Telecom. Video Compression

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Pulse Code Modulation

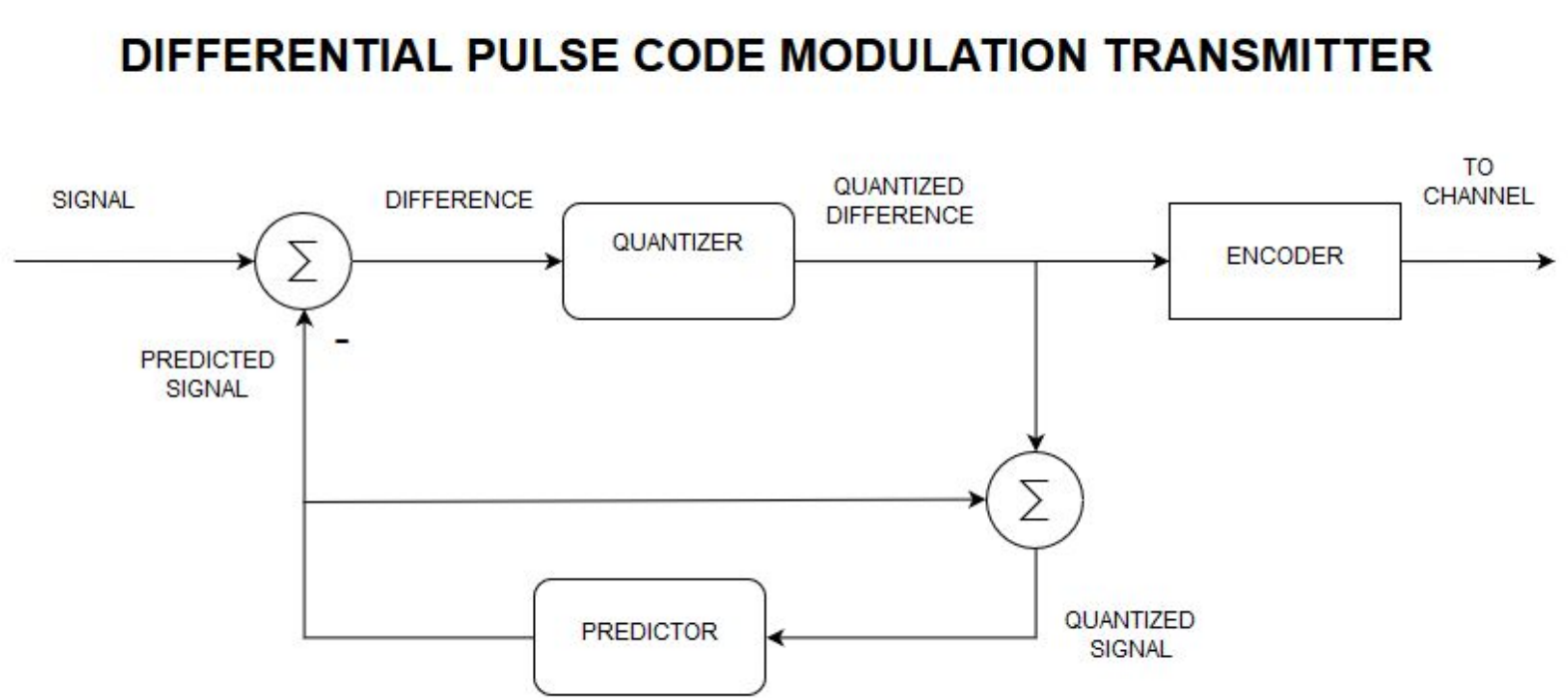
- Video sampled and discretized already to 8 bits/pixel
- Uniform quantization to reduce bandwidth
- Variations of PCM

