DISCRETE-TIME SIGNAL PROCESSING

SECOND EDITION

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SAMPLING OF CONTINUOUS-TIME SIGNALS

4.0 INTRODUCTION

Discrete-time signals can arise in many ways, but they most commonly occur as representations of sampled continuous-time signals. It is remarkable that under reasonable constraints, a continuous-time signal can be quite accurately represented by samples taken at discrete points in time. In this chapter we discuss the process of periodic sampling in some detail, including the phenomenon of aliasing, which occurs when the signal is not bandlimited or when the sampling rate is too low. Of particular importance is the fact that continuous-time signal processing can be implemented through a process of sampling, discrete-time processing, and the subsequent reconstruction of a continuous-time signal.

4.1 PERIODIC SAMPLING

Although other possibilities exist (see Steiglitz, 1965; Oppenheim and Johnson, 1972), the typical method of obtaining a discrete-time representation of a continuous-time signal is through periodic sampling, wherein a sequence of samples, $x[n]$, is obtained from a continuous-time signal $x_c(t)$ according to the relation

$$x[n] = x_c(nT), \qquad -\infty < n < \infty. \tag{4.1}$$

In Eq. (4.1), T is the *sampling period*, and its reciprocal, $f_s = 1/T$, is the *sampling*

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