Addendum 1

Additional noise reduction techniques for the Interpolated modes using pulse train standing waves i.e. the I3 modes.

Inventor and Author: Lawrence Byng
Original Publication Date: Sept 6th 2025

Document Version: 1.0

Using the LB28 base modes as a benchmark, the I3 modes require some additional steps to achieve a similar level of noise resilience i.e. the Bit Error Rate at low levels of Eb/N0.

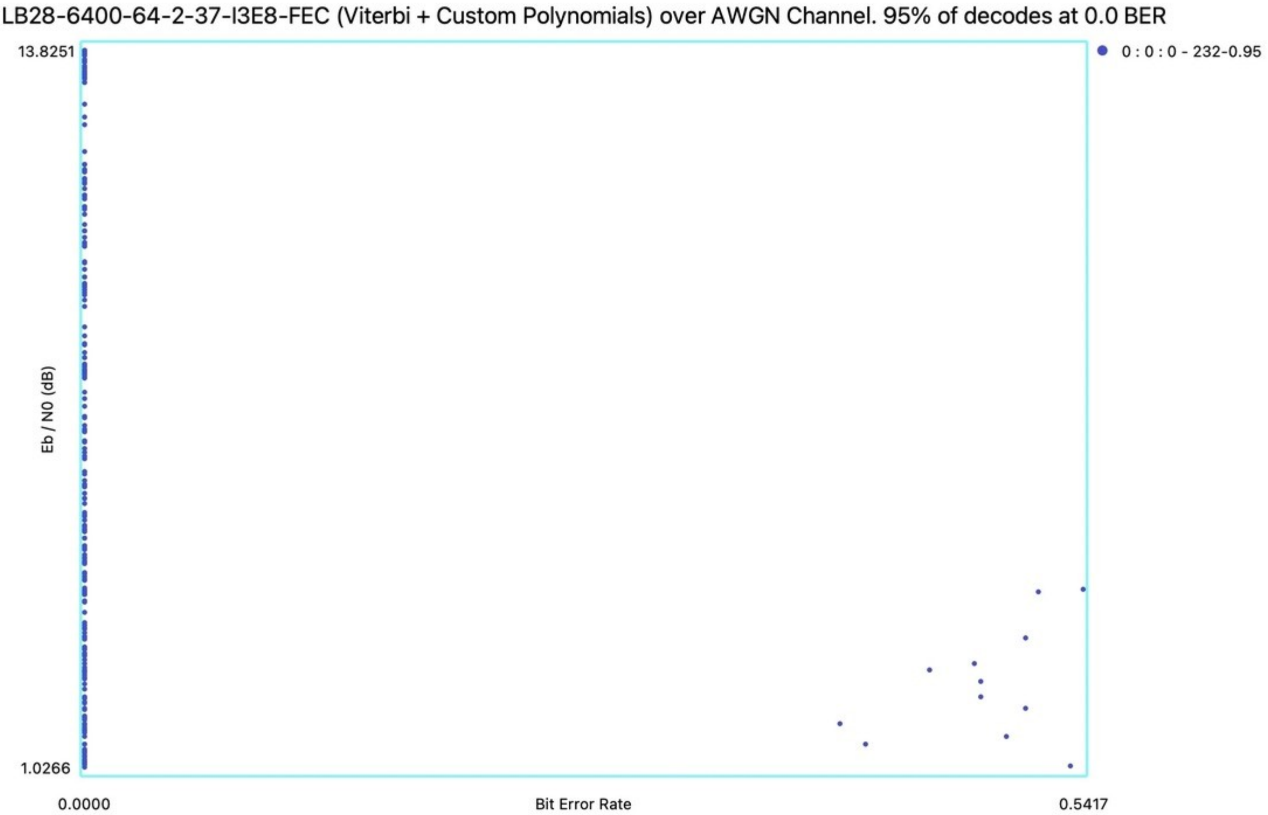
During prototype development of the I3 modes utilizing pulse train standing waves, several additional techniques have been incorporated that significantly enhance noise resilience.

Table of Contents

Forward Error Correction - FEC

Viterbi + Custom Polynomials

The following diagram shows forward error correction in the form of Viterbi decoder using a ½ convolutional encoder with custom generator polynomials and no puncture code. The technique shows a 95% success rate at Eb/N0 above 1.0 to bring the error rate to 0.0 BER for a perfect decode. In the test, 1.0 Eb/N0 is equivalent to a -26.67 SNR level.



Quantized Holographic Photons / Phonons

Utilizing pulse train standing waves for phase extraction requires a signal generated by the interposed three phase signal generator as detailed in the earlier published LB28 design document.

The signal generated by this process is analogous to a time-scale hologram and can be thought of in similar terms to that of a photon or phonon...i.e. a packet of light or sound quantized by the number of pulses in the packet; depending on weather the transmission utilizes electromagnetic waves or sound waves, the process is somewhat similar. For electromagnetic waves, the signal creates a quantized time-scale photon hologram and for sound waves it creates a quantized time-scale phonon hologram.

The hologram has two degrees of freedom; time and scale. These translate to the disposition i.e. the start of the decoding process relative to the signal start representing time and the number of pulses utilized in the pulse train for a specific decode representing scale.

The hologram can be processed from multiple perspectives. The number of permutations / perspectives is derived from the triangular number for the given mode. For example a mode with 64 pulses per block, i.e. 32 pulses per 3 bit sequence has T_{32} or 528 permutations. In reality, this number is T_{32} -3 as the pulse train length is truncated to a useable length of pulse train length divisible exactly by 3.

Any of these 525 permutations can be used to make a decode. The more accurate decodes are from signals that contain the highest number of pulses.

A technique can be applied that takes the received bit sequence from several samples of the quantized time-scale hologram and then aggregates these into a single bit sequence and sends this to the Viterbi decoder for final processing.