Pulse compression comparison in Q-DAS systems: Ternary codes vs. Binary codes

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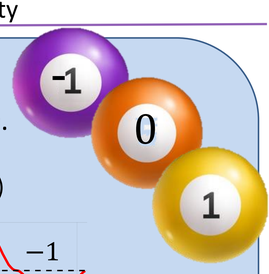
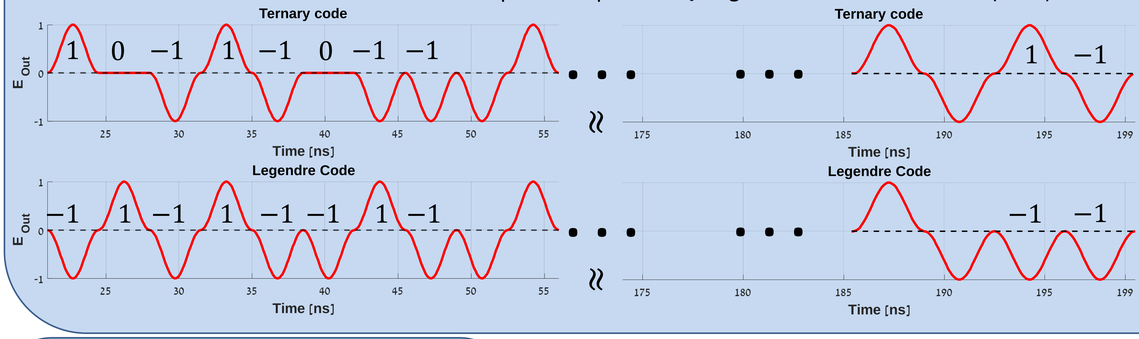
The challenge



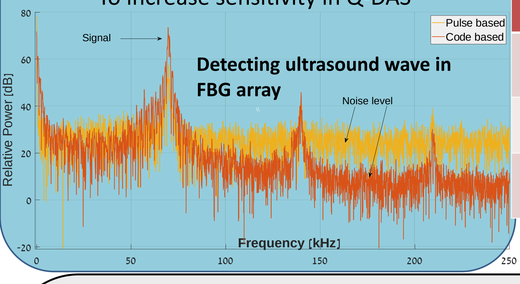
Given a set of only three numbers : {-1, 0,+1}
find a sequence, for pulse compression, that will perform best for a Quasi-DAS system.

Transmit as much power as possible + High Peak to SideLobe Ratio (PSLR)



Why do we need pulse compression?