Sample Video & Quantized Video

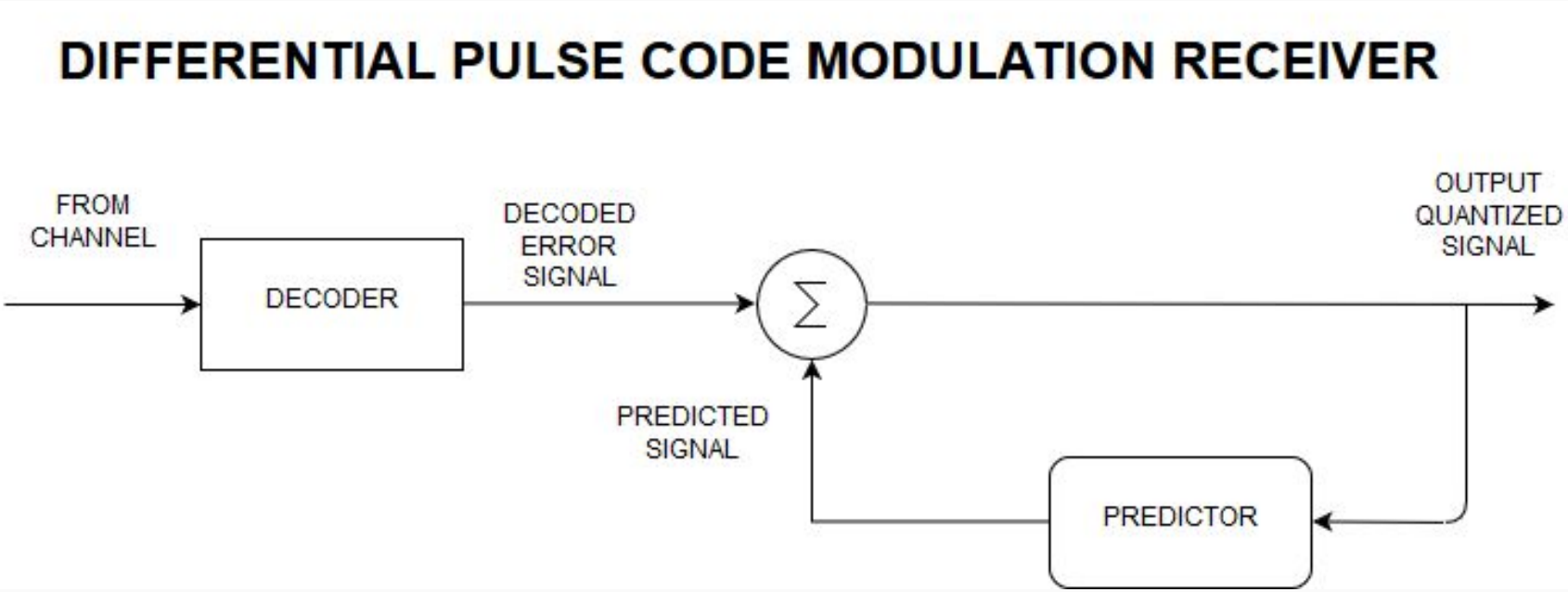
Differential PCM

- Uses PCM as baseline but transmit “differences”
- Build predictor model that exploits correlation between adjacent samples
- Higher order works best up to a limit
- Low values take less bits to transmit

