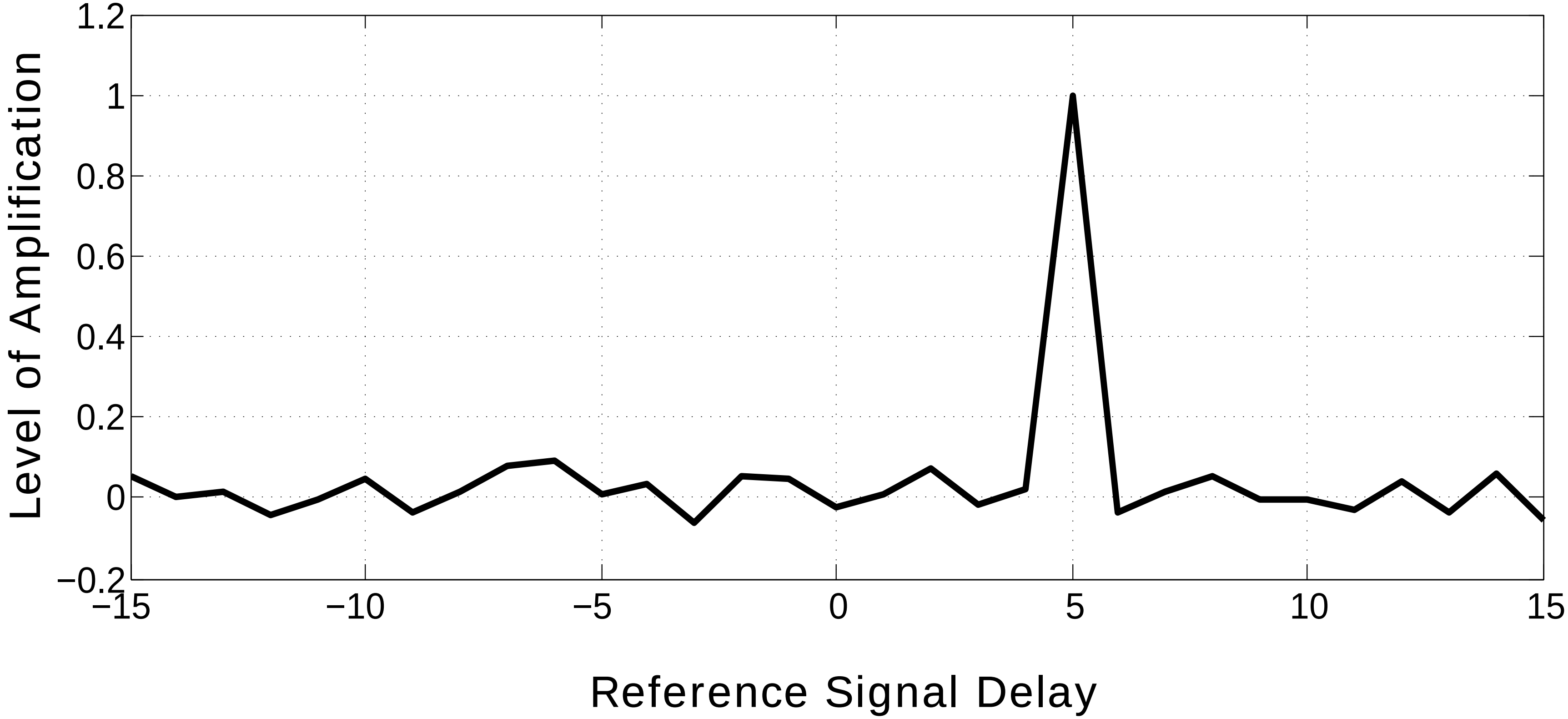
Moving Sources

- **Pre-Correlation**:

