Simulação de Esquemas de Modulação Digital

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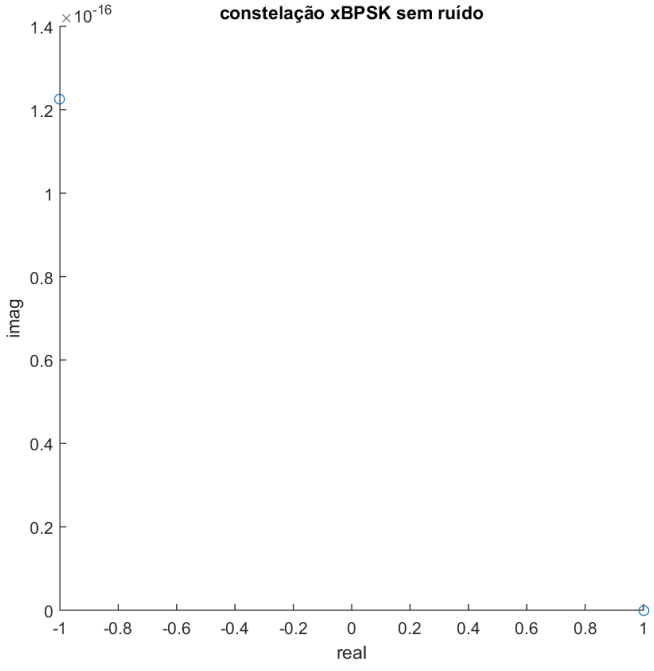
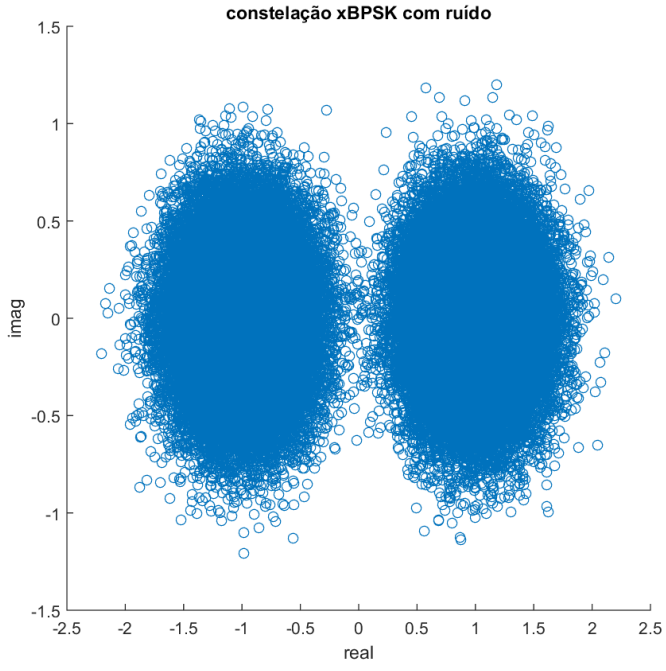
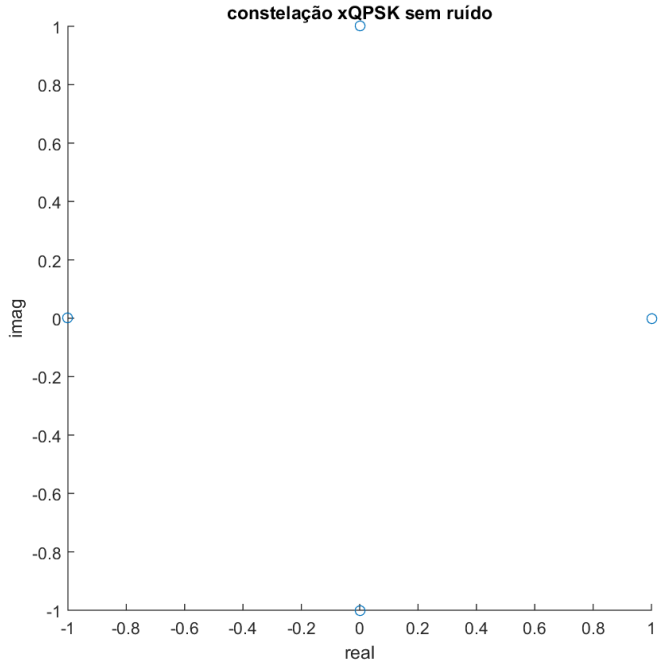
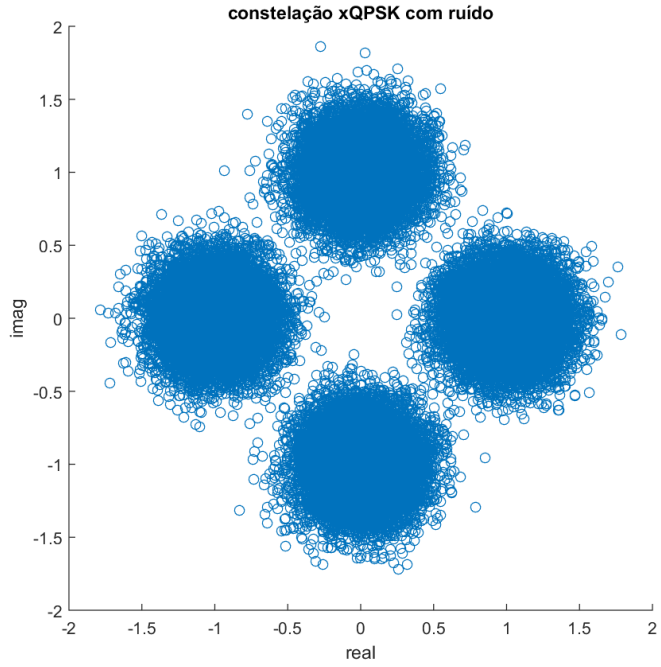
BPSK


