Simulated Comparison of RRC Demod vs DigiTrak IIR DSP Demod

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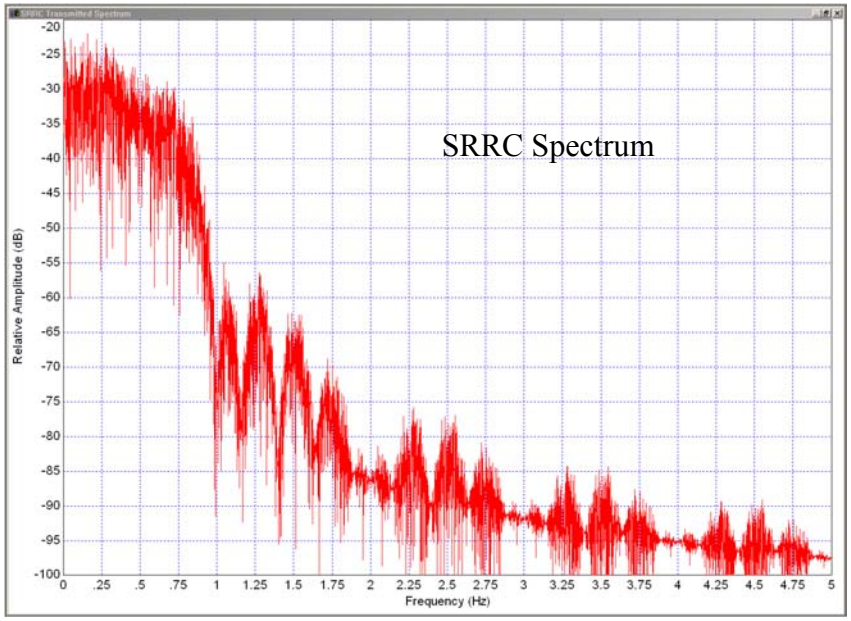
Critical Aspects of High Data Rate System Design

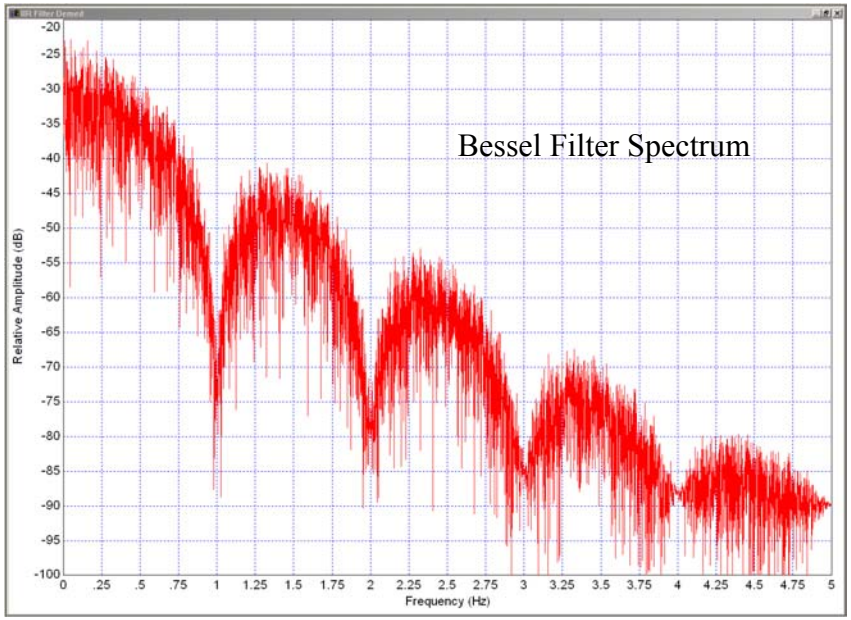
- Octal Phase, Virterbi Encoding/Decoding specified.
- Must be able to estimate the phase of each symbol.
- Narrow Carrier tracking loop bandwidth required.
- Limited carrier acquisition time (0.5 seconds for 300 BPS, 0.25 seconds for 1200 BPS.
- Acquisition frequency uncertainty ±500 Hz**.**
- Symbol synchronization critical to carrier tracking.
- Only 180 degree transitions useable for symbol synchronization.
- Narrow loop bandwidth brings 1/f noise into consideration.
- 1200 BPS not directly scaled from 300 BPS.
- Limited out-of-band transmit spectrum specification.