DPCM Transmitter

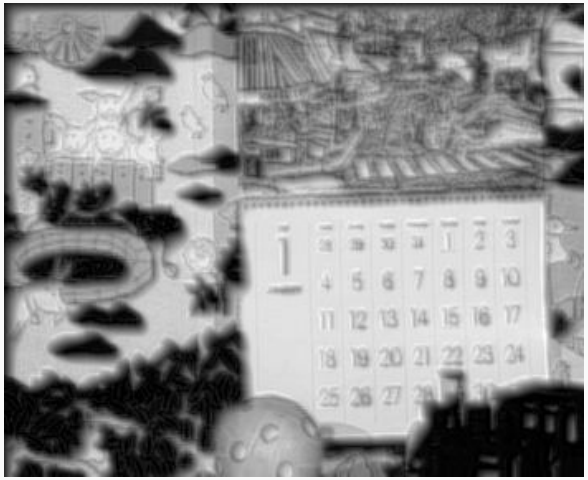


DPCM Receiver



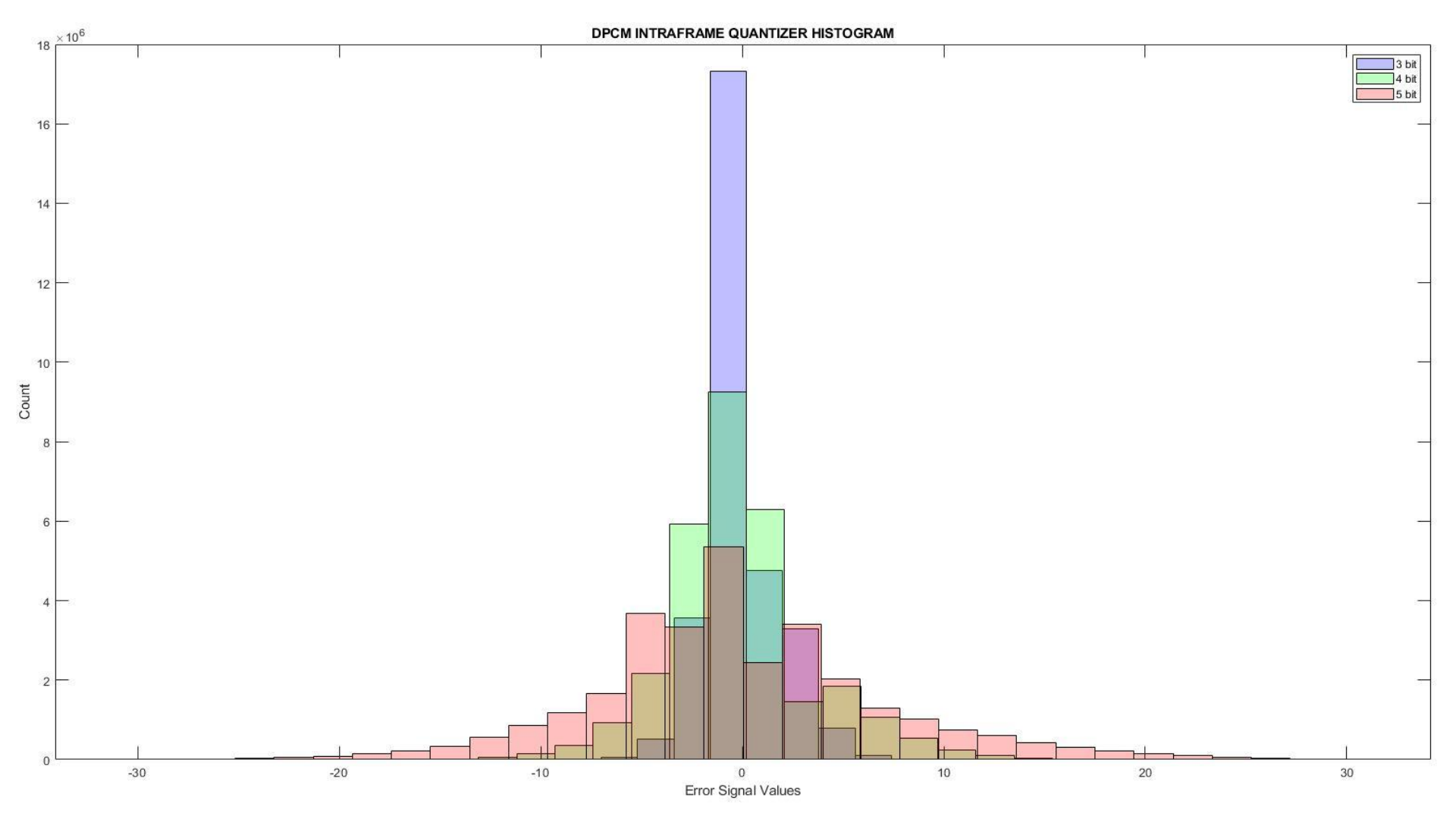
DPCM Receiver Results

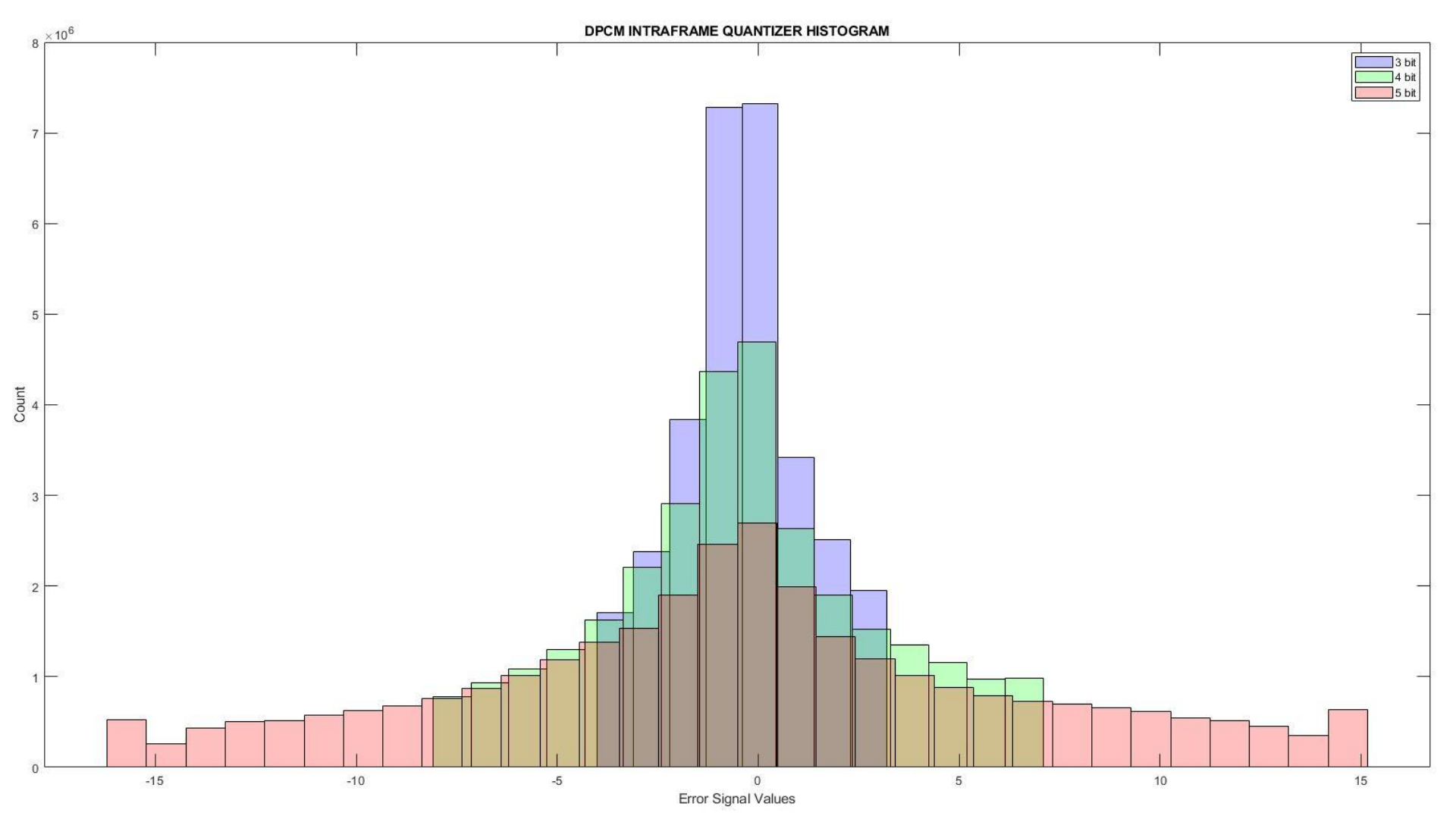
3-Bit Quantizer

