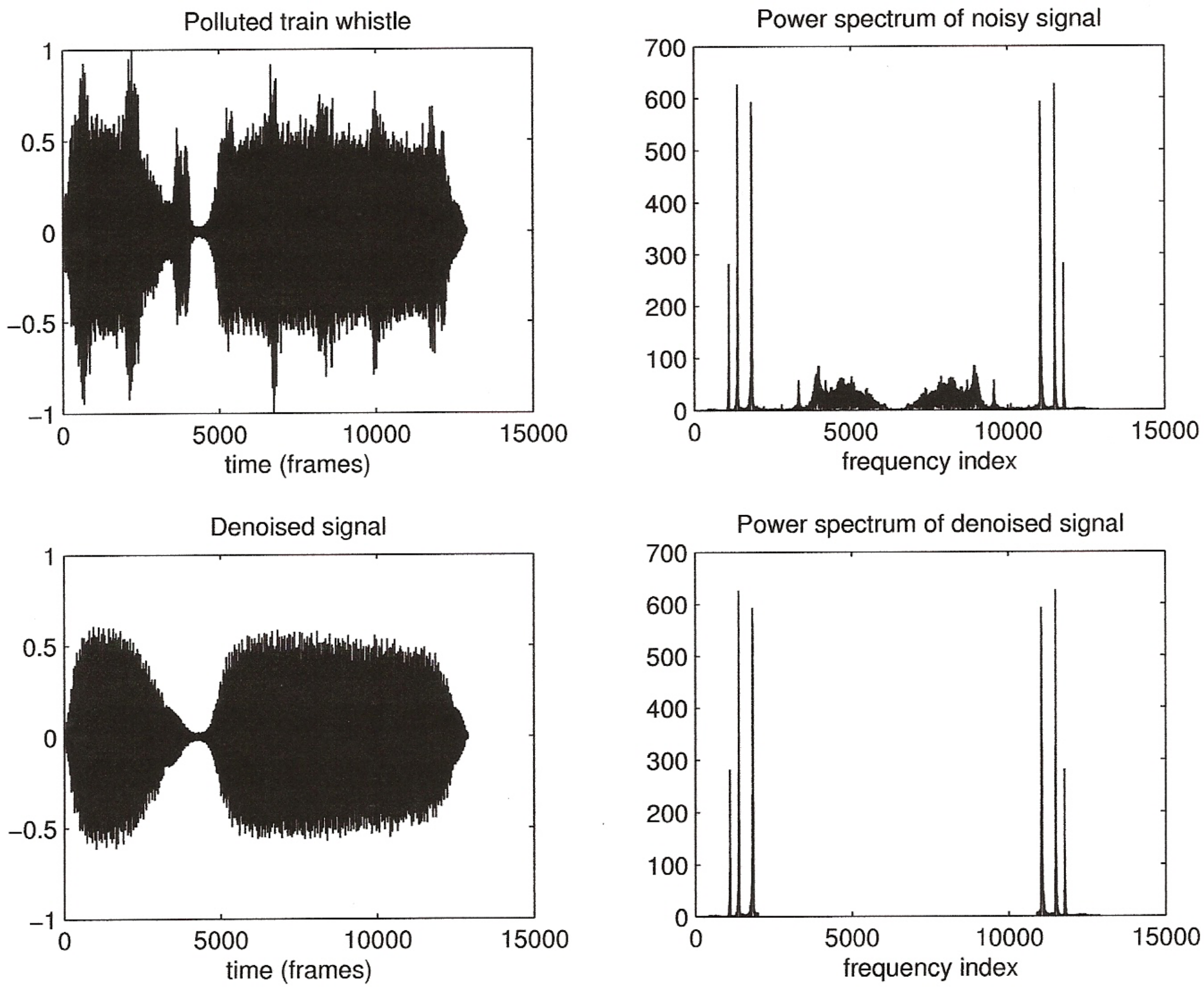
A3, Task 3

denoised.m

```
%% Load the sound
[f freq Nbits] = wavread('train_bird.wav');
N = length(f)

%% Proposed threshold frequency separating the two types of sounds
%% (chosen after trial and error)
tau = 2000

%% Compute DFT of signal
F = fft(f);

%% Listen to the original noisy signal
sound(f)

%% Plot the noisy signal and its power spectrum
subplot(2,2,1); plot(f);
title('Polluted train whistle'); xlabel('time (frames)');
subplot(2,2,2); plot(abs(F));
title('Power spectrum of noisy signal'); xlabel('frequency index');

%% Select frequencies for train whistle and reconstruct the sound
F_train = F;
F_train(tau:N-tau) = 0;
f_train = ifft(F_train);

%% Select frequencies for bird chirping and reconstruct the sound
F_bird = F;
F_bird(1:tau-1) = 0;
F_bird(N-tau+1:N) = 0;
f_bird = ifft(F_bird);

%% Listen to the denoised signal (train whistle)
sound(real(f_train))

%% Listen to the high-frequency sound (bird chirps)
%% (should have the train whistle filtered out)
sound(real(f_bird))

%% Plot the denoised signal and its power spectrum
subplot(2,2,3); plot(real(f_train));
title('Denoised signal'); xlabel('time (frames)');
subplot(2,2,4); plot(abs(F_train));
title('Power spectrum of denoised signal'); xlabel('frequency index');

%% Export the plots
print -deps a3q3plot.eps
```

Comments

1. The power spectrum of noisy signal has both low and high frequencies, but for the denoised signal only low frequencies occur.
2. The noisy signal has more pronounced "ragged edges" due to the bird chirps. However, the same basic shape occurs.



3. We have set to zero the frequency coefficients from index 2000 to 10880 (N − tau = 12880 − 2000). The value tau = 2000 was chosen so as to zero out the small magnitude, high frequency Fourier coefficients representing the bird chirps. (Other reasonable choices for tau are possible.)