constelação xBPSK sem ruído
×10^-16
1.4
1.2
1
0.8
0.6
0.4
0.2
0
imag
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
real

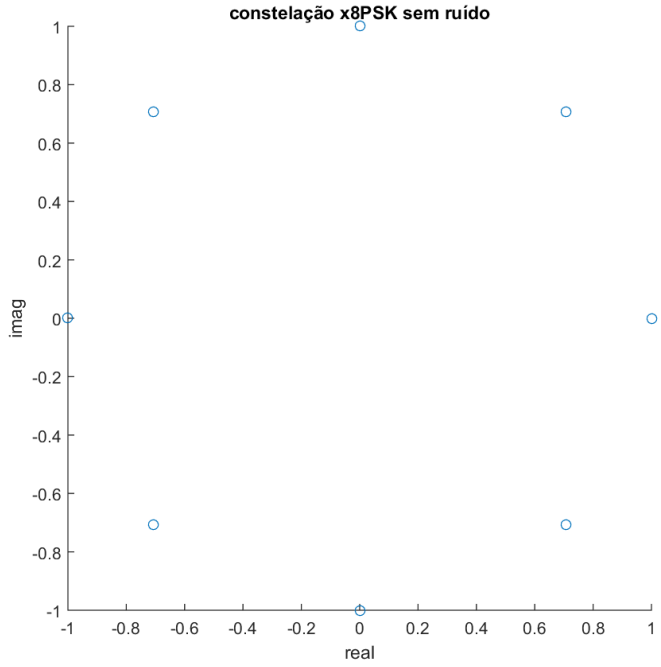

constelação xBPSK com ruído
1.5
1
0.5
0
-0.5
-1
-1.5
imag
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
real

