Fundamentals of Analog and Digital Communication Systems

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assumption is not justifiable. Schemes will be presented for the non-coherent detection of ASK and FSK signals, plus a technique for detecting information transmitted by phase shifts without having a phase-coherent channel.

ASK Detector

The noncoherent detector for ASK signals is shown in Fig. 11-1. The

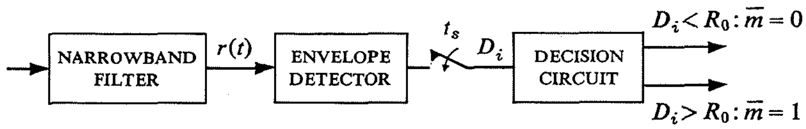

Figure 11-1 Noncoherent ASK detector

narrowband filter is used to improve the incoming SNR by removing the noise outside of the filter bandwidth B. Therefore, the output noise has power $N_0 B$ and can be represented by the narrowband approximation discussed in Chapter 8. It will be assumed that the filter bandwidth B is approximately equal to the bit rate $1/T_b$. This assumption permits us to ignore intersymbol interference, i.e., energy associated with one bit influencing a decision regarding the next bit. Because the signal information is present in the amplitude, an envelope detector followed by a threshold-decision circuit is used to determine whether the incoming data bit is a ZERO or a ONE.

We can determine the conditional probability density functions for the received waveform given that either a ZERO or a ONE was transmitted. With no signal present the filter output is simply narrowband noise. We know from Chapter 8 that the probability density function for the envelope is Rayleigh, i.e.,

$$p_0(r) = \frac{r}{N_0 B} \exp\left[\frac{-r^2}{2N_0 B}\right] \qquad r > 0, \tag{11.1a}$$

where the noise power P in (8.19o) has been replaced by $N_0 B$. We can express the incoming signal $s_1(t)$ as

$$s_1(t) = V \cos(\omega_0 t + \theta), \tag{11.1b}$$

where the initial phase angle θ is a random variable uniformly distributed from 0 to 2π radians. Hence, with signal present the filter output is given by the sum of (8.19f) and (11.1b). One component of the noise is

where the θ found in (11.1b) has been arbitraril
without affecting the final results. The joint de
lope and phase of an incoming waveform consis
can be shown (see Problem 11.1-1) to be

$$p_1(r, \phi) = \frac{r}{2\pi N_0 B} \exp\left[-\frac{r^2 + V^2 -}{2N}\right.$$

We can obtain the envelope density function $p_1($
which gives

$$p_1(r) = \int_0^{2\pi} p_1(r, \phi)\, d\phi$$

$$= \frac{r}{N_0 B} \exp\left[-\frac{r^2 + V^2}{2N_0 B}\right] \frac{1}{2\pi} \int_0^{2\pi} \exp\left[\right.$$

$$= \frac{r}{N_0 B} \exp\left[-\frac{r^2 + V^2}{2N_0 B}\right] I_0\left(\frac{rV}{N_0 B}\right),$$

where $I_0(x)$ is the modified Bessel Function of
order. The density functions $p_i(r)$, $i = 0$ or 1, ar

It will be necessary for us to determine the t
obtain solutions for the error performance. A