D1

Illustrative Problem 2.4 [Autocorrelation and Power Spectrum] Generate a discrete-time sequence of $N = 1000$ i.i.d. uniformly distributed random numbers in the interval $(-\frac{1}{2}, \frac{1}{2})$ and compute the estimate of the autocorrelation of the sequence $\{X_n\}$,

$$\hat{R}_x(m) = \begin{cases} \dfrac{1}{N-m} \displaystyle\sum_{n=1}^{N-m} X_n X_{n+m}, & m = 0, 1, \ldots, M \\ \dfrac{1}{N-|m|} \displaystyle\sum_{n=|m|}^{N} X_n X_{n+m}, & m = -1, -2, \ldots, -M \end{cases} \tag{2.4.6}$$

Also, compute the power spectrum of the sequence $\{X_n\}$ by evaluating the discrete Fourier transform (DFT) of $\hat{R}_x(m)$. The DFT, which is efficiently computed by use of the fast Fourier transform (FFT) algorithm, is defined as

$$\mathcal{S}_x(f) = \sum_{m=-M}^{M} R_x(m) e^{-j2\pi f m/(2M+1)} \tag{2.4.7}$$

D1

```
function [Rx]=Rx_est(X,M)
% [Rx]=Rx_est(X,M)
%                 RX_EST  estimates the autocorrelation of the sequence of random
%                 variables given in X. Only Rx(0), Rx(1), ... , Rx(M) are computed.
%                 Note that Rx(m) actually means Rx(m-1).
N=length(X);
Rx=zeros(1,M+1);
for m=1:M+1,
  for n=1:N-m+1,
    Rx(m)=Rx(m)+X(n)*X(n+m-1);
  end;
  Rx(m)=Rx(m)/(N-m+1);
end;
```

D2

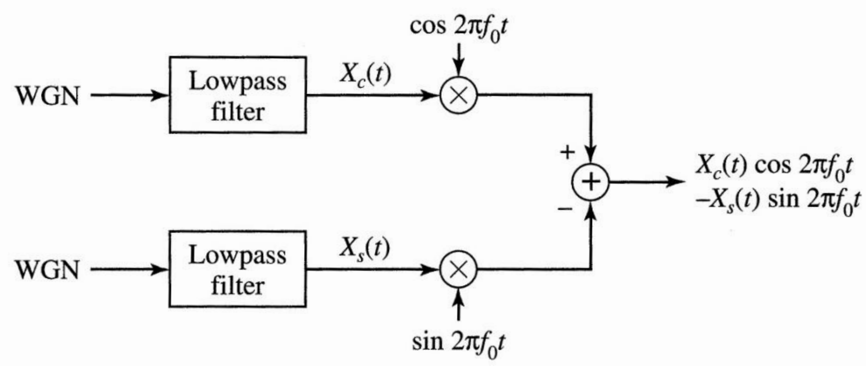

Figure 2.20 Generation of a bandpass random process

Illustrative Problem 2.10 [Generation of Samples of a Bandpass Random Process] Generate samples of a Gaussian bandpass random process by first generating samples of two statistically independent Gaussian random processes $X_c(t)$ and $X_s(t)$ and then using these to modulate the quadrature carriers $\cos 2\pi f_0 t$ and $\sin 2\pi f_0 t$, as shown in Figure 2.20.

Low pass filter $$H(z) = \frac{1}{1 - 0.9z^{-1}}$$