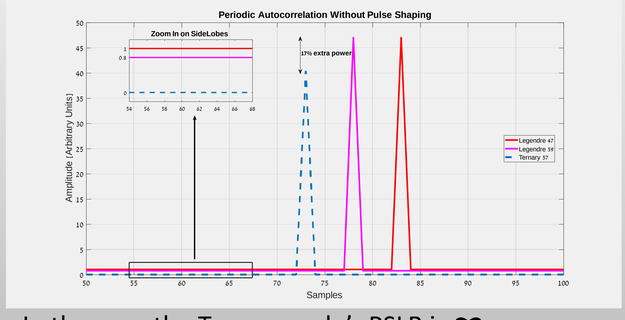
To increase sensitivity in Q-DAS

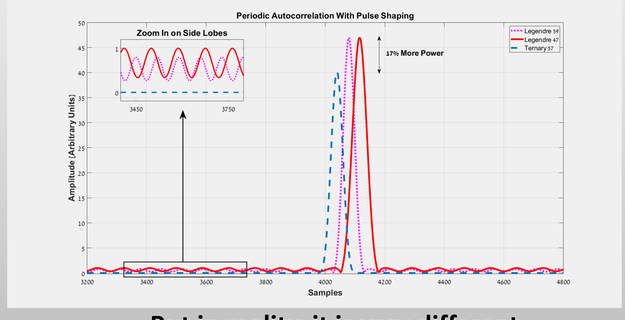


same P_{in}	Binary PPA	Ternary PPA
T_{code}	Shorter	Longer
$PSLR$	👎	✓

same T_{code}	Binary PPA	Ternary PPA
P_{in}	Higher	Lower
$PSLR$	👎	✓

Simulation

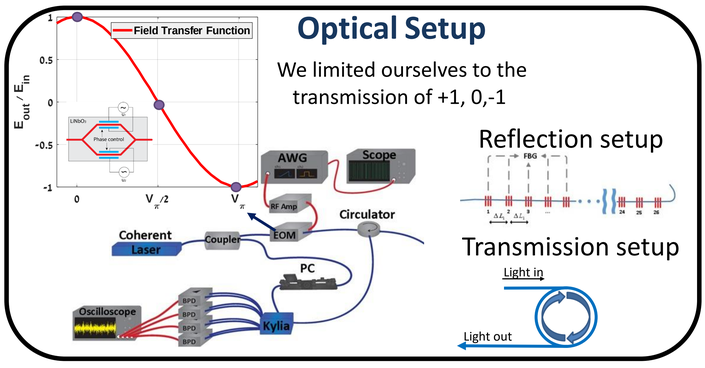




In theory – the Ternary code's PSLR is ∞,
regardless of the number of reflectors in the array.

But in reality, it is very different

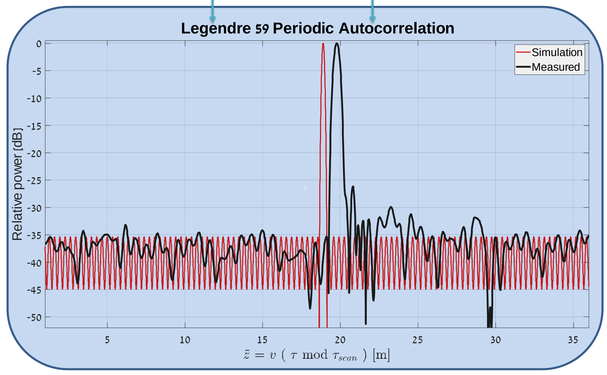
Optical Setup



We limited ourselves to the transmission of +1, 0,-1

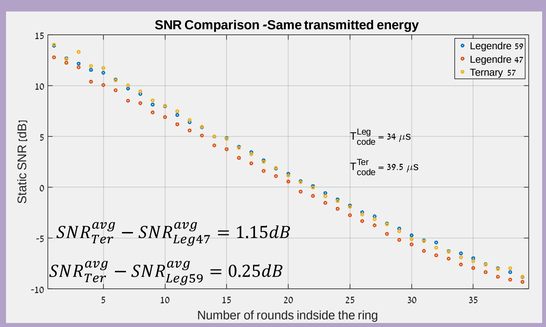
Reflection setup

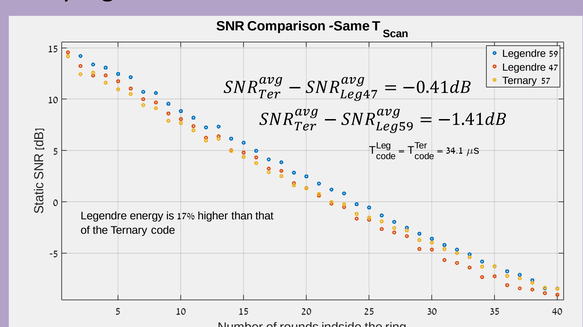
Transmission setup



Results

Transmission mode – no Rayleigh noise





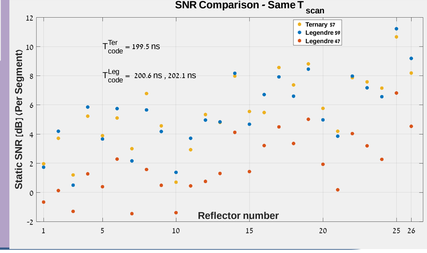
For a Q-DAS system that its SNR is limited by the code's sidelobes – The Ternary code should define the SNR upper bound.

The ternary code is preferred over the binary code whenever:

- A decrease of scan rate is tolerable (Transmitting the same energy)
- The number of reflectors is large

Reflection mode –Rayleigh adds to sidelobes

$SNR^{avg}_{Ter} - SNR^{avg}_{Leg47} = 3.82dB$
$SNR^{avg}_{Ter} - SNR^{avg}_{Leg59} \approx 0dB$



Funding

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