数字信号处理

Digital Signal Processing

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教学安排：

总学时：48学时

讲授：40学时

上机：8学时，共3个实验（Matlab）

作业（每章交一次作业）

课程网站：校内网络教学平台

课程地位

- 本课程为电子、通信、自动化类学生重要的专业课。
- 是信号处理、信号检测、通信等专业的考研课程之一。

先修课

高等数学
线性代数
复变函数与积分变换
信号与系统

后续课程

现代信号处理
数字图像处理
DSP原理及应用
语音信号处理
模式识别
……

Textbook and Reference

- Discrete-time Signal Processing, A.V.Oppenheim, R.W. Schafer, J.R.Buck, Second Edition，清华大学出版
- Digital Signal Processing: Principles, Algorithms, and Applications, 4th Edition, Proakis.J.G, Manolakis.D.G, Prentice-Hall
- 离散时间信号处理(第2版) , Oppenheim A V, Schafer R W, Buck J R, 刘树棠 黄建国译，西安交通大学出版社
- 数字信号处理，丁玉美，西安电子科技大学出版社，第二版
- 数字信号处理:理论算法与实现，胡广书，清华大学出版社
- 数字信号处理，程佩青，清华大学出版社

This course includes 3 major parts

- Basis of discrete-time signal and system analysis
  - Chapter2~5
- The discrete Fourier transform (DFT) and FFT
  - Chapter8~9
- Structure and designing of filter
  - Chapter6~7

