Example 8-19: Noise Filtering Trumpet Signal by Thresholding.

Purpose:

The signal of an actual trumpet playing note B has broad-spectrum noise added to it. The goal is to retrieve the original signal from the noisy signal. The trumpet signal is sampled at 44100 sample/s. The signal-to-noise ratio is 8.54 dB.

Inputs:

Signal of an actual trumpet playing note B from the file `trumpet.mat`.
fs=Sampling rate in samples per s used.
NS=noise strength (multiplies `randn`).
T=threshold for noisy spectrum.

Outputs:

Plot and sound of noisy trumpet.
Plot and sound of filtered noisy trumpet.
Spectrum of noisy trumpet (top) and thresholded spectrum (bottom).
Signal-to-noise ratio (SNR) in dB.

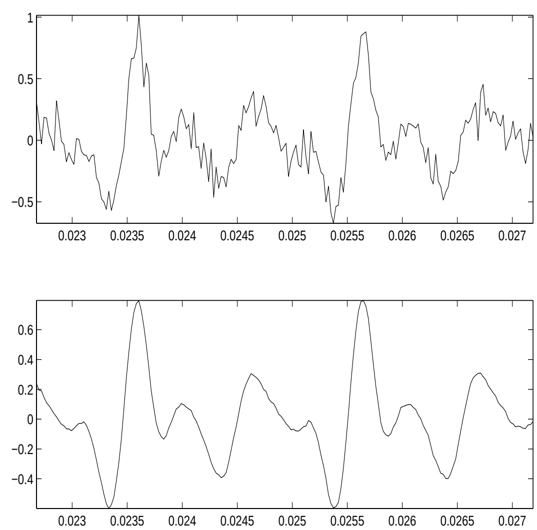

Figure 1: Plots of noisy (top) and filtered (bottom) trumpet signals.

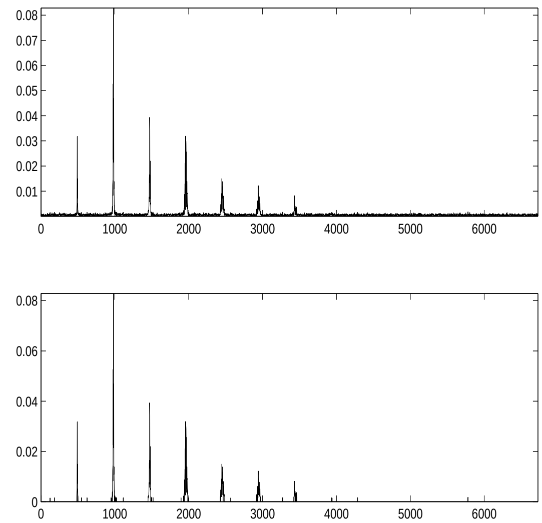

Figure 2: Spectrum of noisy trumpet (top) and thresholded spectrum.

Comments:

- The first sound is the noisy trumpet.
  Hit any key to hear the filtered signal.
- The trumpet signal is an actual trumpet playing note B, which has a fundamental frequency of 491 Hz and period $\frac{1}{491} \approx 2$ ms. This is apparent in its waveform plot.
- Additive white noise sounds like hissing.

Program:

```
clear;load 'trumpet.mat'
NS=0.1;T=0.0015;fs=44100;
L=length(X);rand('seed',0);
N=NS*randn(1,L);Y=X+N;%noisy
FY=fft(Y)/L;FZ=FY;
FZ(find(abs(FY)<T))=0;
Z=L*real(ifft(FZ));
SNR=10*log10(sum(X.*X)/sum(N.*N))
%Plot time waveforms and spectra:
I=[1000:1199];t=I/fs;%display
subplot(211),plot(t,Y(I))
subplot(212),plot(t,Z(I))
F=[1:5000];f=(F-1)*fs/L;figure
subplot(211),plot(f,abs(FY(F)))
subplot(212),plot(f,abs(FZ(F)))
soundsc(Y,fs),pause,soundsc(Z,fs)
```