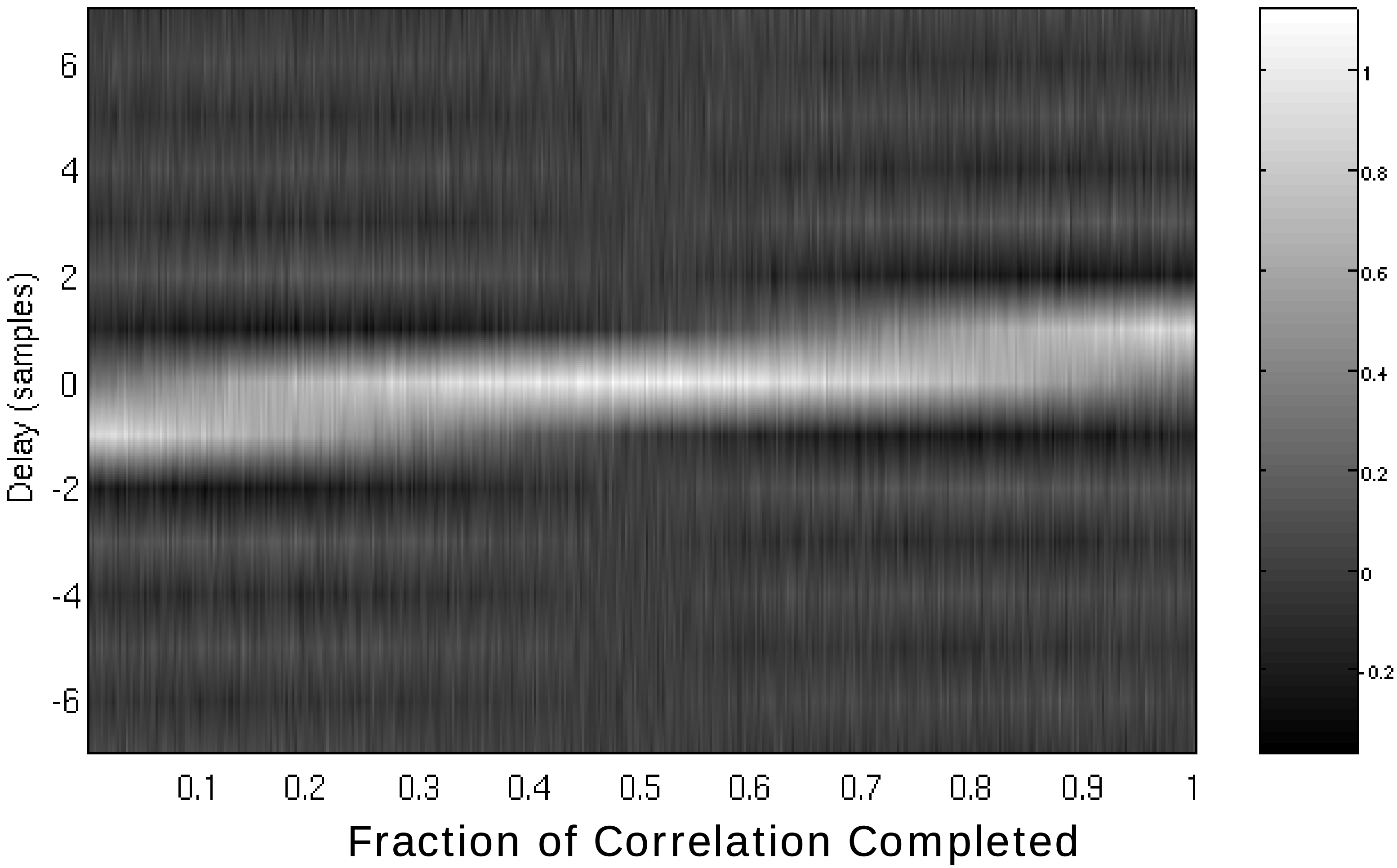
Can make the pre-correlation mitigation algorithm adaptive to track any changes

RFI voltage model is created from the addition of weighted and delayed reference voltage samples (equivalent to amplifying and phase shifting in frequency domain)