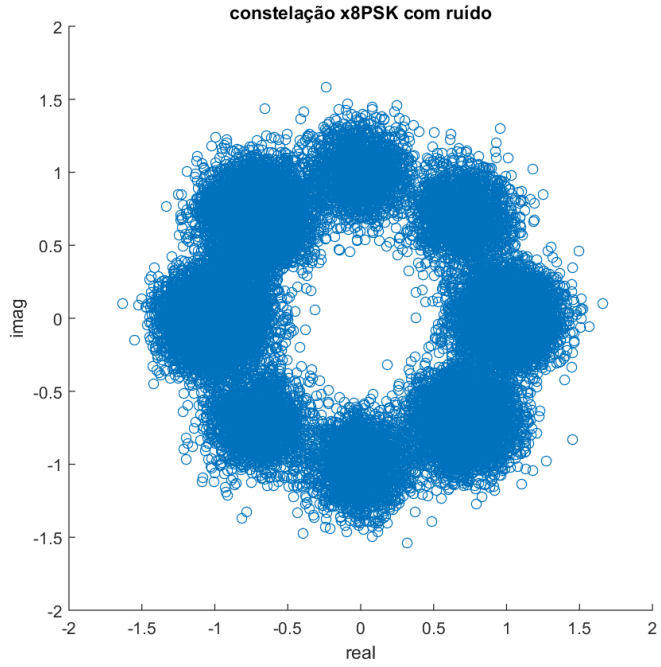
QPSK


constelação xQPSK sem ruído
imag
real
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

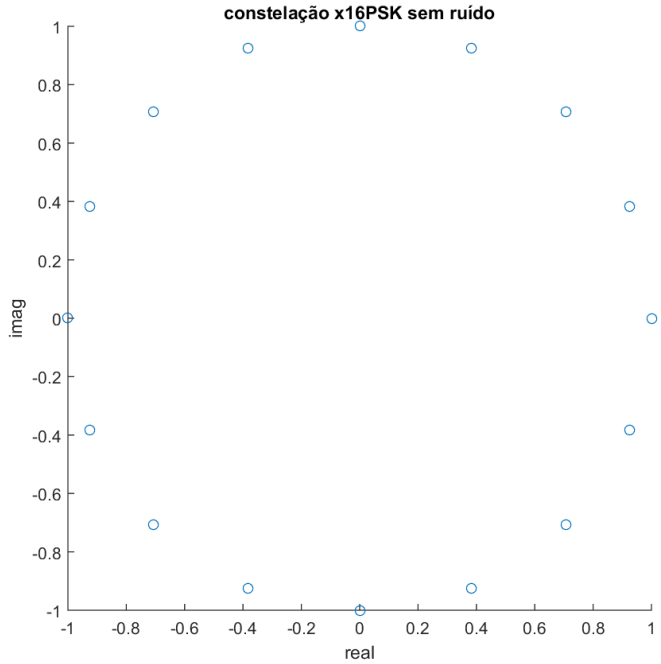

constelação xQPSK com ruído
imag
real
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

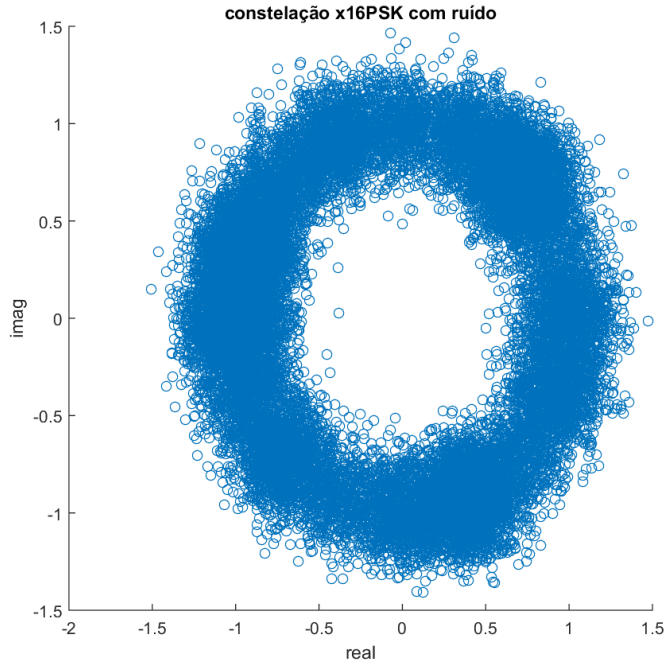
PSK 8


constelação x8PSK sem ruído
imag
real
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

