看到版上总有人在问边际谱和 HHT 谱的画法，又搜索了一下，好像没有这方面的主题帖子，就发两个以前写的小程序，权作抛砖引玉吧。

```
% 边际谱与 FFT 比较
clear

T = 1;                          % 仿真时间
f1 = 15.2;
f2 = 40;
fs = 1000;                      % 采样率
N = T*fs;
n = 1:N;
s = sin(2*pi*f1/fs*n) + sin(2*pi*f2/fs*n);
s_fft = abs(fft(s))/N;

imf = emd(s);
[A, fa, tt] = hhspectrum(imf);
[E, tt1] = toimage(A,fa,tt,length(tt));

for k=1:size(E,1)
    bjp(k) = sum(E(k,:))*1/fs*1/T;
```

```
end
f = (0:N-3)/N*(fs/2);

figure(1);
plot(f,bjp);
xlabel('频率  / Hz');
ylabel('幅值');

figure(2);
plot(0:fs/N:fs/2-fs/N, s_fft(1:end/2))


% 实际信号的 HHT 谱和边际谱
clear

rand('seed', 0);

T = 0.01;                    % 仿真时间
R = 5000;                    % 码速率
fd = 10000;                  % 载波频差
fc = 20000;                  % 载波频率
fs = 200000;                 % 采样率
```

```
samp = fs/R;                % 每个码元上的采样点数
N = T*fs;
n = 1:N;
x = randint(1, R*T, 2);
y = fskmod(x, 2, fd, samp, fs);
y = y .* exp(i*2*pi*fc/fs*n);
y = real(y);
% z = awgn(y, 20, 'measured');
z = y;

imf = emd(z);
[A, fa, tt] = hhspectrum(imf);
if size(imf,1) > 1
    [A,fa,tt] = hhspectrum(imf(1:end-1, :));
else
    [A,fa,tt] = hhspectrum(imf);
end
[E, tt1] = toimage(A,fa,tt,length(tt));
disp_hhs(E, tt1);
% 使用灰度图显示
% colormap(gray(255))
```

```
for k = 1:size(E,1)
    bjp(k) = sum(E(k,:))*1/fs*1/T;
end
f = (0:N-3)/N*(fs/2);
figure(2);
plot(f, bjp);
```