

Sistemas de Comunicações I

Eng. de Telecomunicações

Aula – PCM

Formatação do sinal

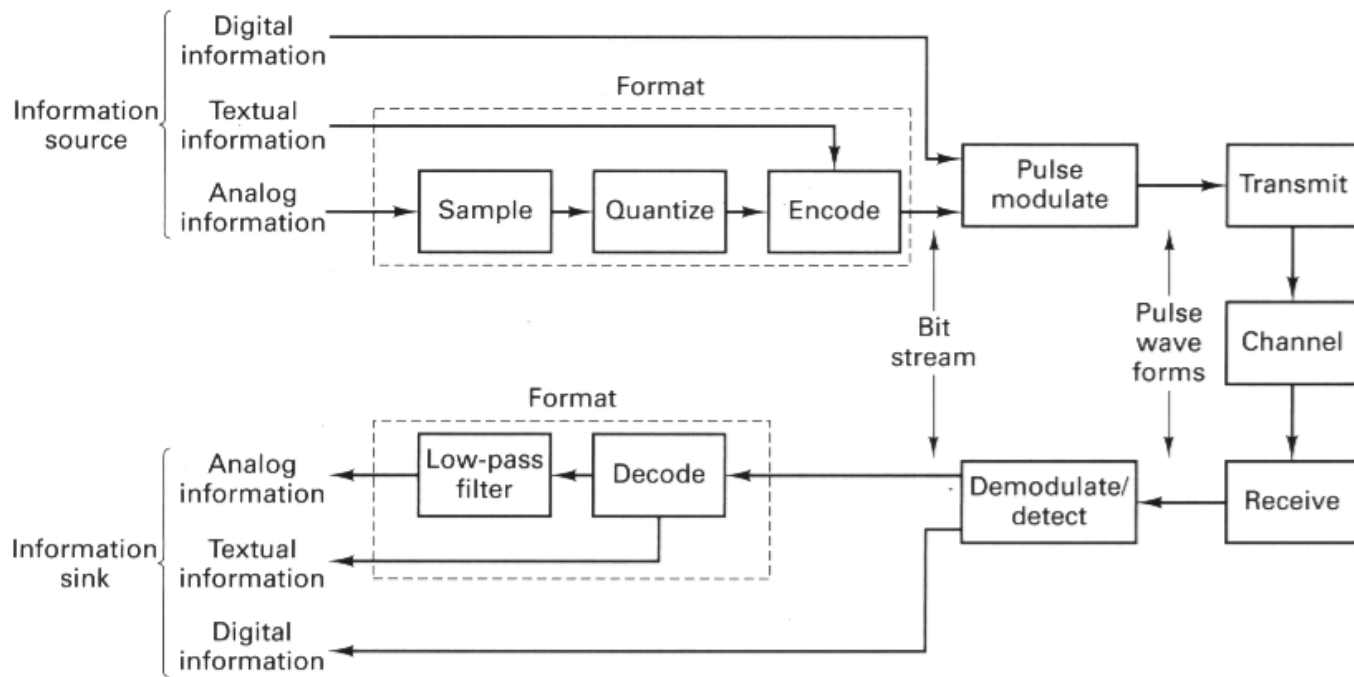


Figure 2.2 Formatting and transmission of baseband signals.

Formatação do sinal

Bits				5	0	1	0	1	0	1	0	1	0	1
				6	0	0	1	1	0	0	1	1	0	1
1	2	3	4	7	0	0	0	0	0	1	1	1	1	1
0	0	0	0	NUL	DLE	SP	0	@	P	'	p			
1	0	0	0	SOH	DC1	!	1	A	Q	a	q			
0	1	0	0	STX	DC2	"	2	B	R	b	r			
1	1	0	0	ETX	DC3	#	3	C	S	c	s			
0	0	1	0	EOT	DC4	\$	4	D	T	d	t			
1	0	1	0	ENQ	NAK	%	5	E	U	e	u			
0	1	1	0	ACK	SYN	&	6	F	V	f	v			
1	1	1	0	BEL	ETB	'	7	G	W	g	w			
0	0	0	1	BS	CAN	(	8	H	X	h	x			
1	0	0	1	HT	EM	)	9	I	Y	i	y			
0	1	0	1	LF	SUB	*	:	J	Z	j	z			
1	1	0	1	VT	ESC	+	;	K	[	k	{			
0	0	1	1	FF	FS	,	<	L	\	l	|			
1	0	1	1	CR	GS	-	=	M	]	m	}			
0	1	1	1	SO	RS	.	>	N	^	n	~			
1	1	1	1	SI	US	/	?	O	-	o	DEL			