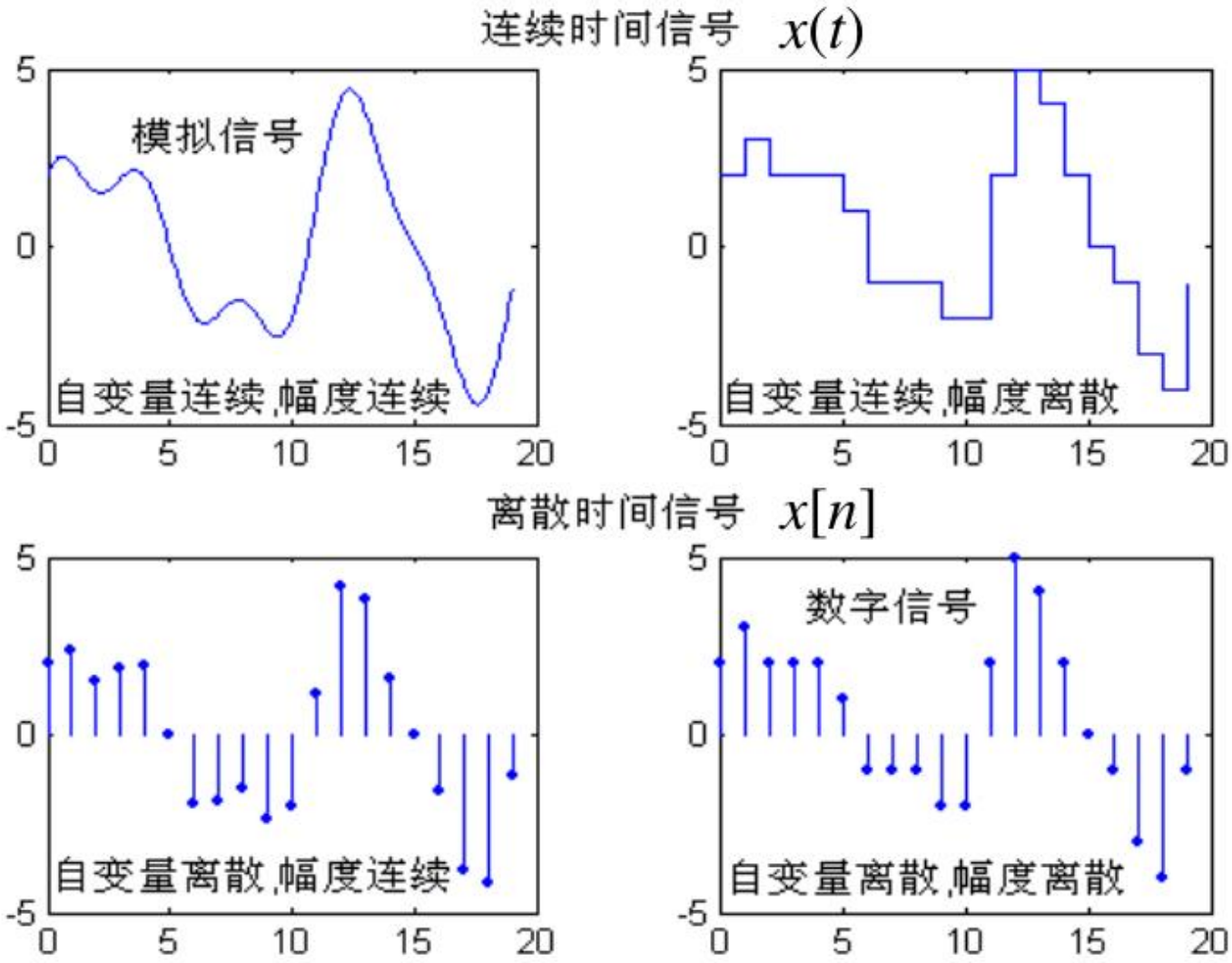
Marking

项 目		比例
平时成绩	课堂表现	10%
	平时作业（测验）	25%
	上机仿真报告	15%
期终考试		50%
总计		100%

CHAPTER 1 INTRODUCTION

- What is digital signal
- What is digital signal processing
- Character of digital signal processing
- Application of digital signal processing

1.What is digital signal

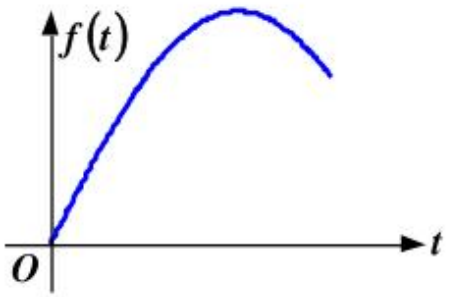


CT signals and DT signals

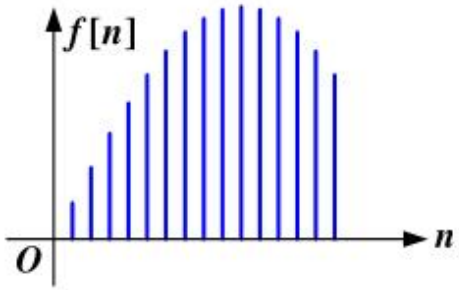
- **Continuous-time signals, CT signals**
  - Continuous time
  - Continuous amplitude
  - Voice signal, temperature signal et. al.
- **Discrete-time signals, DT signals**
  - Discrete time
  - Continuous amplitude
  - Sequence
- **Digital Signal**
  - Discrete time
  - Discrete amplitude

- **CT signals (Analog Signal)**

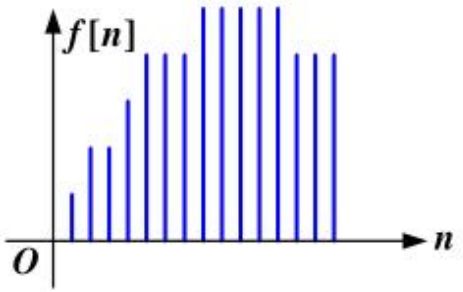
采样 **Sampling**



- **DT signals (Sequence)**



量化 **Quantization**



- **Digital Signal**

Example: the storage of voice signal in different materials

vocal cord shakes ⇨ air pressure changes and spreads ⇨

the voltage of microphone changes ⇨
- Recorded using analog signals
- Recorded using digital signals

(1) magnetic tape: Recorded according to the intensity of magnetism

(2) ethane-resin disc: Recorded according to the undulant channels

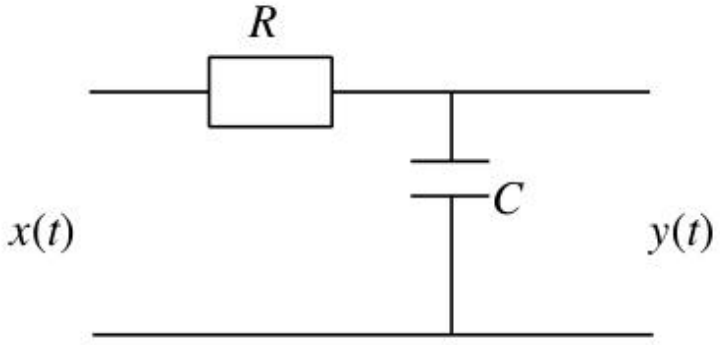
} **analog signals**

(3) disk: Recording 0 or 1 according to the direction in which the mote is magnetized