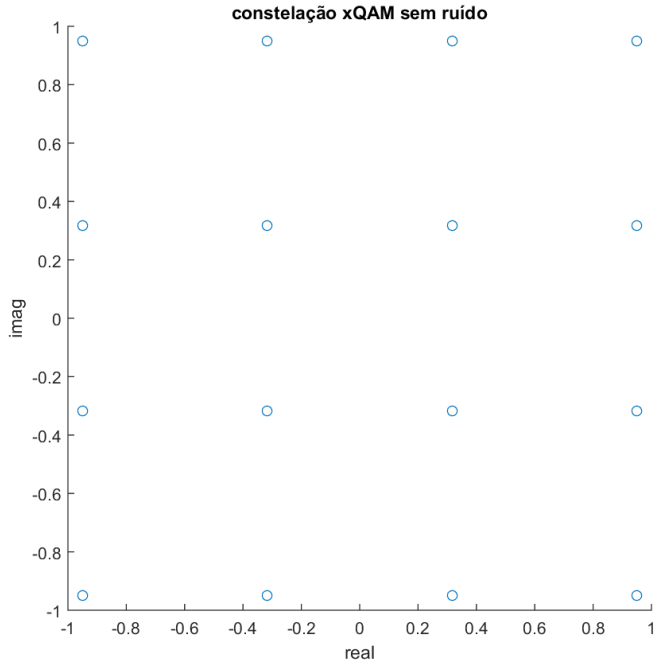

constelação x8PSK com ruído
imag
real
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

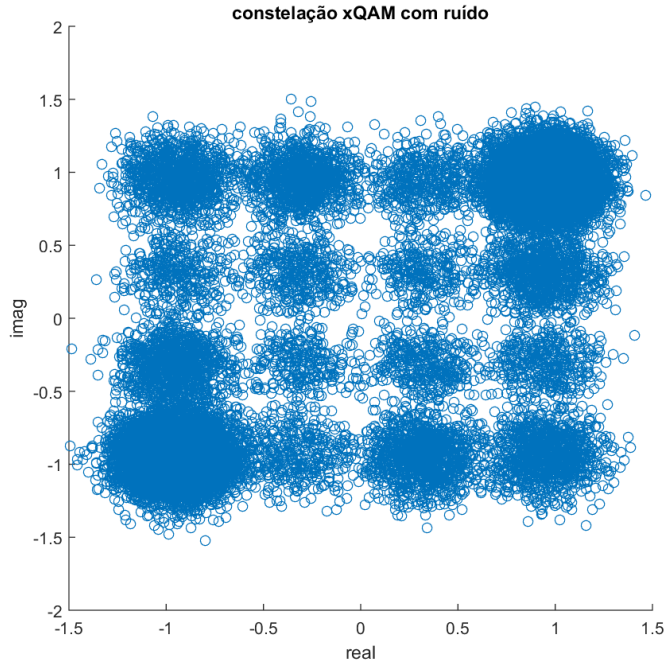
PSK 16


constelação x16PSK sem ruído
imag
real
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1


constelação x16PSK com ruído
imag
real
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5

QAM


constelação xQAM sem ruído
imag
real
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1


constelação xQAM com ruído
imag
real
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5