NUL	Null, or all zeros	DC1	Device control 1
SOH	Start of heading	DC2	Device control 2
STX	Start of text	DC3	Device control 3
ETX	End of text	DC4	Device control 4
EOT	End of transmission	NAK	Negative acknowledge
ENQ	Enquiry	SYN	Synchronous idle
ACK	Acknowledge	ETB	End of transmission
BEL	Bell, or alarm	CAN	Cancel
BS	Backspace	EM	End of medium
HT	Horizontal tabulation	SUB	Substitute
LF	Line feed	ESC	Escape
VT	Vertical tabulation	FS	File separator
FF	Form feed	GS	Group separator
CR	Carriage return	RS	Record separator
SO	Shift out	US	Unit separator
SI	Shift in	SP	Space
DLE	Data link escape	DEL	Delete

Figure 2.3 Seven-bit American standard code for information interchange (ASCII).

Formatação do sinal

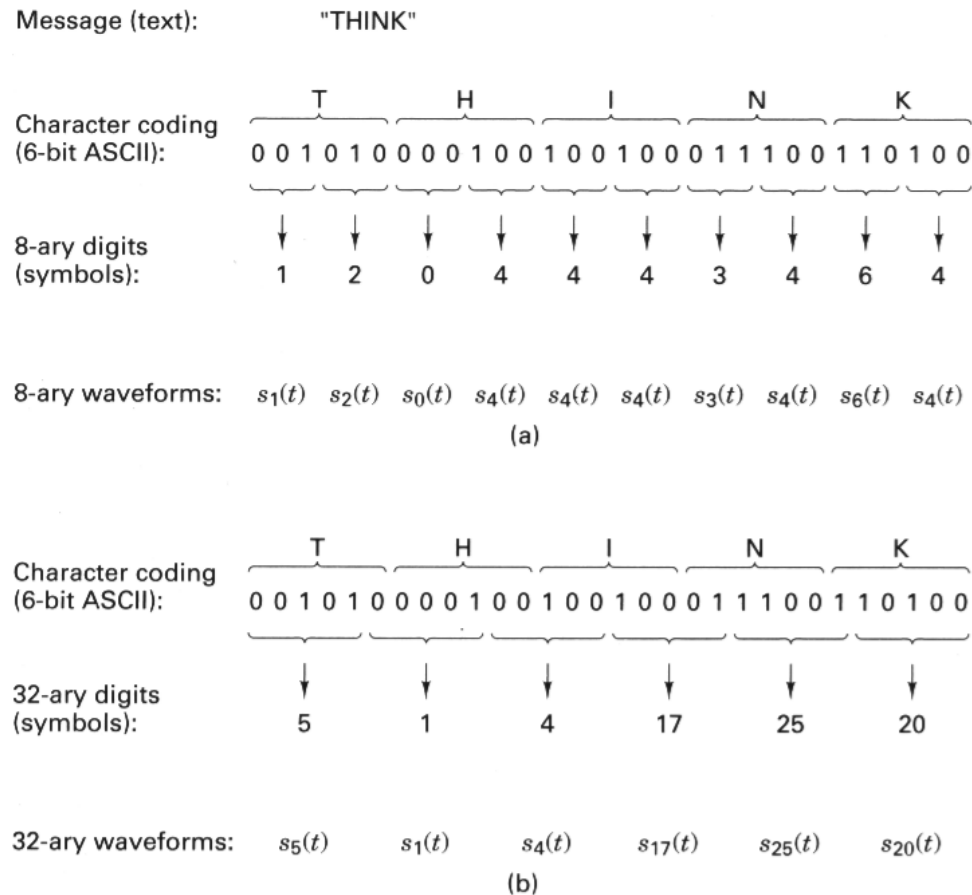


Figure 2.5 Messages, characters, and symbols. (a) 8-ary example. (b) 32-ary example.