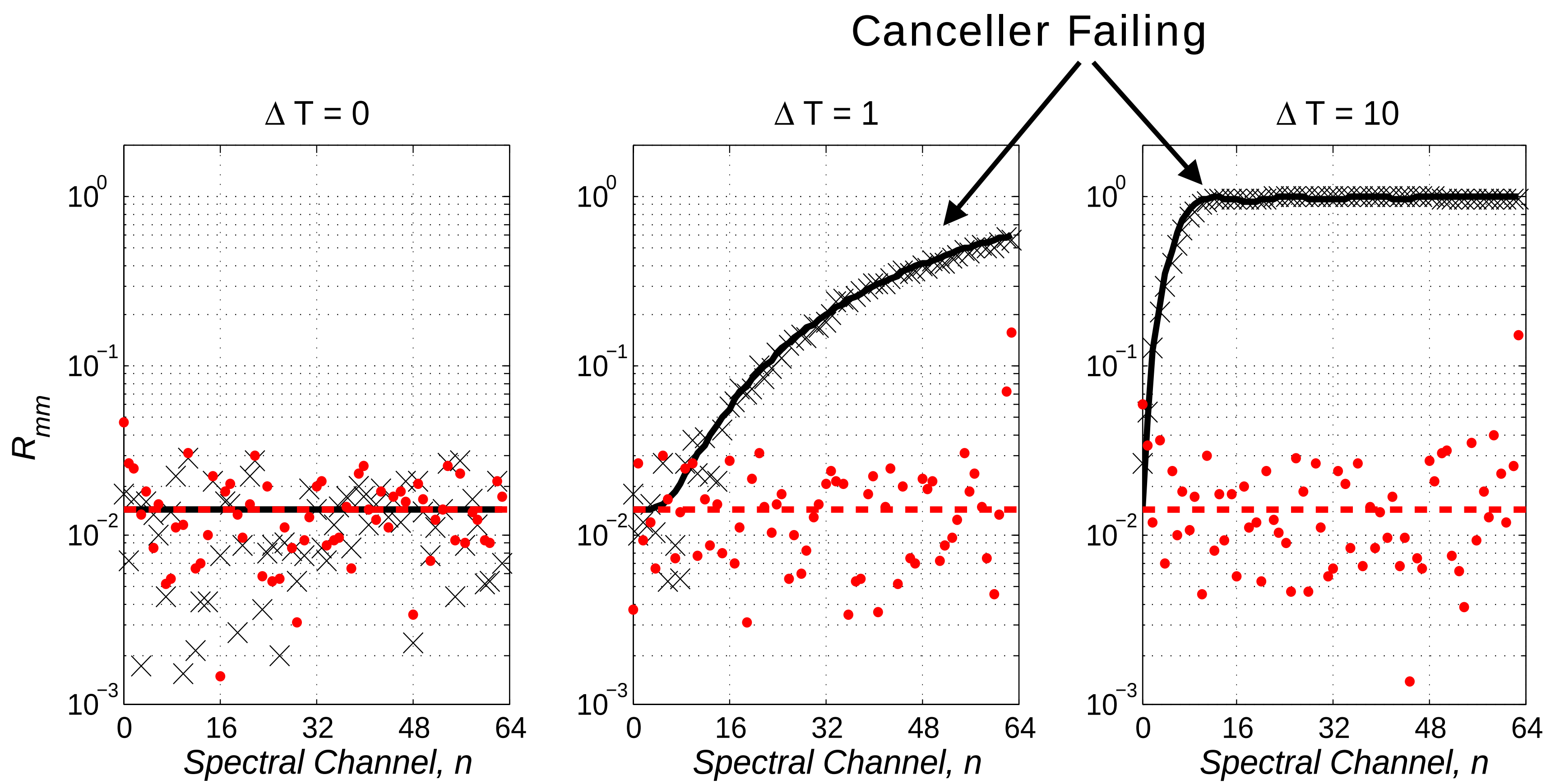
Example weights for broadband noise delayed by 5 samples



The weights track the changing geometric delay



Adaptive weights (red dots) result in correct cancellation



Moving Sources

- **Post-Correlation**:

If fringe rate is known and not too large, modify the post-correlation mitigation algorithms