SXRRC vs. IIR Transmitted Spectra



SXRRC Transmit Filter

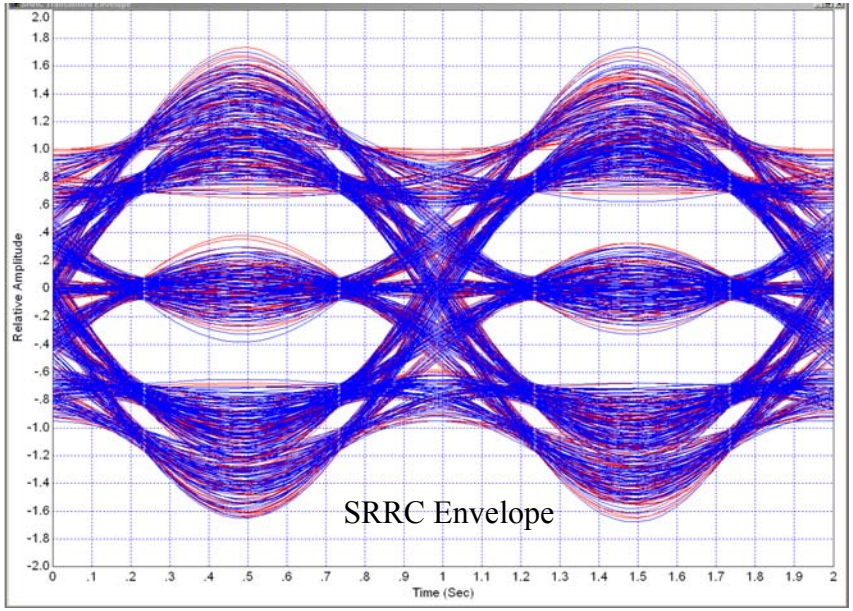
- 32 Samples Per Bit
- Baseband Filter – SXRRC alpha = 1, 113 Taps
- Transmitted power relative to carrier = 0.72 dB
- Noise Power in 600 Hz Bandwidth, 750 Hz from carrier = -59.4 dBc



IIR Transmit Filter

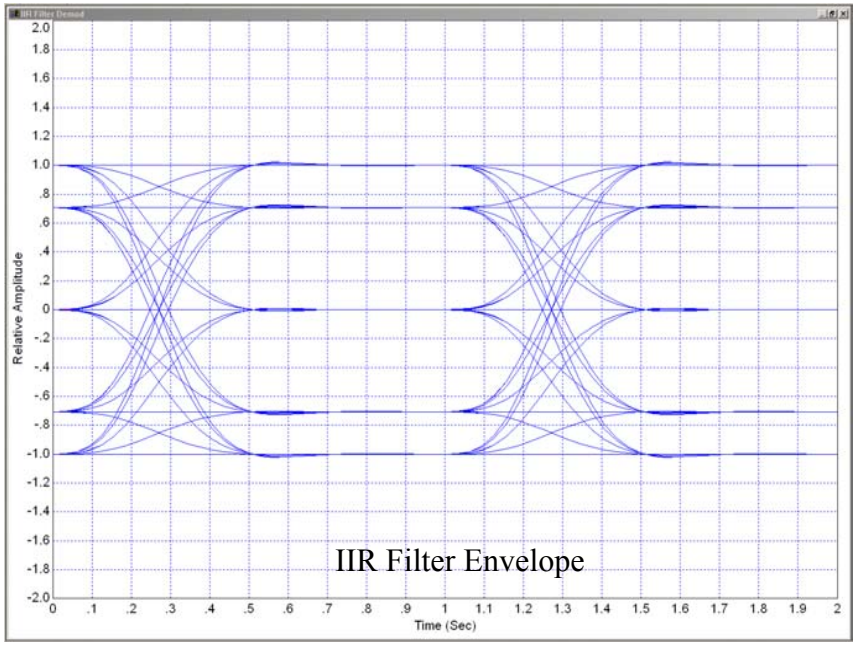
- 32 Samples Per Bit
- Baseband Filter – 5 Pole Bessel
- Transmitted power relative to carrier = -0.52 dB
- Noise Power in 600 Hz Bandwidth, 750 Hz from carrier = -46.2 dBc