Amostragem

$$T_s \leq \frac{1}{2f_m} \text{ sec}$$

$$f_s \geq 2f_m$$

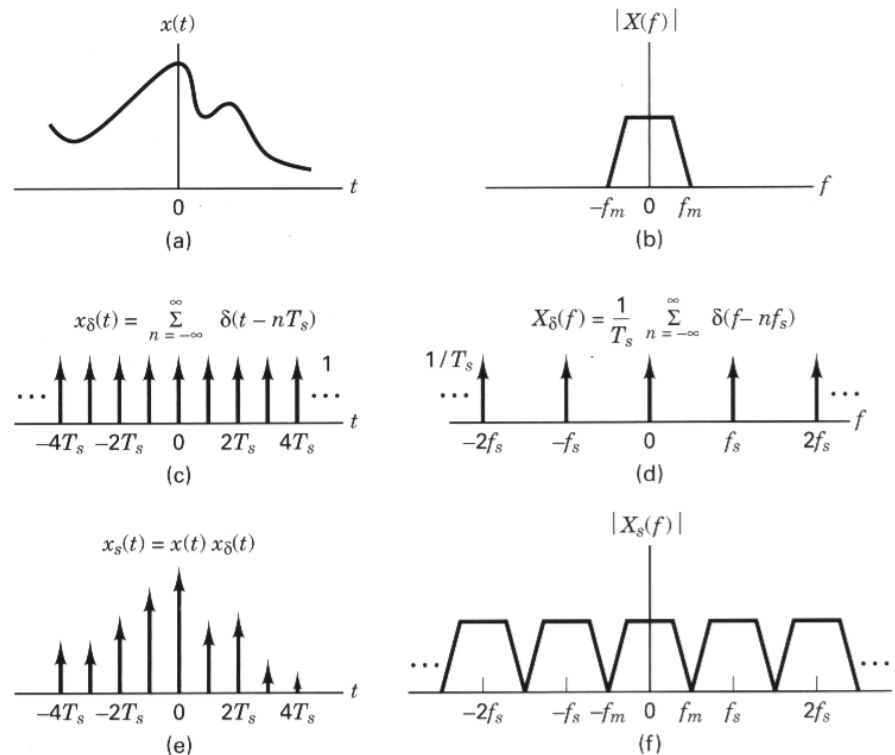


Figure 2.6 Sampling theorem using the frequency convolution property of the Fourier transform.

Amostragem

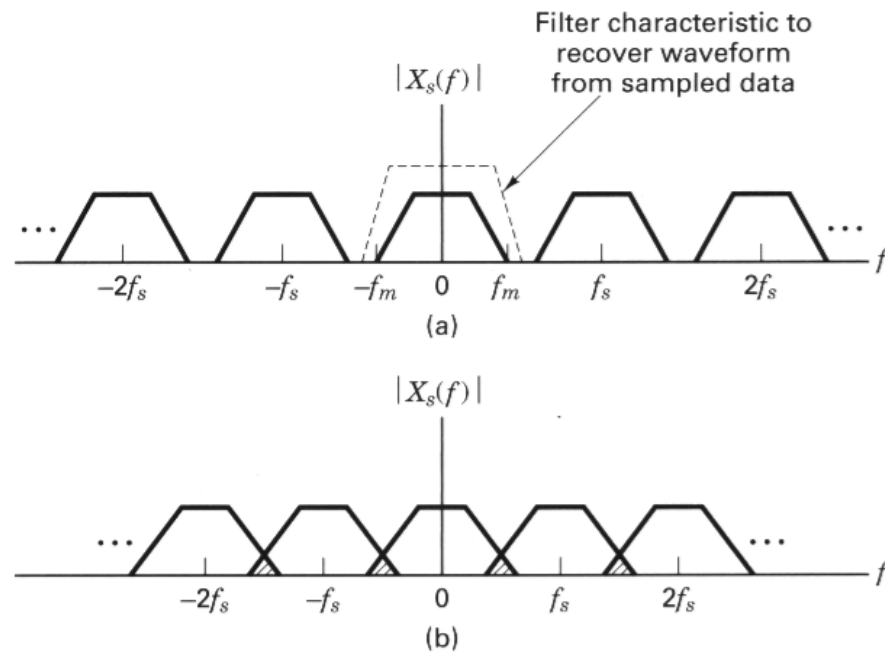


Figure 2.7 Spectra for various sampling rates. (a) Sampled spectrum ($f_s > 2f_m$). (b) Sampled spectrum ($f_s < 2f_m$).