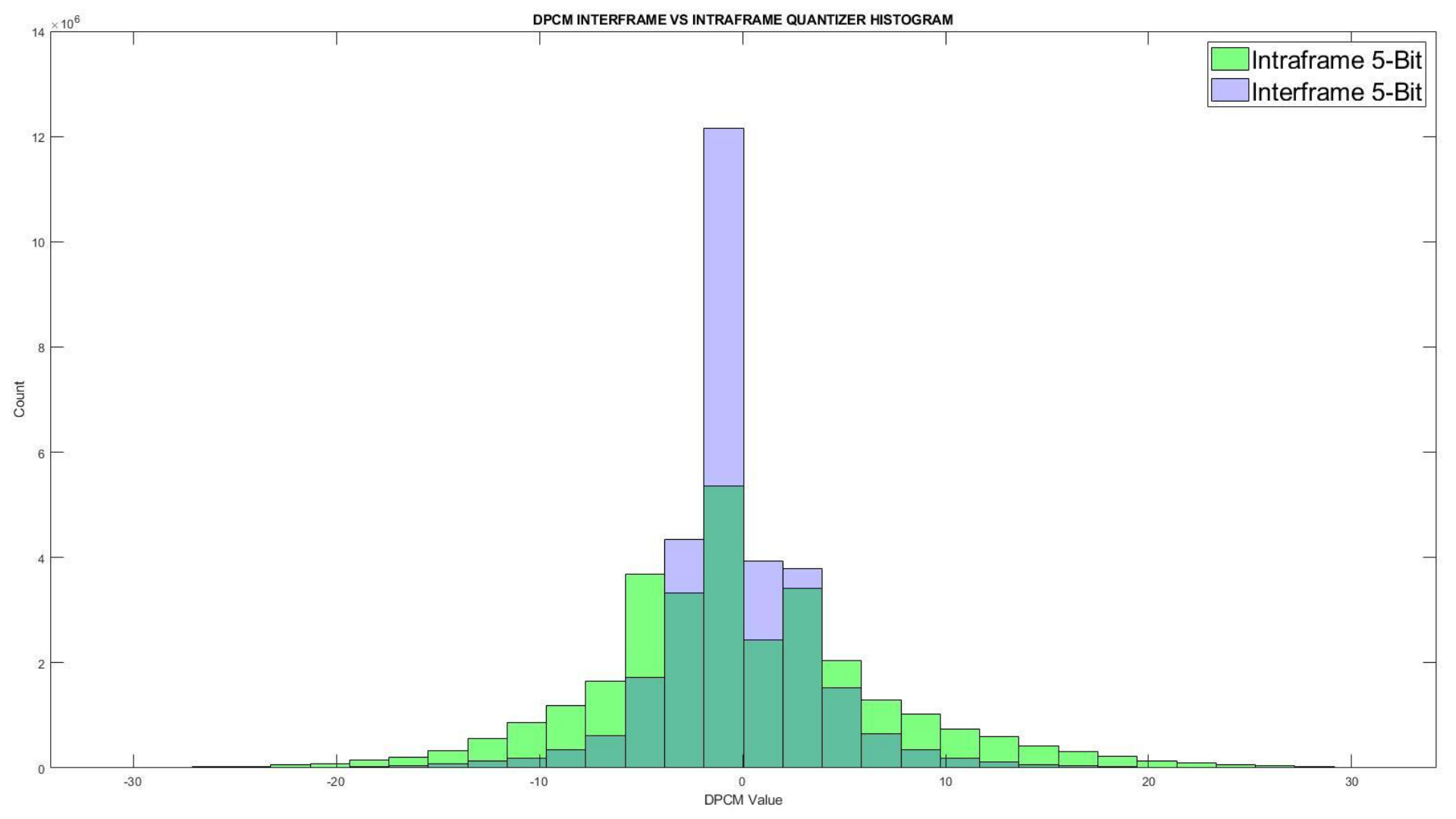


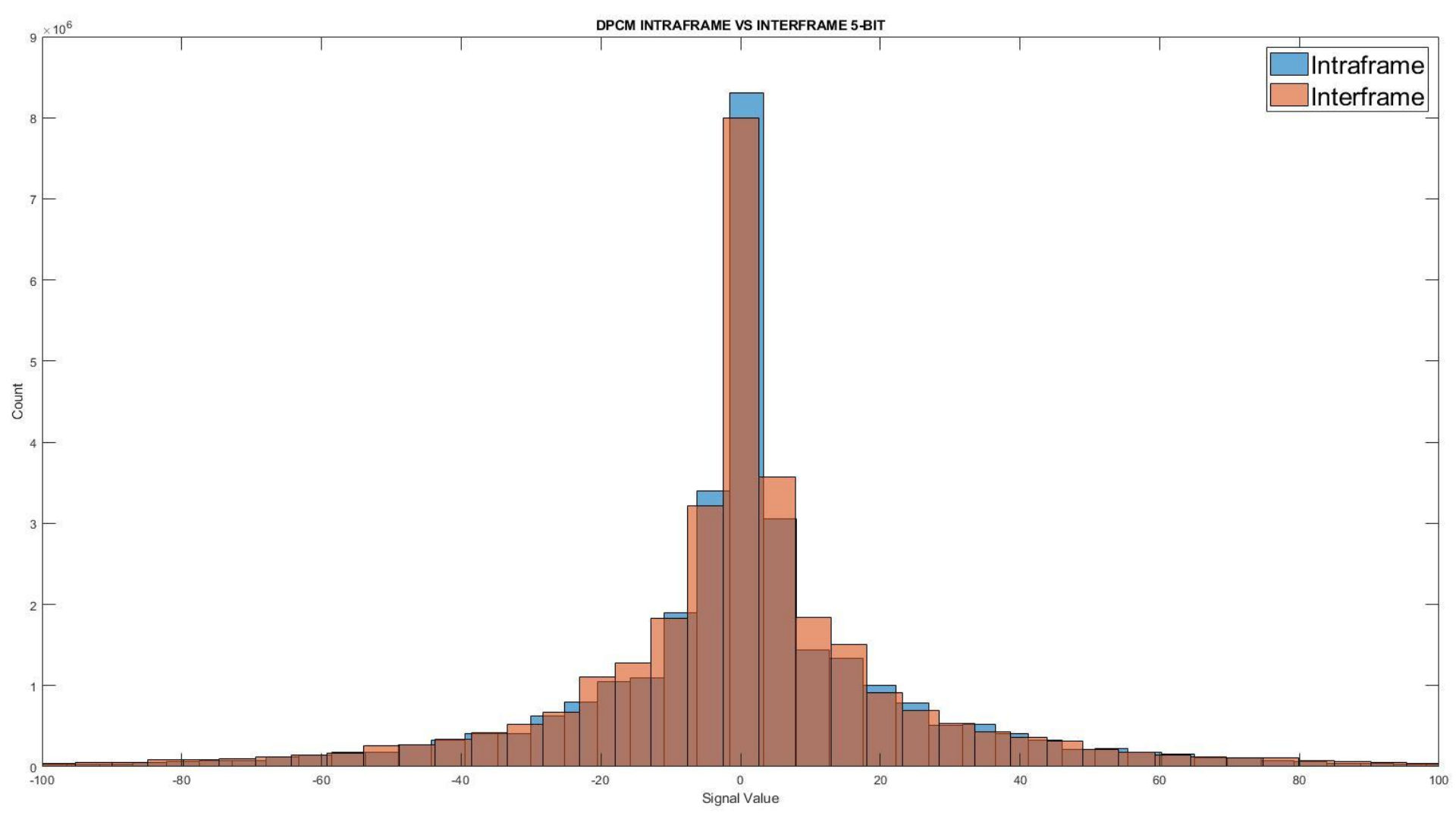
4-Bit Quantizer

5-Bit Quantizer

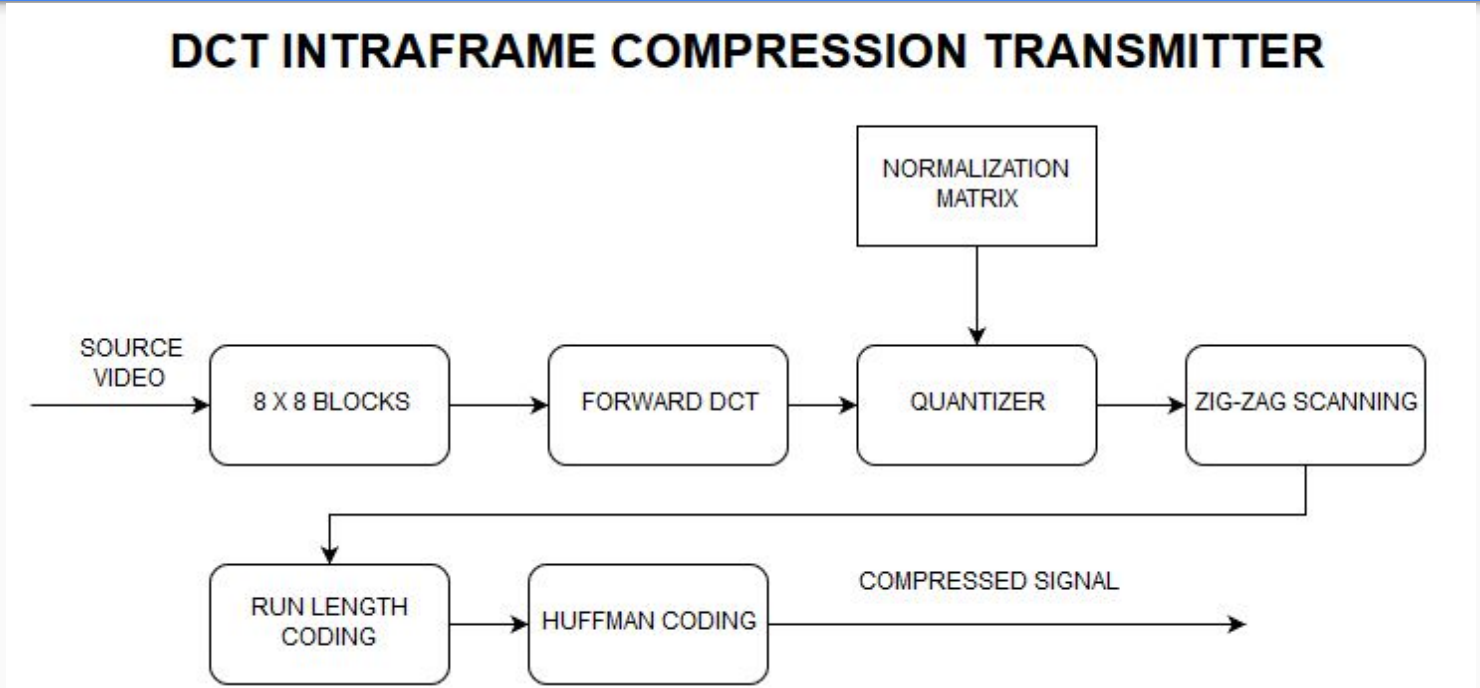

DPCM INTRAFRAME QUANTIZER HISTOGRAM
×10^6
18
16
14
12
10
8
6
4
2
0
Count
-30
-20
-10
0
10
20
30
Error Signal Values
3 bit
4 bit
5 bit


DPCM INTRAFRAME QUANTIZER HISTOGRAM
×10^6
8
7
6
5
4
3
2
1
0
Count
-15
-10
-5
0
5
10
15
Error Signal Values
3 bit
4 bit
5 bit