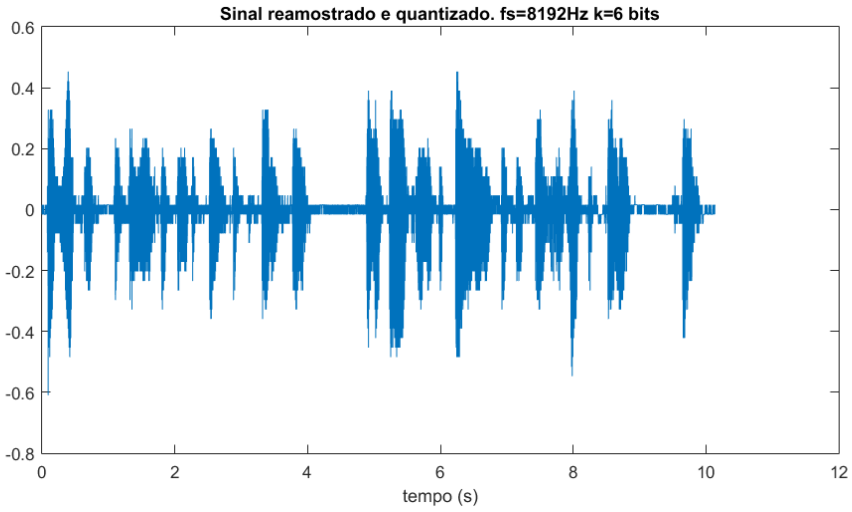
Taxa de erro de bits

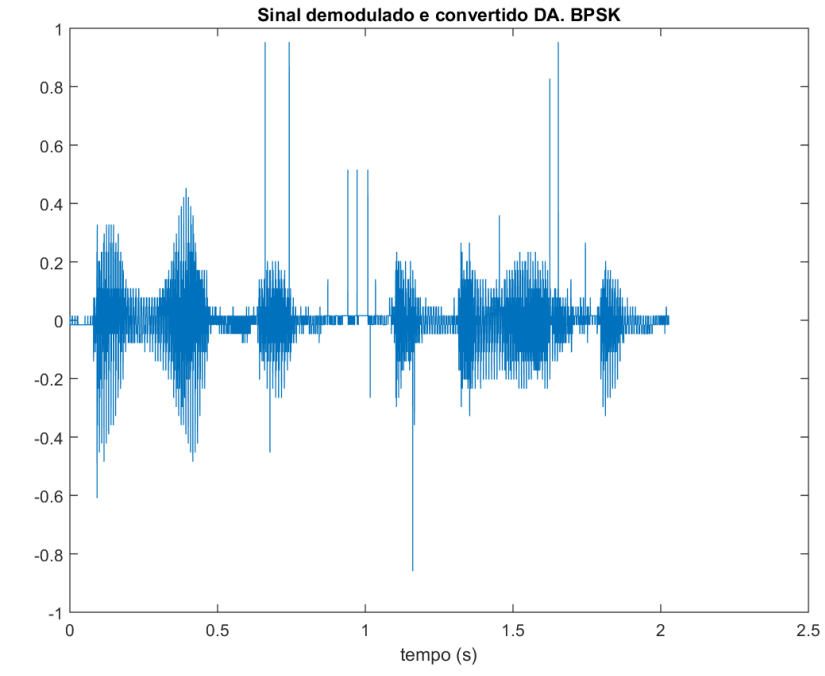
BER BPSK = 2.4085e-04
BER QPSK = 1.9067e-04
BER 8PSK = 0.0122
BER 16PSK = 0.0808
BER QAM = 0.0379

Largura de banda

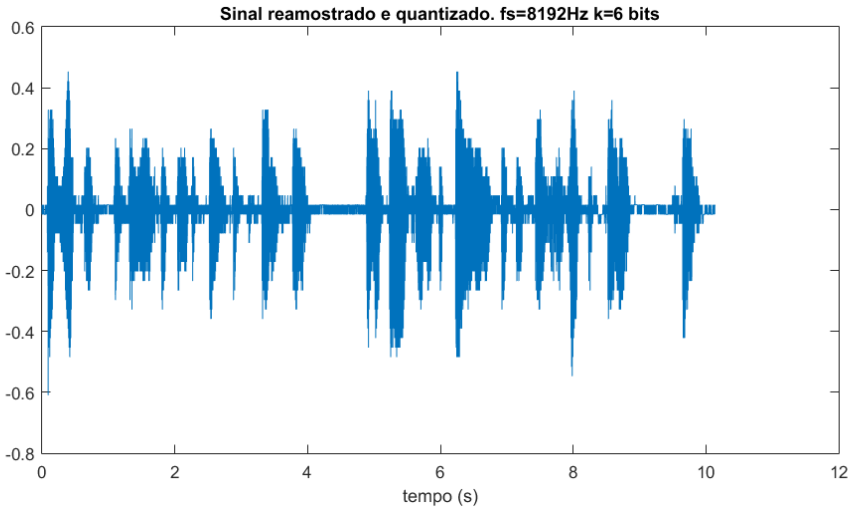
BPSK = 49152 Hz
BER QPSK = 24576 Hz
BER 8PSK = 16384 Hz
BER 16PSK = 12288 Hz
BER QAM = 12288 Hz