Amostragem

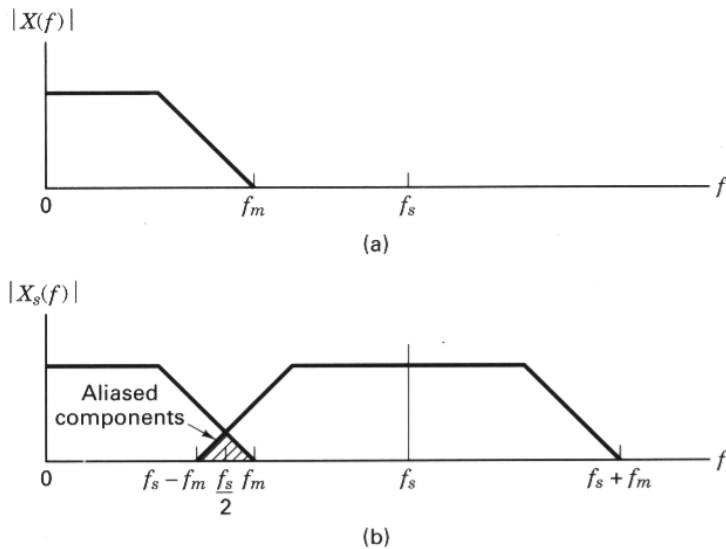


Figure 2.9 Aliasing in the frequency domain. (a) Continuous signal spectrum. (b) Sampled signal spectrum.

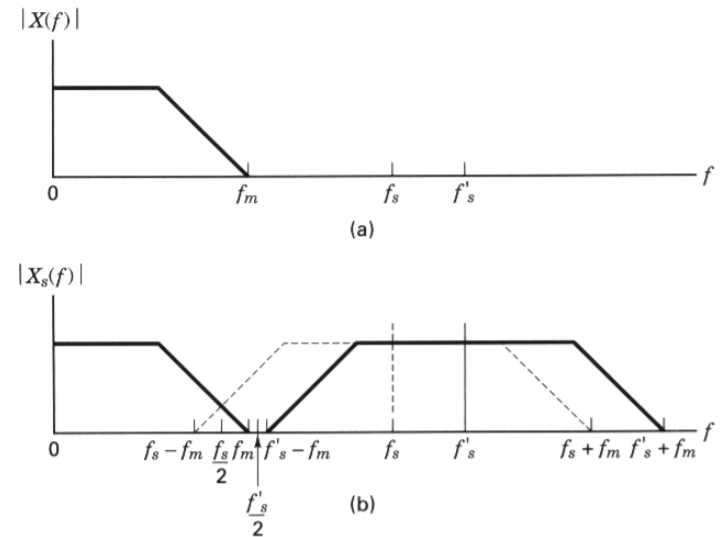


Figure 2.10 Higher sampling rate eliminates aliasing. (a) Continuous signal spectrum. (b) Sampled signal spectrum.