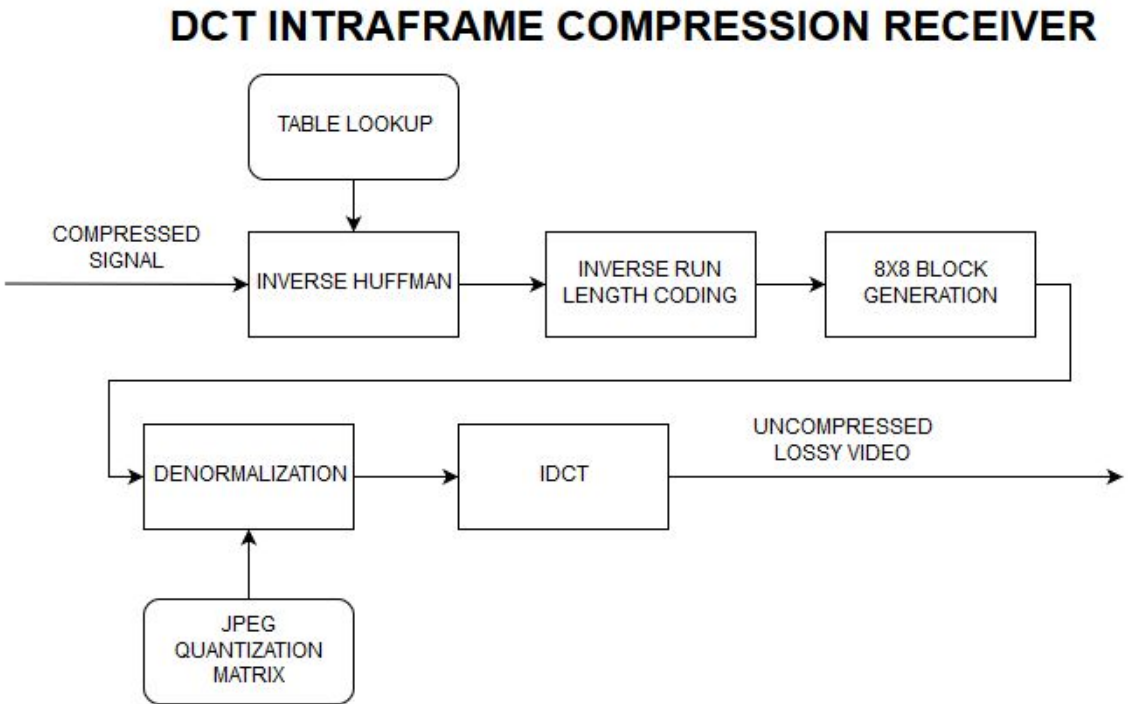

DPCM INTERFRAME VS INTRAFRAME QUANTIZER HISTOGRAM
×10^6
14
12
10
8
6
4
2
0
Count
-30
-20
-10
0
10
20
30
DPCM Value
Intraframe 5-Bit
Interframe 5-Bit


DPCM INTRAFRAME VS INTERFRAME 5-BIT
×10^6
9
8
7
6
5
4
3
2
1
0
Count
-100
-80
-60
-40
-20
0
20
40
60
80
100
Signal Value
Intraframe
Interframe