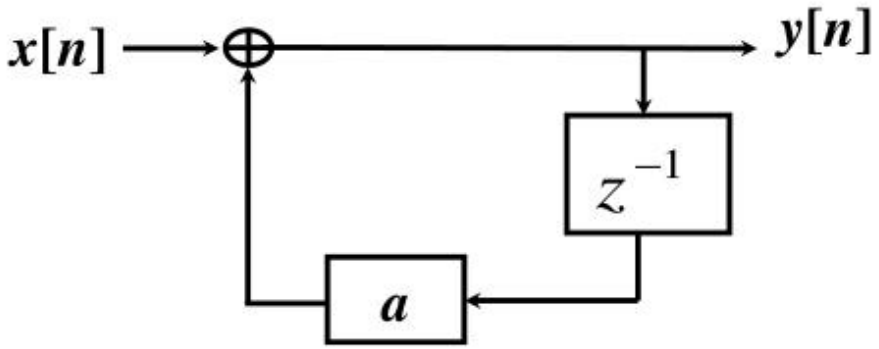
(4) CD: Recording 0 or 1 according to the accidented surface

} **digital signals**

2. What is digital signal processing



Continuous-time low pass filter



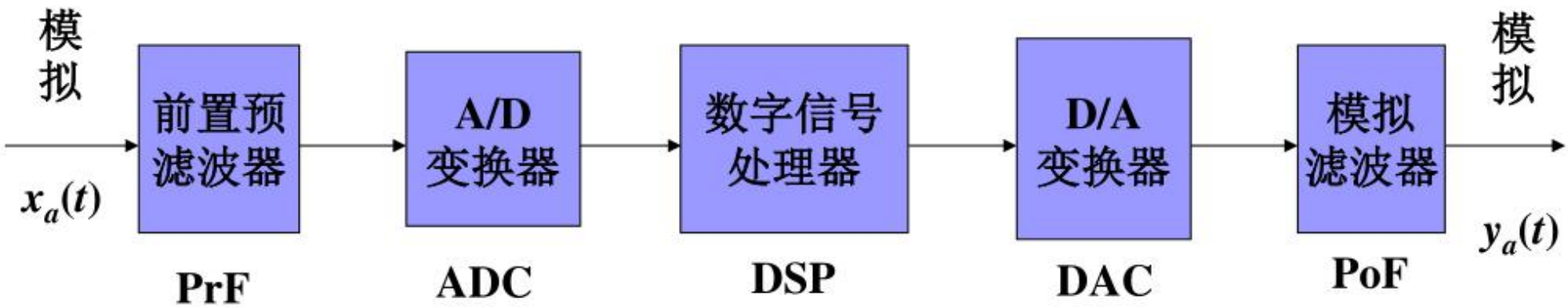
Discrete-time low pass filter

$$y[n] = x[n] + a\,y[n-1]$$

Digital signal processing:

additions, multiplications, delaying

用数字系统处理模拟信号

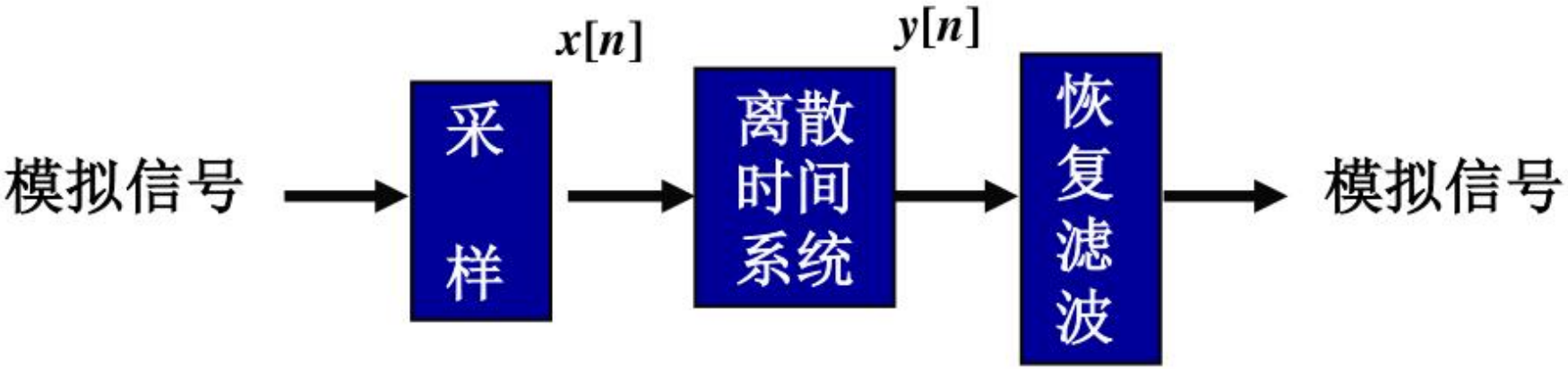


- 模数转换（A/D）：包括采样、量化、编码

  Sampling, Quantization, Coding

- 存在量化误差
- 实际工程实现的方式

用离散时间系统处理模拟信号



- 无量化编码过程，不存在量化误差
- 离散时间系统是不考虑有限字长效应的理想系统
- 本课程的主要研究内容是离散时间系统

Realization method

- **Software** flexible; slowly
- **Hardware and software** fast，flexible

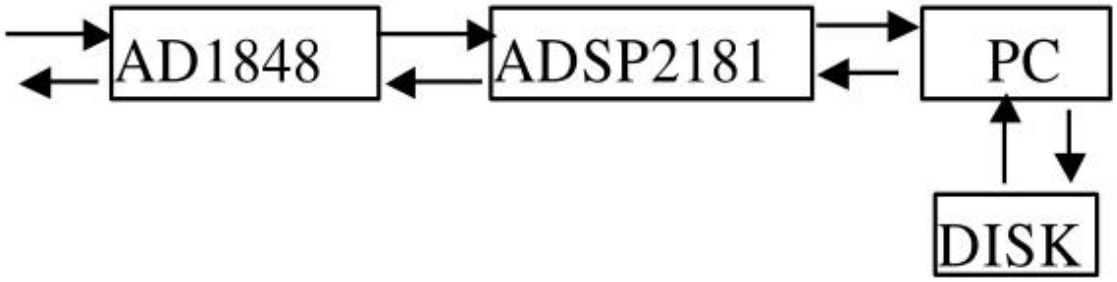
Programmable DSP chip

- ✓美国德州仪器公司(TI)：TMS320CX系列 占有90%
- ✓AT&T公司dsp16,dsp32系列
- ✓Motorola公司的dsp56x,dsp96x系列
- ✓AD公司的ADSP21X,ADSP210X系列

Special DSP chip——FFT, FIR filter, convolution, et.al

- ✓BB公司：DF17XX系列
- ✓MAXIM公司：MAXIM27X ,MAXIM28X
- ✓National公司：National-SEMI系列：MF系列。

Example of hardware and software realization



3.Character of digital signal processing

- higher precision
- higher flexibility
- more process abilities
- higher reliability (programmable)
- cheaper

The advantage of digital TV:

	DTV	ATV
source coding	MPEG2	PAL/NTSC/SECAM
transport and receiving	digital	analog
Subjective quality	Studio, nearly; Only relative to compression; Advanced transport technologies (channel coding, modulation) to wipe off the influence from environment (multipath interference);	Can not achieve the effect of SDTV; Influenced by environment;
resource	Save power (10%) and spectrum; an analog channel transports 4 SDTV (or 1 HDTV)	Forbidden channels, the channels nearby can not be used, 2 channels transport 1 program;
function	Stereo surround; Transport data; VOD; Mobile broadcast;	One track/dimensional sound; Transport only a little data; Be not mobile;

4.Application of digital signal processing

- communications
- entertainment
- medicine
- military
- exploration
- archaeology

Applications