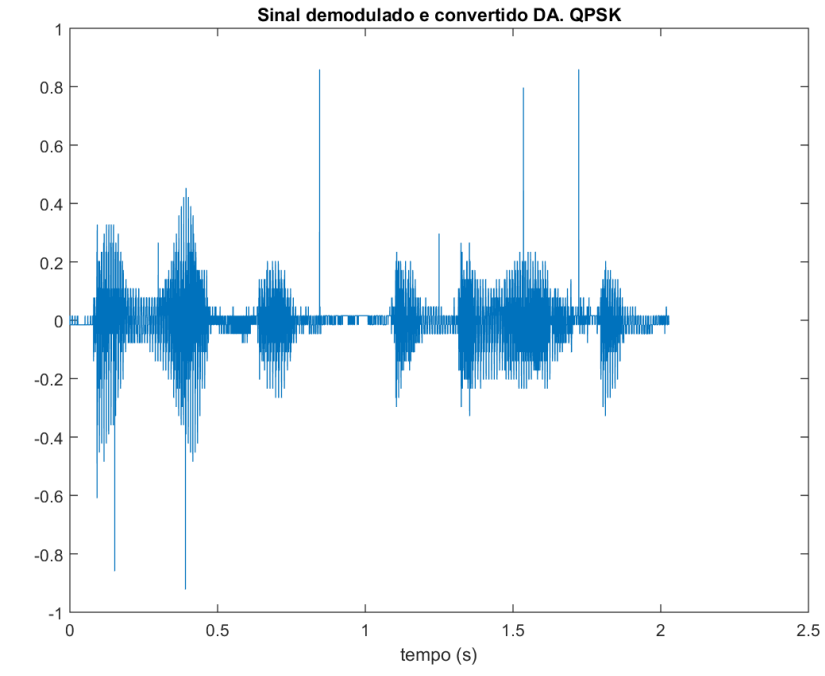
BPSK


Sinal reamostrado e quantizado. fs=8192Hz k=6 bits
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
tempo (s)

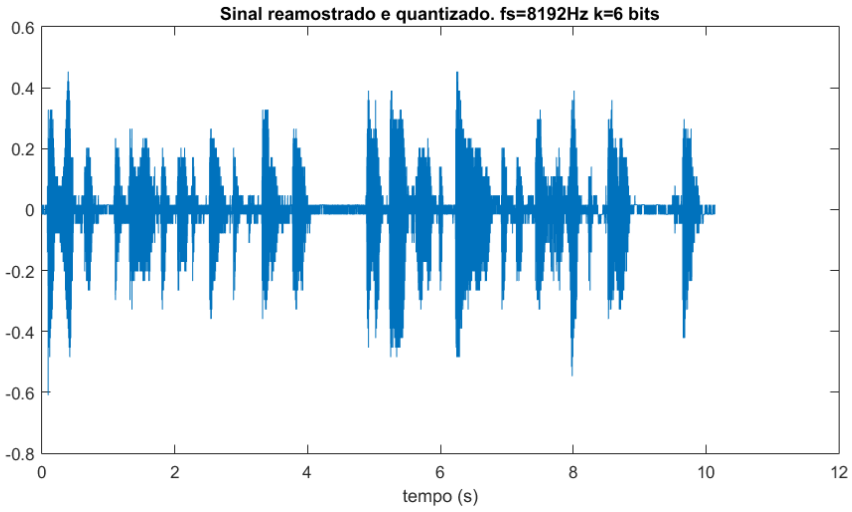

Sinal demodulado e convertido DA. BPSK
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
tempo (s)

