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% lssb.m
% Matlab demonstration script for LSSB-AM modulation. The message signal
% is +1 for 0 < t < t0/3, -2 for t0/3 < t < 2t0/3 and zero otherwise.
echo on
t0=.15;                                % signal duration
ts=0.001;                              % sampling interval
fc=250;                                % carrier frequency
snr=10;                                % SNR in dB (logarithmic)
fs=1/ts;                               % sampling frequency
df=0.25;                               % desired freq. resolution
t=[0:ts:t0];                           % time vector
snr_lin=10^(snr/10);                   % SNR
% the message vector
m=[ones(1,t0/(3*ts)),-2*ones(1,t0/(3*ts)),zeros(1,t0/(3*ts)+1)];
c=cos(2*pi*fc.*t);                     % carrier vector
udsb=m.*c;                             % DSB modulated signal
[UDSB,udssb,df1]=fftseq(udsb,ts,df);   % Fourier transform
UDSB=UDSB/fs;                          % scaling
f=[0:df1:df1*(length(udssb)-1)]-fs/2; % frequency vector
n2=ceil(fc/df1);                       % location of carrier in freq. vector
% remove the upper sideband from DSB
UDSB(n2:length(UDSB)-n2)=zeros(size(UDSB(n2:length(UDSB)-n2)));
ULSSB=UDSB;                            % generate LSSB-AM spectrum
[M,m,df1]=fftseq(m,ts,df);             % Fourier transform
M=M/fs;                                % scaling
u=real(ifft(ULSSB))*fs;                % generate LSSB signal from spectrum
signal_power=spower(udsb(1:length(t)))/2;
%                                      % compute signal power
noise_power=signal_power/snr_lin;      % compute noise power
noise_std=sqrt(noise_power);           % compute noise standard deviation
noise=noise_std*randn(1,length(u));    % generate noise vector
r=u+noise;                             % add the signal to noise
[R,r,df1]=fftseq(r,ts,df);             % Fourier transform
R=R/fs;                                % scaling
pause  % Press a key to show the modulated signal power
signal_power
pause  % Press any key to see a plot of the message signal
clf
subplot(2,1,1)
plot(t,m(1:length(t)))
axis([0,0.15,-2.1,2.1])
xlabel('Time')
title('The message signal')
pause  % Press any key to see a plot of the carrier
subplot(2,1,2)
plot(t,c(1:length(t)))
xlabel('Time')
title('The carrier')
pause  % Press any key to see a plot of the modulated signal and its spectrum
clf
subplot(2,1,1)
plot([0:ts:ts*(length(u)-1)/8],u(1:length(u)/8))
xlabel('Time')
title('The LSSB-AM modulated signal')
subplot(2,1,2)
plot(f,abs(fftshift(ULSSB)))
xlabel('Frequency')
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title('Spectrum of the LSSB-AM modulated signal')
pause   % Press any key to see the spectra of the message and the modulated
signals
clf
subplot(2,1,1)
plot(f,abs(fftshift(M)))
xlabel('Frequency')
title('Spectrum of the message signal')
subplot(2,1,2)
plot(f,abs(fftshift(ULSSB)))
xlabel('Frequency')
title('Spectrum of the LSSB-AM modulated signal')

pause  % Press any key to see a noise sample
subplot(2,1,1)
plot(t,noise(1:length(t)))
title('noise sample')
xlabel('Time')
pause  % Press a key to see the modulated signal and noise
subplot(2,1,2)
plot(t,r(1:length(t)))
title('Modulated signal and noise')
xlabel('Time')
subplot(2,1,1)
pause % Press any key to see the spectrum of the modulated signal
plot(f,abs(fftshift(ULSSB)))
title('Modulated signal spectrum')
xlabel('Frequency')
subplot(2,1,2)


pause  % Press a key to see the modulated signal noise in freq. domain
plot(f,abs(fftshift(R)))
title('Modulated signal noise spectrum')
xlabel('Frequency')
```