Quantização

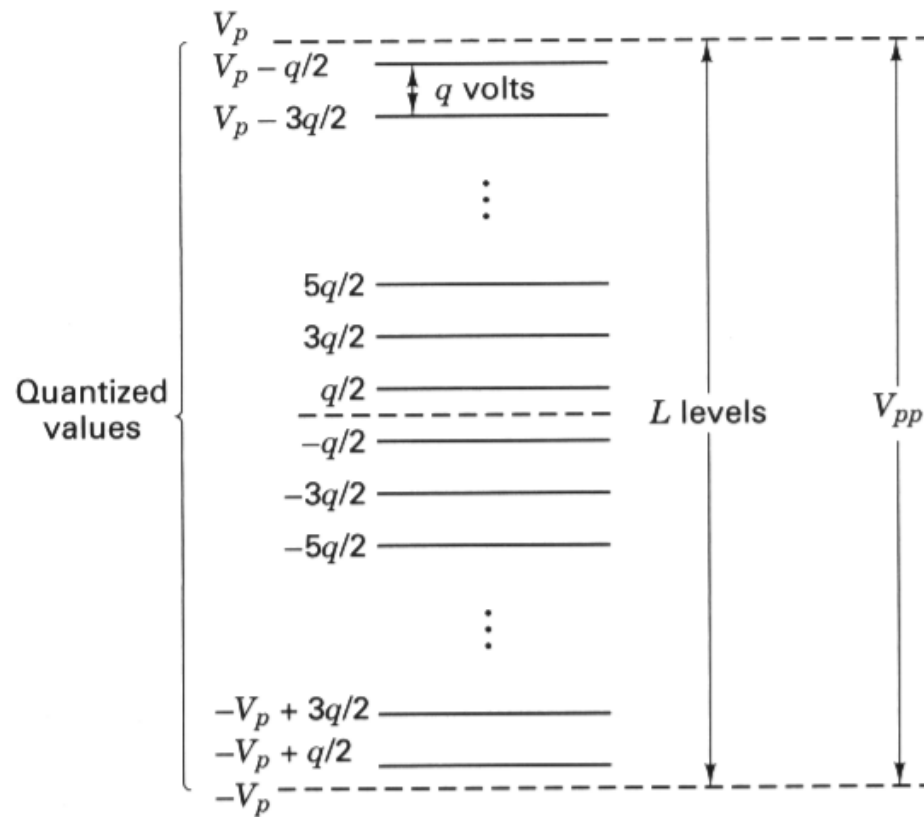


Figure 2.15 Quantization levels.

Quantização

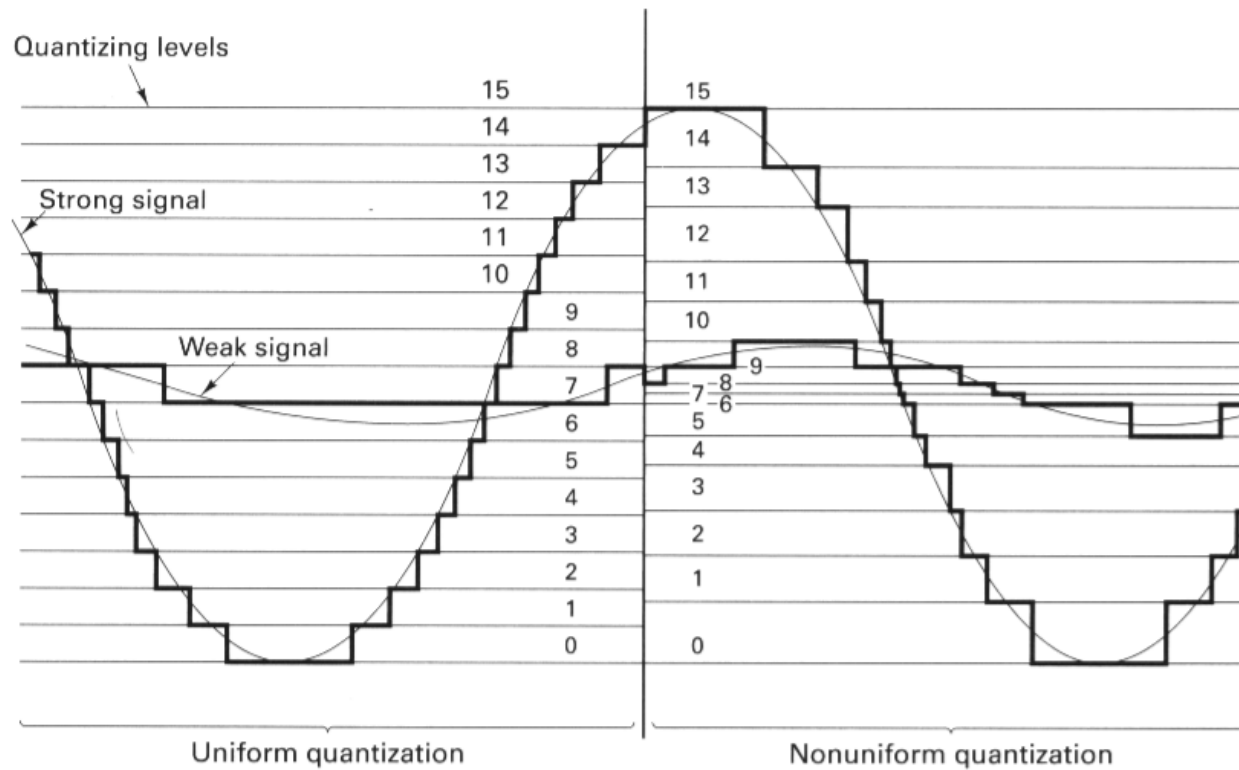


Figure 2.18 Uniform and nonuniform quantization of signals.