SXRRC vs. IIR Transmitted Envelope



SCRRC Transmit Filter

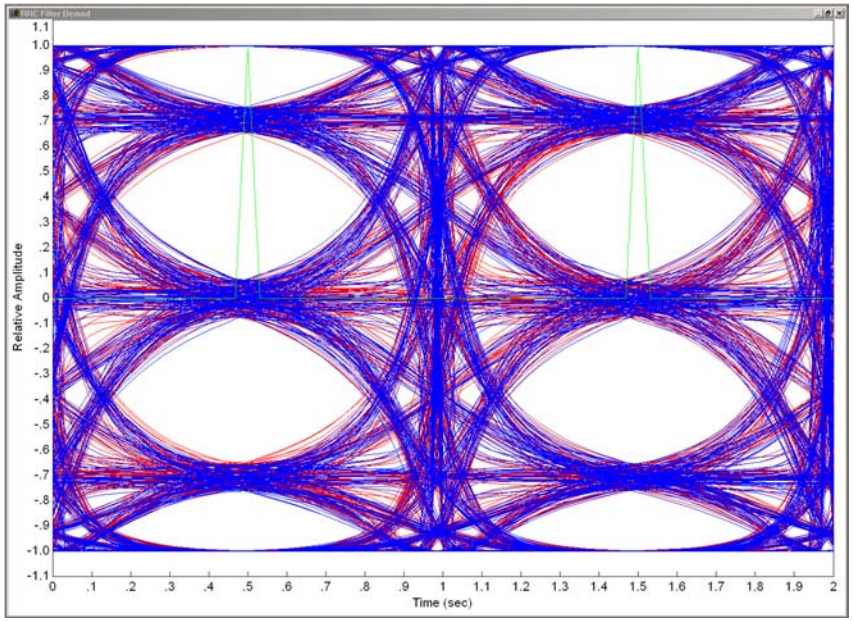
- 32 Samples Per Bit
- Baseband Filter – SXRRC alpha = 1, 113 Taps
- Transmitted power relative to carrier = 0.72 dB

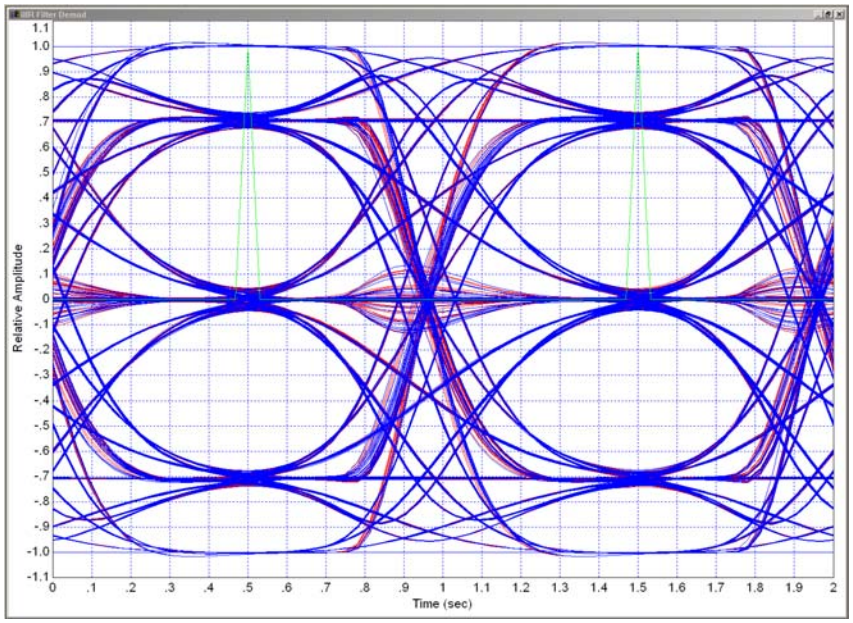


IIR Transmit Filter

- 32 Samples Per Bit
- Baseband Filter – 5 Pole Bessel
- Transmitted power relative to carrier = -0.52 dB

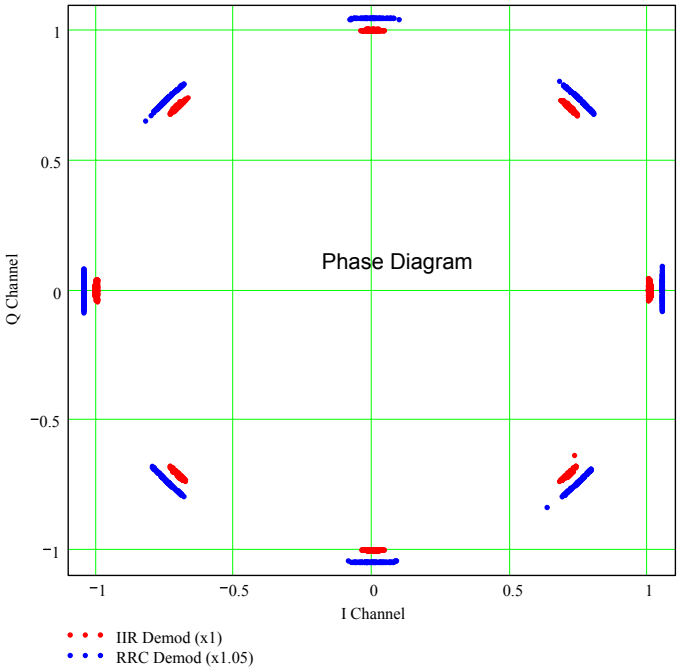
SRRC vs. IIR High Es/N0 Recovered Signal