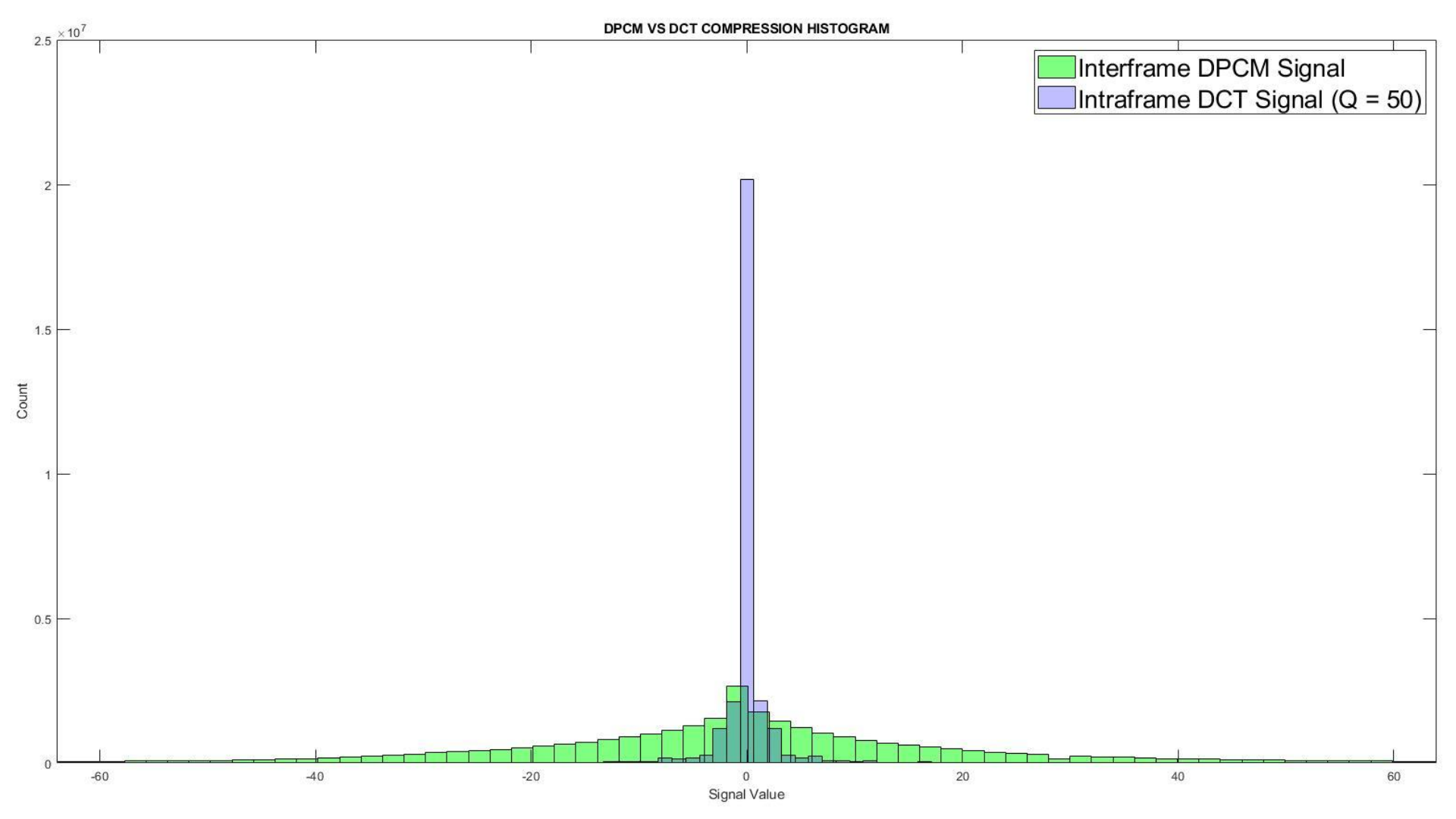
DCT Compression

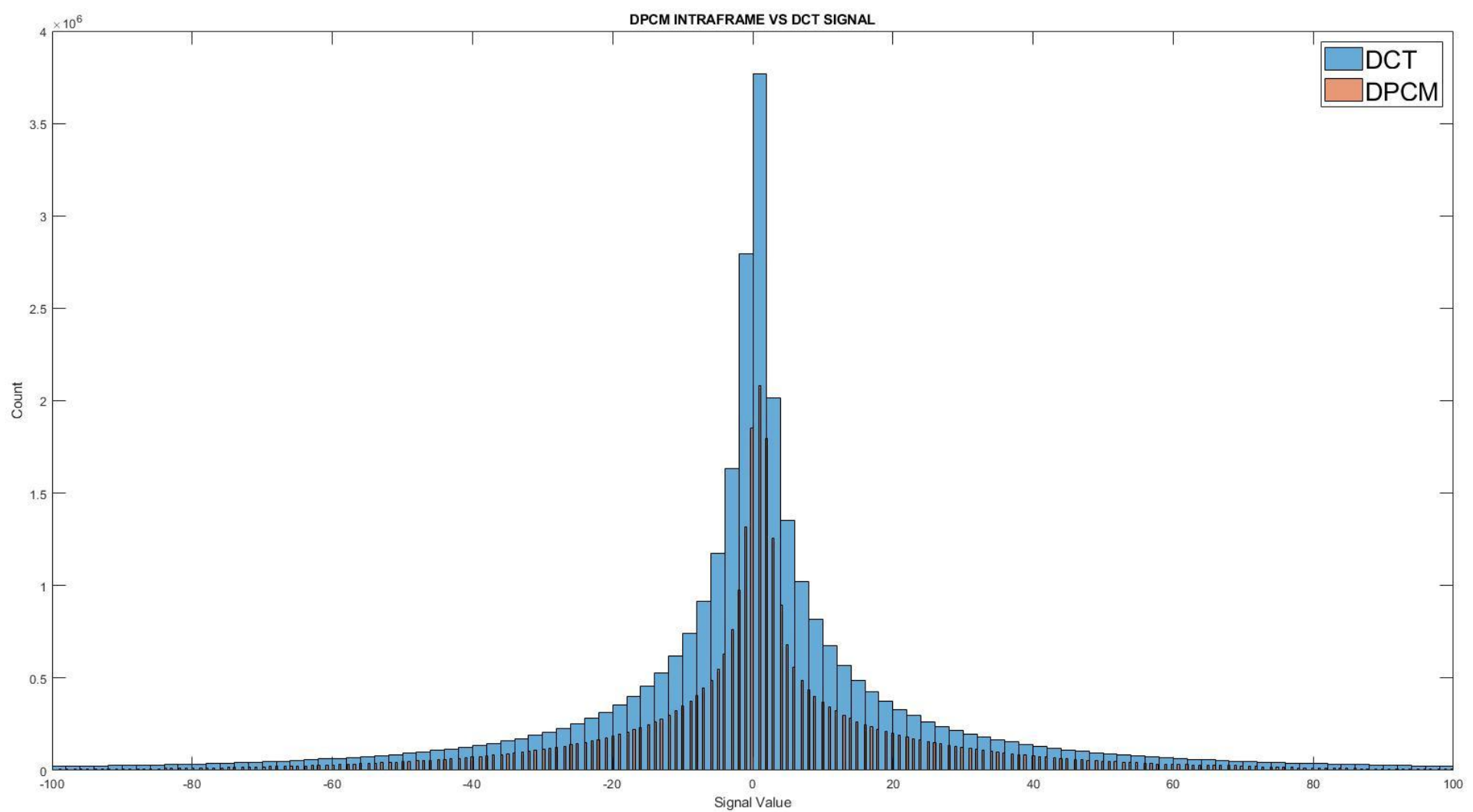


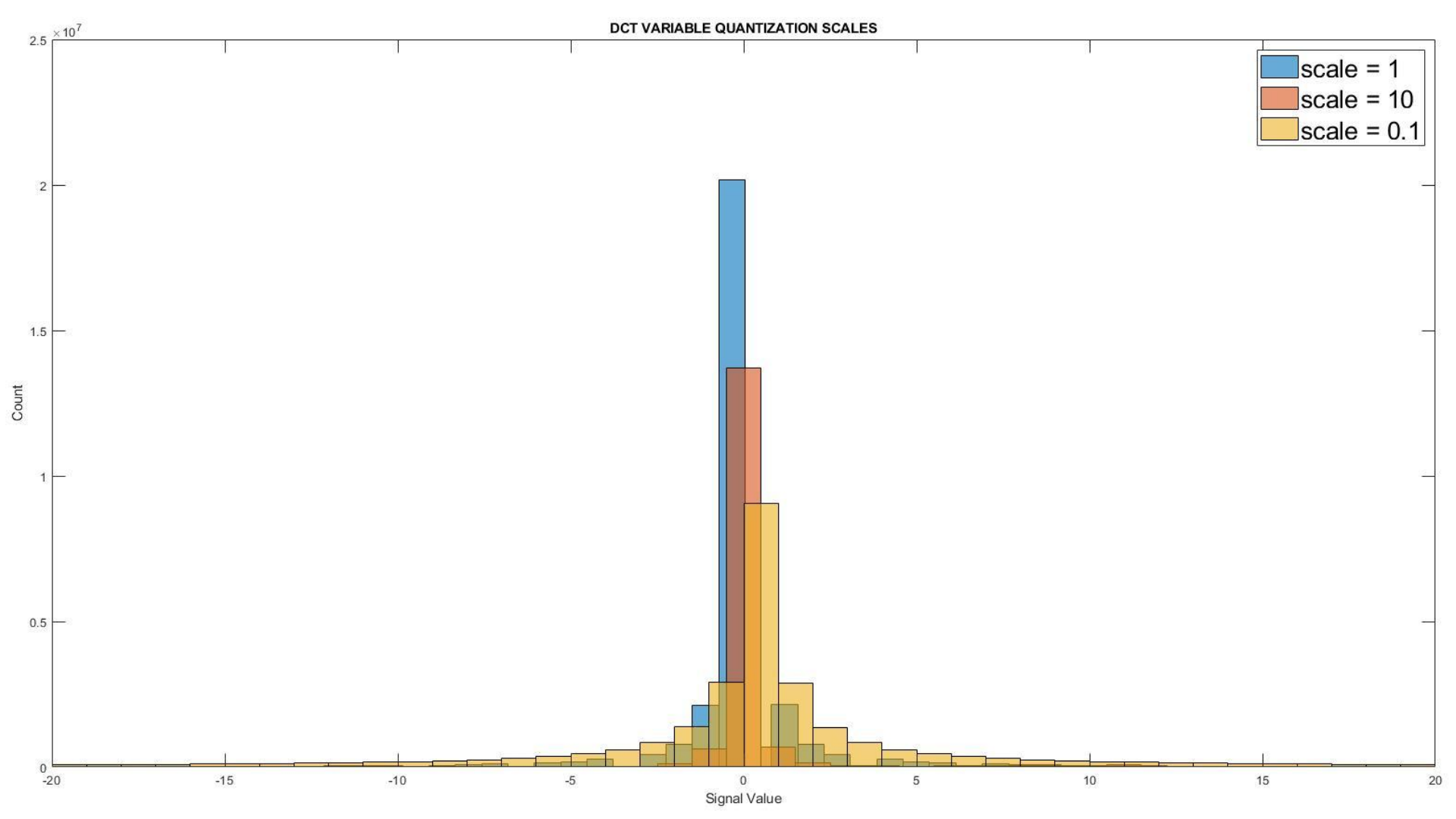
DCT Receiver



16	11	10	16	24	40	51	61
12	12	14	19	26	58	60	55
14	13	16	24	40	57	69	56
14	17	22	29	51	87	80	62
18	22	37	56	68	109	103	77
24	35	55	64	81	104	113	92
49	64	78	87	103	121	120	101
72	92	95	98	112	100	103	99


DPCM VS DCT COMPRESSION HISTOGRAM
×10^7
2.5
2
1.5
1
0.5
0
Count
-60
-40
-20
0
20
40
60
Signal Value
Interframe DPCM Signal
Intraframe DCT Signal (Q = 50)


DPCM INTRAFRAME VS DCT SIGNAL
×10^6
4
3.5
3
2.5
2
1.5
1
0.5
0
Count
-100
-80
-60
-40
-20
0
20
40
60
80
100
Signal Value
DCT
DPCM


DCT VARIABLE QUANTIZATION SCALES
×10^7
2.5
2
1.5
1
0.5
0
Count
-20
-15
-10
-5
0
5
10
15
20
Signal Value
scale = 1
scale = 10
scale = 0.1

DCT Scales

Scale = 0.1

Scale = 1

Scale = 10

4-bit Quantized PCM

4-bit Quantized DPCM Intraframe

4-bit Quantized DPCM Interframe

Variable Quantizer DCT Intraframe

Comparison

Video Compression Results				
Technique	SNR	Avg. Power	Visual Test	Comp. Ratio
PCM 4bit	30.3047	4.90	2	2
DPCM Intra 4bit	10.7383	6.14	3	2
DPCM Inter 4bit	8.7342	6.30	4	2
DCT Intra (Q=50)	24.2994	10.24	1	4.15