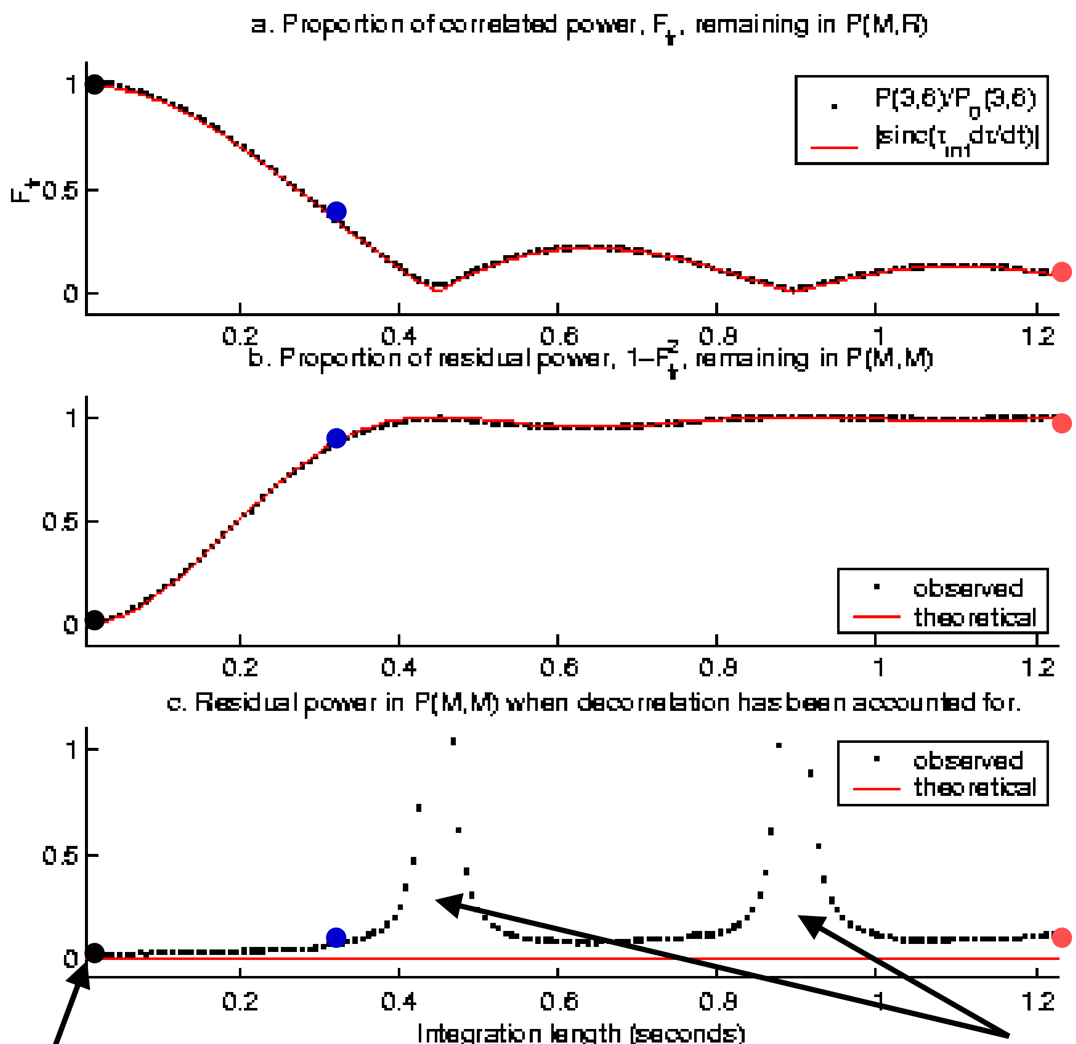
Here applied in the frequency domain

GPS Interference

Cross-power between the main signal and the reference signal

Canceller output power using decorrelated power measurements

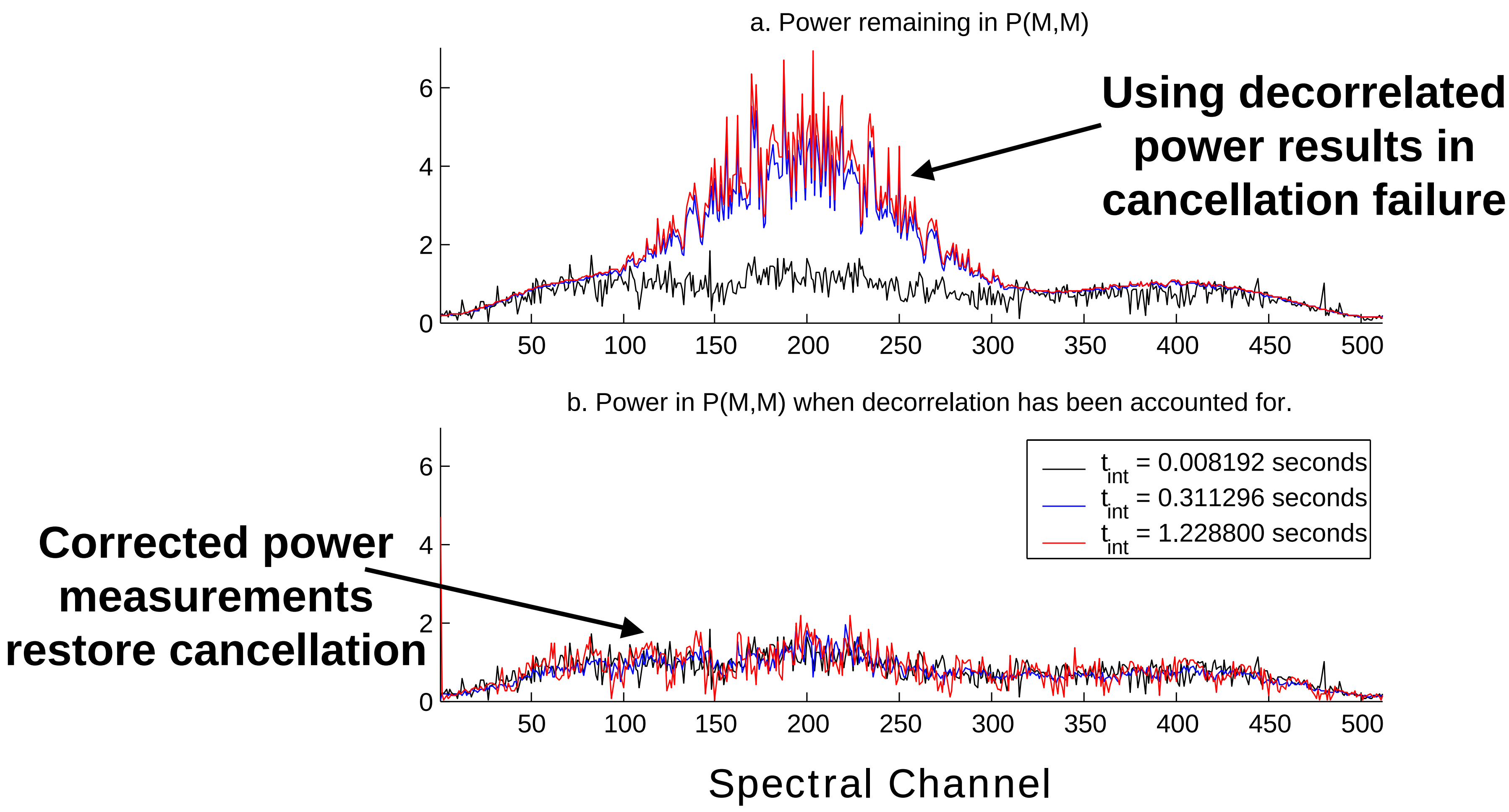
Canceller output power using corrected power measurements



Want to be here

Canceller fails here

Canceller Output Spectra for Three Integration Lengths



Moving Sources

- Both pre- and post-correlation mitigation algorithms can be made to work with moving sources

