Homework Assignment 7

Héctor Andrade Loarca # 375708

Melf Boeckel # 543098

In [1]:
```
% First we call the Wavelab toolbox
WavePath;
```

```
Welcome to WaveLab v 850
Setting Global Variables

WAVELABPATH =

/Applications/MATLAB_R2014a.app/toolbox/Wavelab850/

[Warning: Function realpow has the same name as a MATLAB builtin. We
suggest you
rename the function to avoid a potential name conflict.]
[> In path at 33
  In WavePath at 132
  In pymat_eval at 31
  In matlabserver at 24]
Pathnames Successfully Set
global WAVELABPATH = "/Applications/MATLAB_R2014a.app/toolbox/Wavela
b850/"
global PATHNAMESEPARATOR = "/"; global MATLABVERSION = 8.3
global PREFERIMAGEGRAPHICS = 1
WaveLab v 802 Setup Complete

Available Demos - Figures from the following papers:
  AdaptDemo  - ``Adapting to Unknown Smoothness via Wavelet Shrinkag
e''
  AsympDemo  - ``Wavelet Shrinkage: Asymptopia?''
  BlockyDemo - ``Smooth Wavelet Decompositions with Blocky Coefficie
nt Kernels''
  CorrelDemo - ``Wavelet Threshold Estimators for Data with Correlat
ed Noise''
  IdealDemo  - ``Ideal Spatial Adaptation via Wavelet Shrinkage''
  MESDemo    - ``Minimum Entropy Segmentation''
  MIPTDemo  - ``Nonlinear Wavelet Transforms based on Median-Interpo
laton''
  RiskDemo  - ``Exact Risk Analysis of Wavelet Regression''
  SCDemo     - ``Nonlinear Wavelet Methods for Recovery of Signals,
Densities
                  and Spectra from Indirect and Noisy Data''
  CSpinDemo   - ``Translation-Invariant De-Noising''
  TourDemo   - ``Wavelet Shrinkage and W.V.D. -- A Ten-Minute Tour''
  VdLDemo    - ``WaveLab and Reproducible Research''

Available Workouts:
  BBWorkout  - Workouts for Best Basis
  MPWorkout  - Workouts for Matching Pursuit
  MultiFrac  - Workouts for Continuous Wavelet Transform
  Toons      - The Cartoon Guide to Wavelets

Available Book(s):
  WaveTour   - ``WaveLet Tour of Signal Processing''
```

Lets construct a filter of compactly supported Daubechies wavelets

In [2]:
```
h = MakeONFilter('Daubechies',4);
```

In [3]:
```
% Lets define the size of the signlas
N=4*64;
```

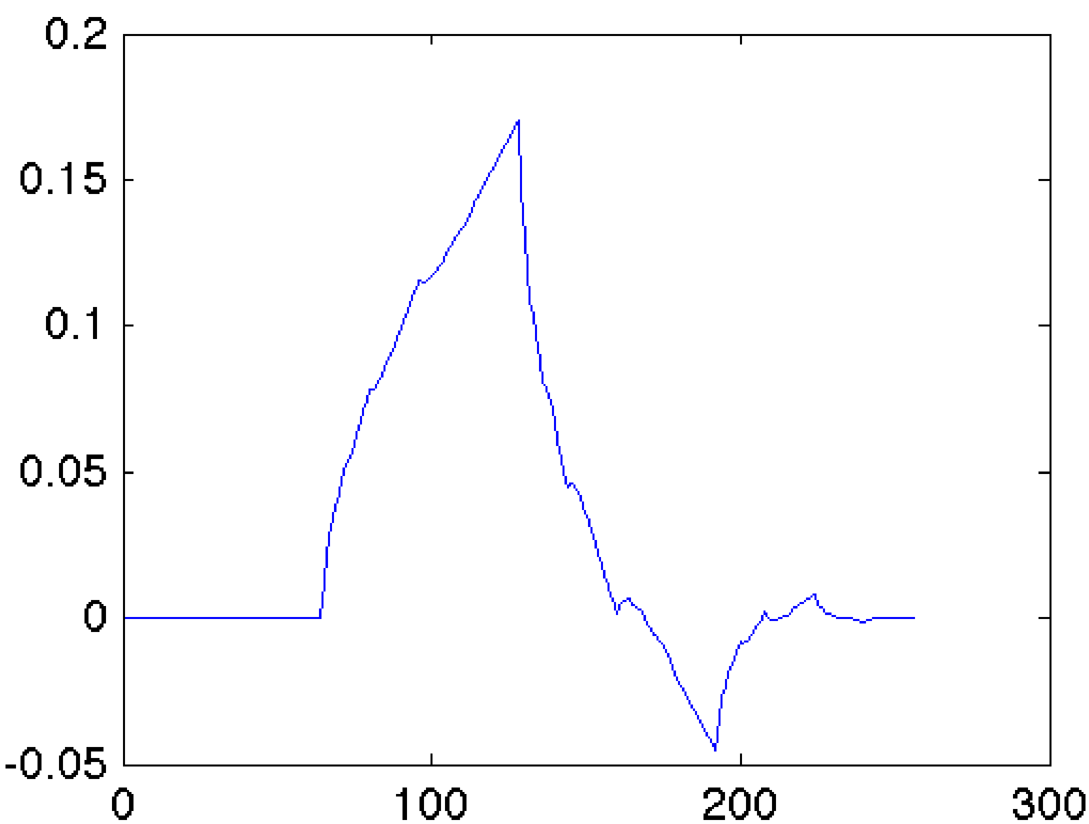
Now lest define e_i , as the canonical vector of length N with 1 in i