PCM

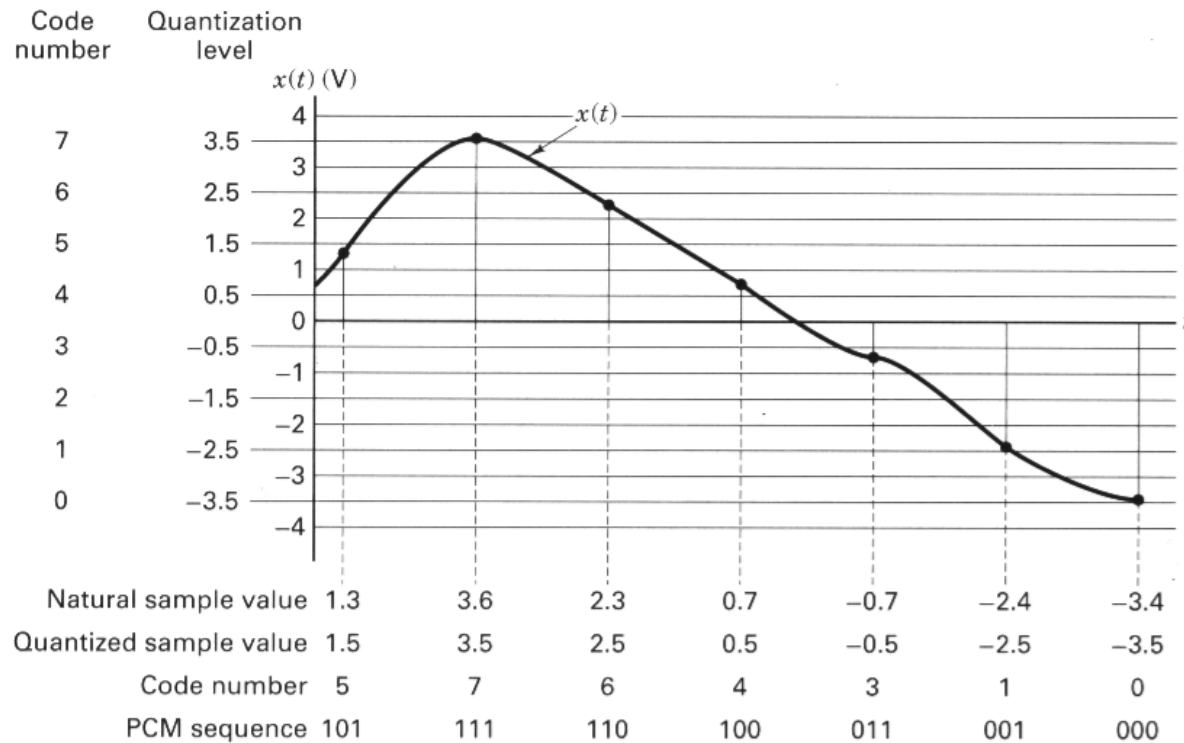


Figure 2.16 Natural samples, quantized samples, and pulse code modulation. (Reprinted with permission from Taub and Schilling, *Principles of Communications Systems*, McGraw-Hill Book Company, New York, 1971, Fig. 6.5-1, p. 205.)

Referência e Leitura: S. Hayki e M. Moher

Cap. 3

- SKLAR, Bernard. Digital Communications: Fundamentals and Applications.; 2ª ed. USA:Prentice Hall,, 2001.
- Fazer leitura das páginas 55-84

Exercícios Matlab

Ex. 1:

- Capturar um sinal de áudio utilizando as ferramentas do toolbox 'Data Acquisition'. Utilizar o matlab no windows.
- Realizar um processo de quantização uniforme do sinal (3, 5, 8 e 13 bits)
- Disponibilizar o sinal na placa de som do micro e observar os efeitos da quantização