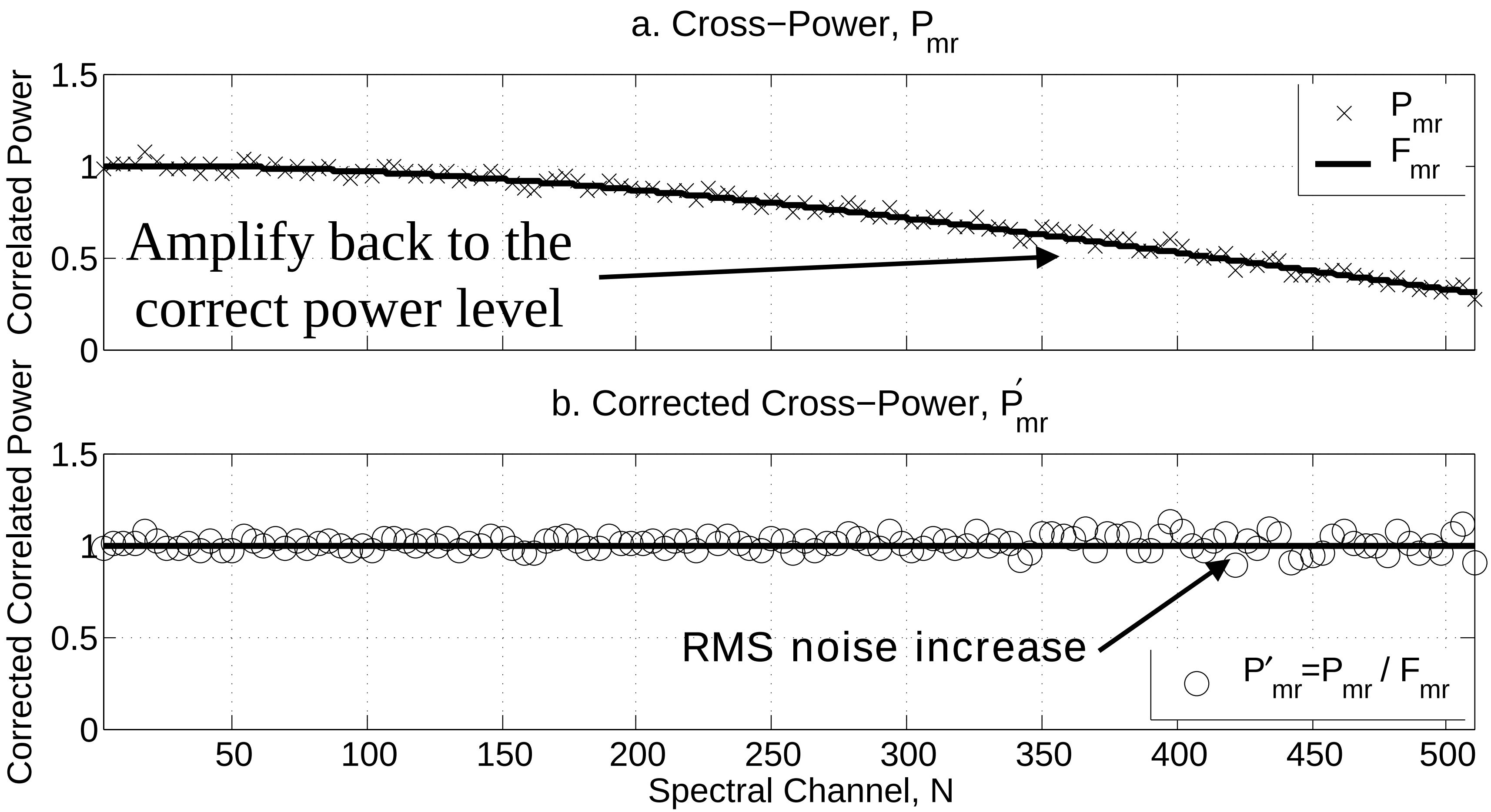
But both lead to a noise increase

Simulation

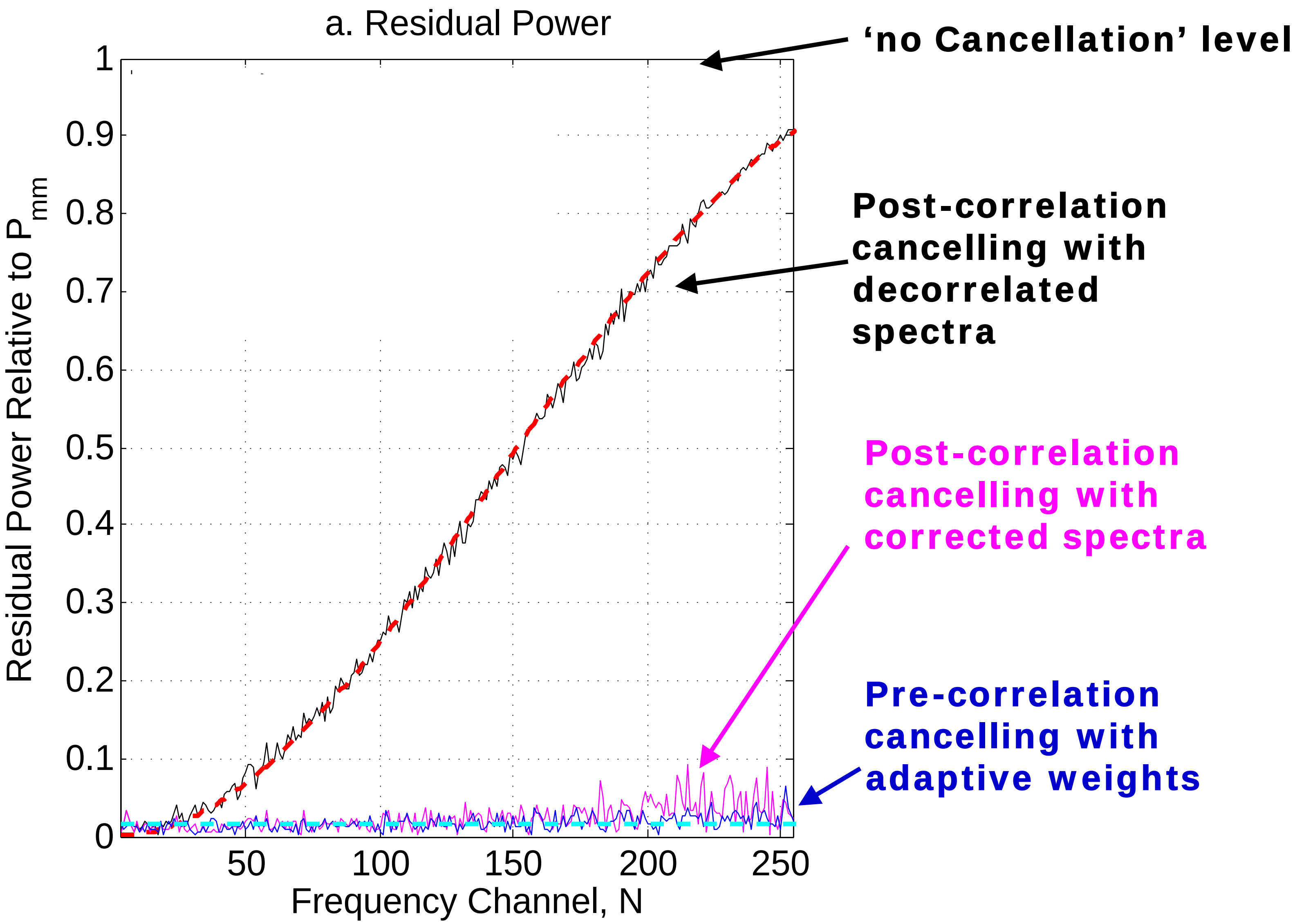
- **Use simulated broadband noise to compare the pre- and post-correlation mitigation algorithms**

Over the course of the correlation, the geometric delay between reference and primary antennas changes by 1.5 RF sample langths

Broadband Noise Simulation. Higher frequencies have a larger fringe rate



A Comparison of the Techniques



Summary

- **Modifications can be made to track varying interference**

  Pre-correlation -> allow weights to adapt
  Post-correlation -> allow for decorrelation

- **Both increase the amount of injected receiver noise**