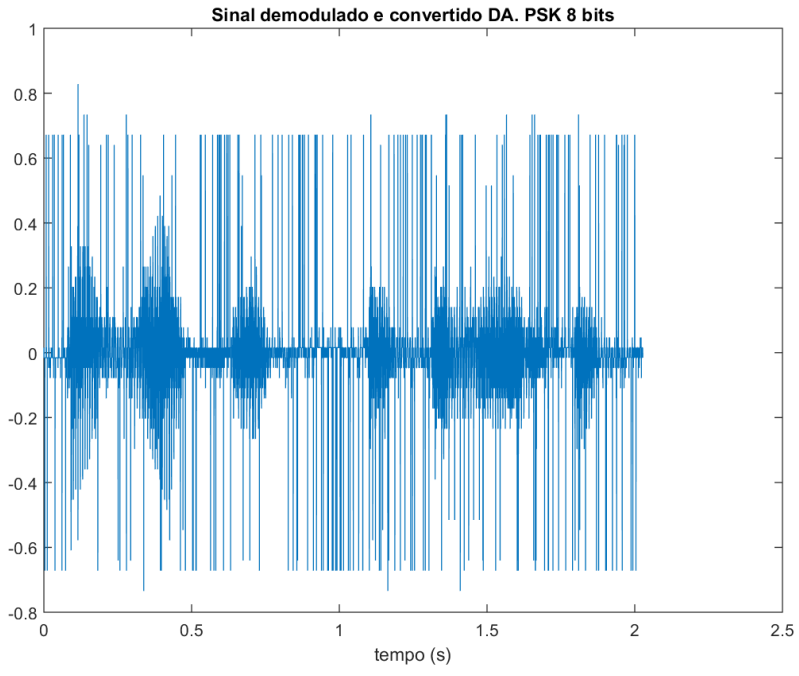
QPSK


Sinal reamostrado e quantizado. fs=8192Hz k=6 bits
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
tempo (s)

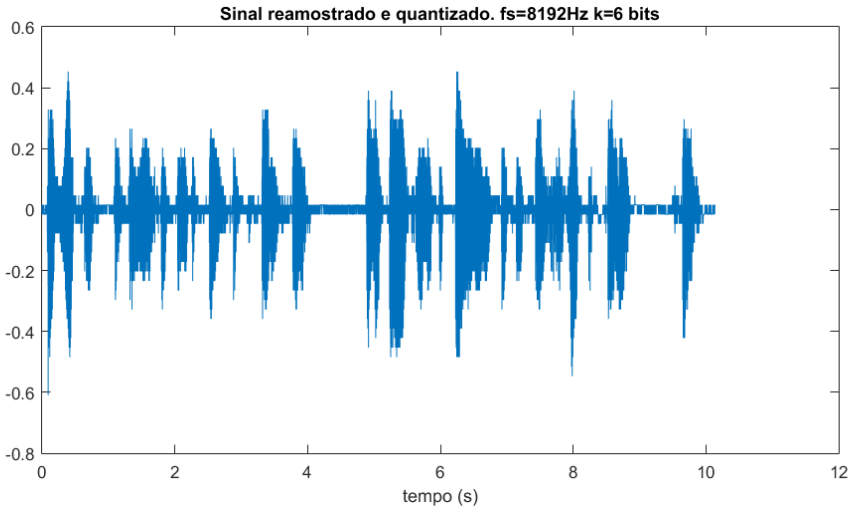

Sinal demodulado e convertido DA. QPSK
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
tempo (s)

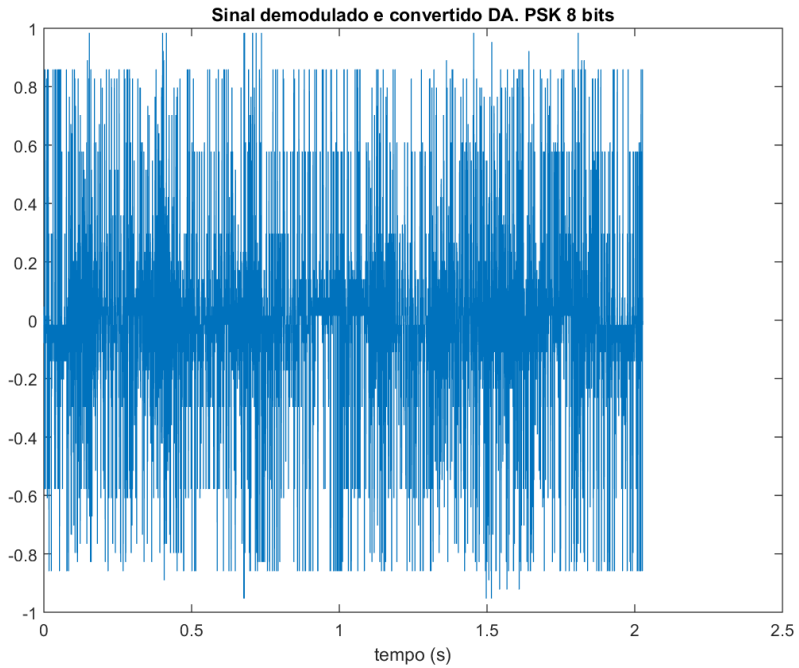
8PSK


Sinal reamostrado e quantizado. fs=8192Hz k=6 bits
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
tempo (s)