RRC Demod Filter

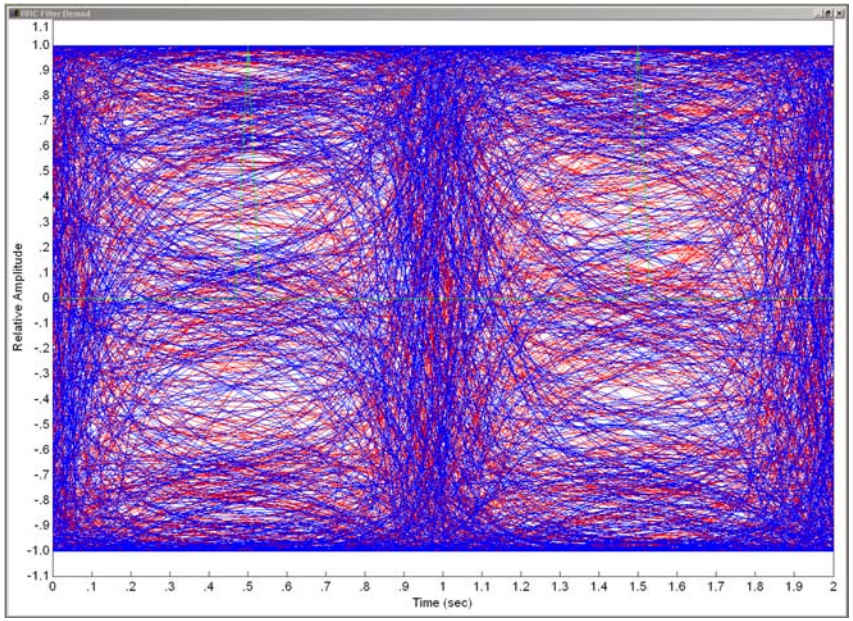
- ❖ Baseband Filter – RRC alpha = 1, 129 Taps
- ❖ RMS Phase Error = 2.26 degrees



IIR Demod Filter

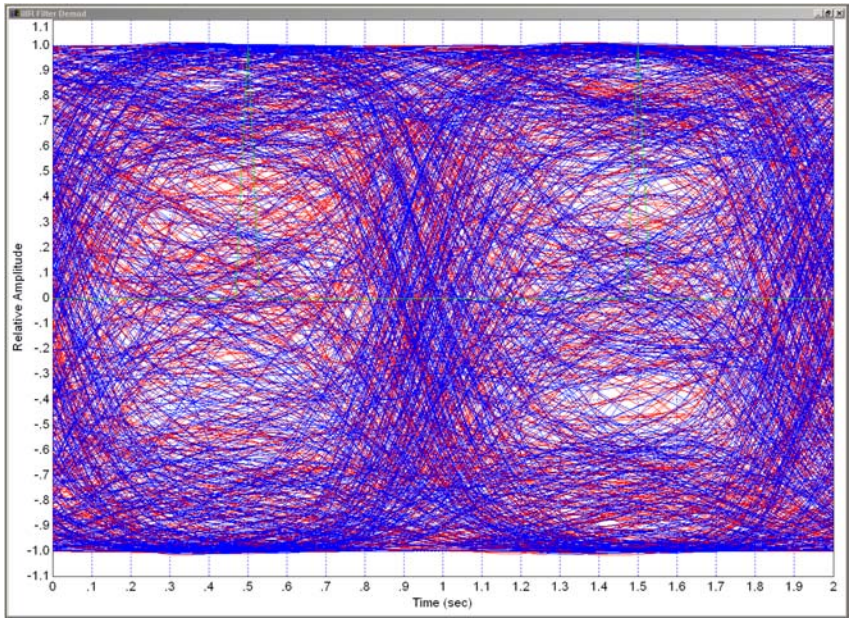
- ❖ Baseband Filter – IIR 200 Hz Noise Bandwidth
- ❖RMS Phase Error = 1.19 degrees

SRRC vs. IIR High 10 dB Es/N0 Recovered Signal



RRC Demod Filter

- Phase Noise = 11.3 degrees



IIR Demod Filter

- Phase Noise = 11.5 degrees

Summary

- Existing Demods can be configured for either approach.
- System performance is comparable at 10 dB Es/N0
  - RRC requires 1.2 dB more transmitter power.
  - IIR filter requires 1.2 dB greater receiver noise bandwidth.
- The two approaches are not compatible on the same channel without system change:
  - Either separate channels must be assigned, or
  - Bi-phase header must identify transmitter type to allow demod mode to change.
- The RRC advantage is reduced transmitter bandwidth, but sacrifices transmitter power.
- Out-of-band spectrum of present system is compatible with 750 Hz channel spacing for 300 BPS, and allows 2.25 KHz spacing for 1200 BPS.*

* ±100 Hz Uncertainty