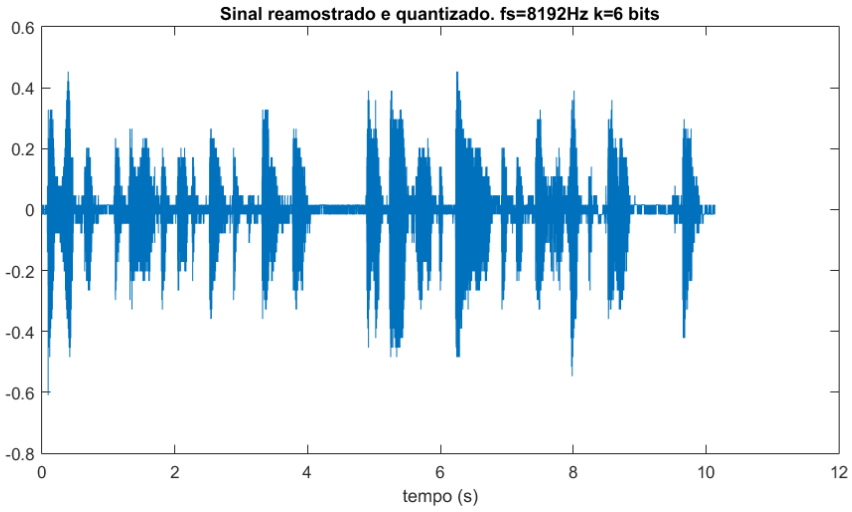

Sinal demodulado e convertido DA. PSK 8 bits
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
tempo (s)

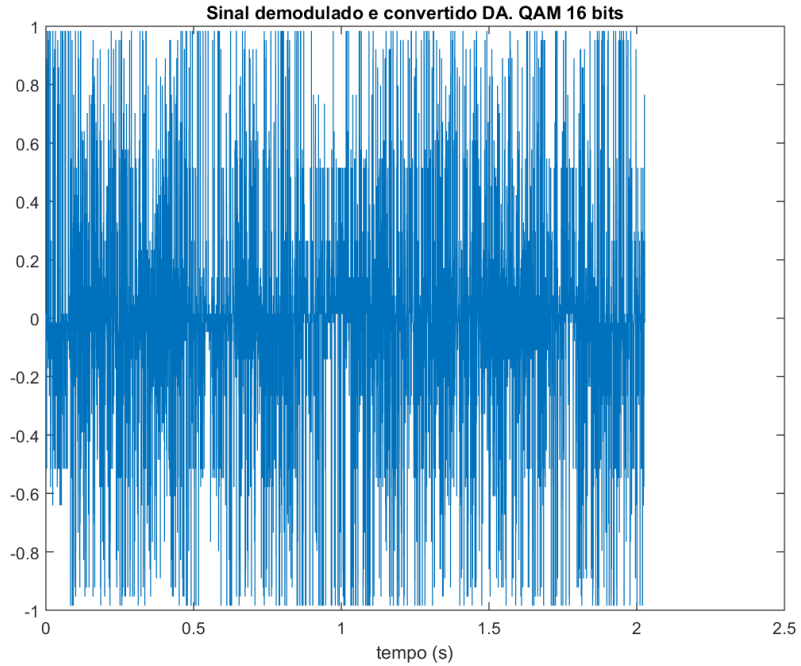
16PSK


Sinal reamostrado e quantizado. fs=8192Hz k=6 bits
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
tempo (s)


Sinal demodulado e convertido DA. PSK 8 bits
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
tempo (s)

QAM


Sinal reamostrado e quantizado. fs=8192Hz k=6 bits
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
tempo (s)


Sinal demodulado e convertido DA. QAM 16 bits
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
tempo (s)

Qualidade de áudio

1. BPSK (quase igual ao original)
2. QAM 16 bits (Melhor custo/benefício)
3. QPSK
4. PSK 8
5. PSK 16