In [4]:
```
i=2;
e_i=zeros(N,1)';
e_i(i)=1.0;
```

Lets check how the scaling function and wavelet function looks like

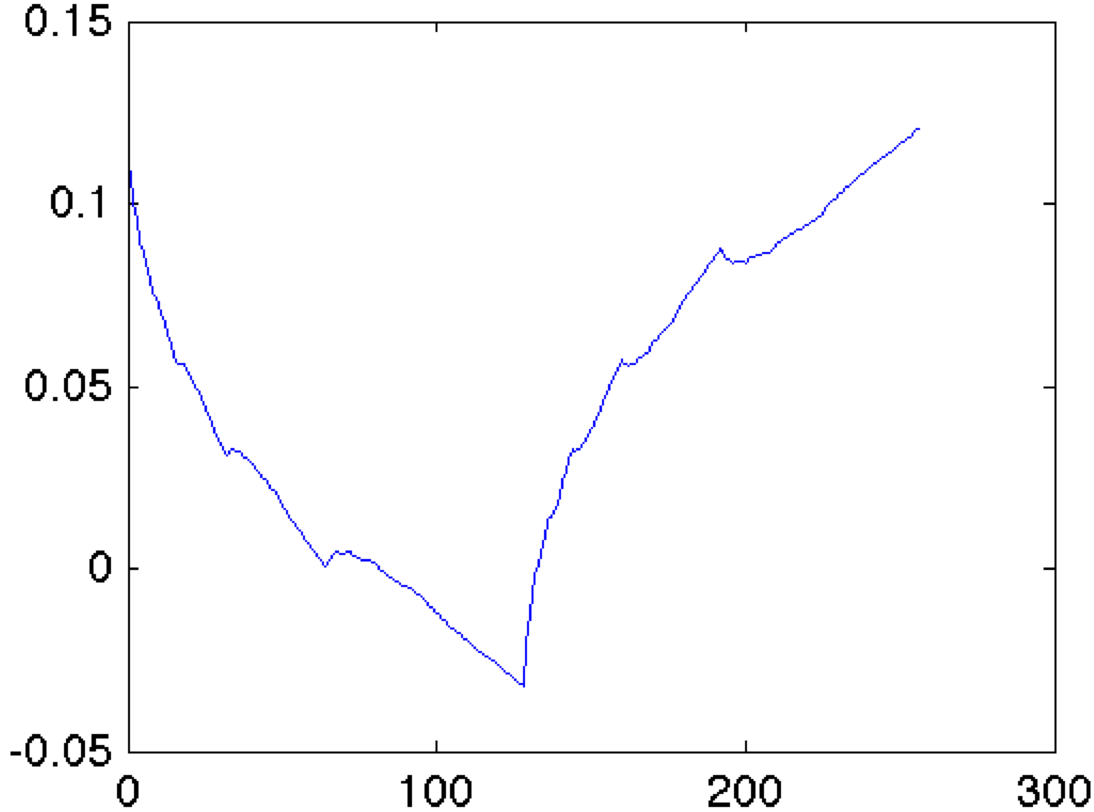
Scaling function:

In [5]:
```
plot(IWT_PO(e_i,2,h));
```



Wavelet function:

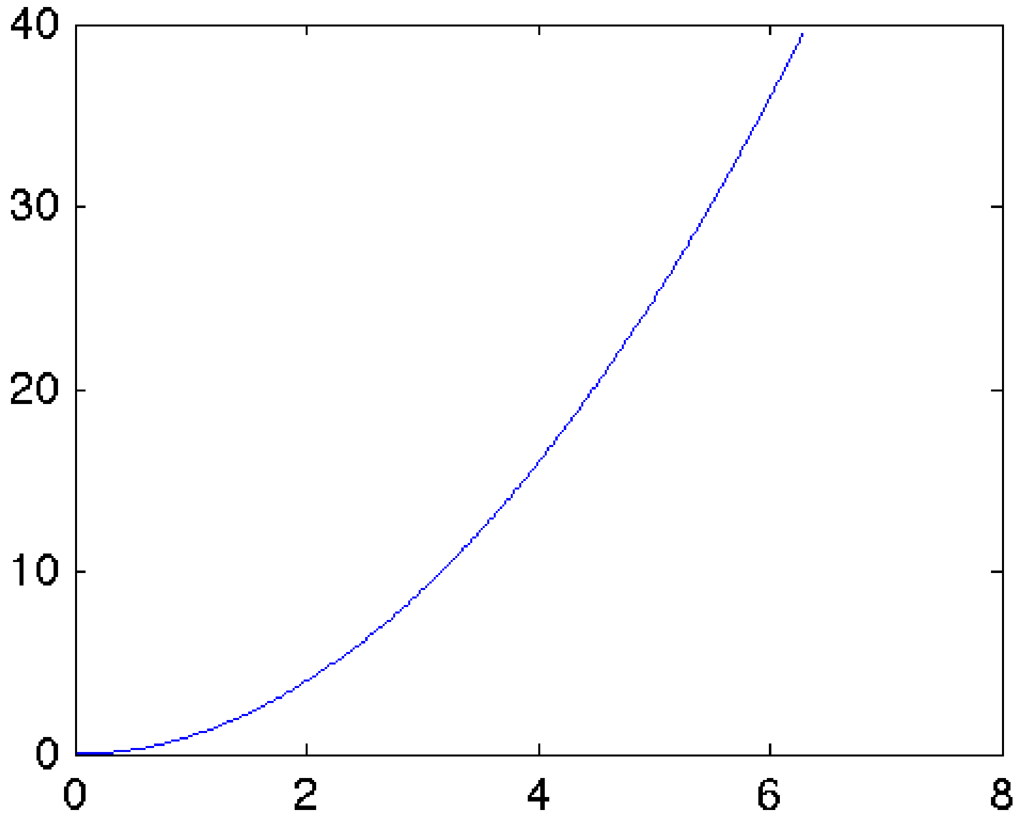
In [6]:
```
plot(IWT_PO(e_i,1,h));
```



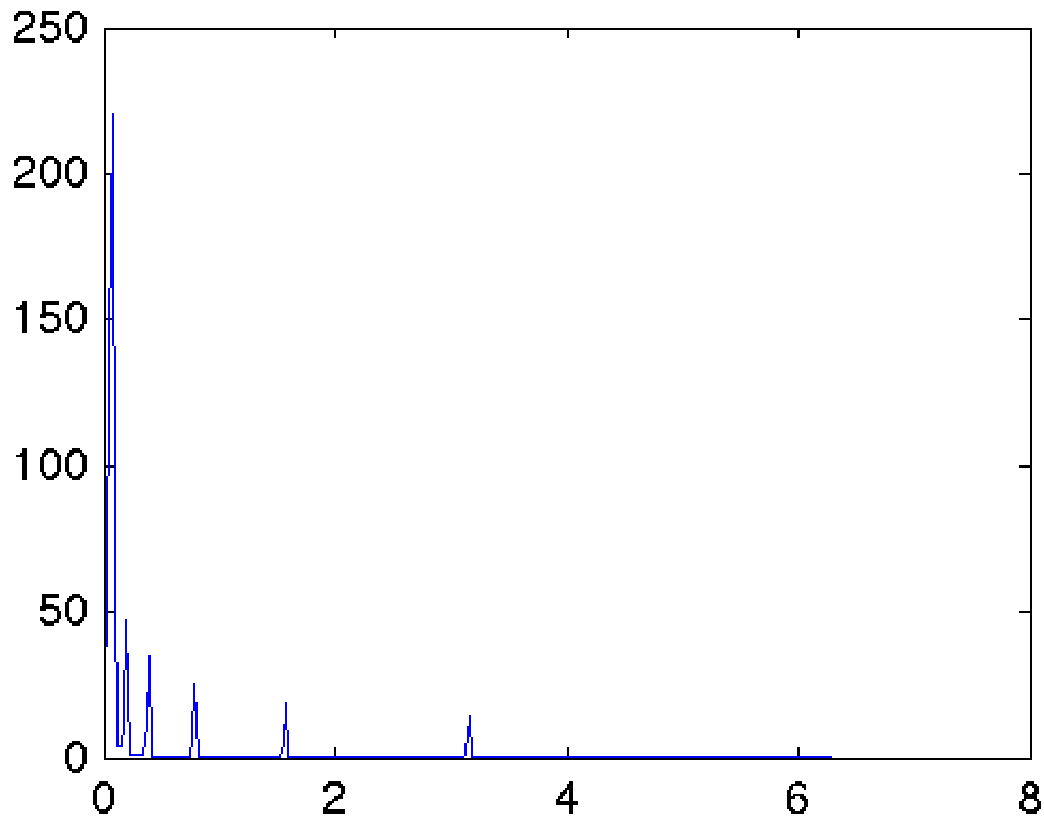
Lets define a smooth function f and plot its wavelet coefficients.

In [7]:
```
x = linspace(0,2*pi,N);
f = x.^2;
```

In [8]:
```
plot(x,f);
```



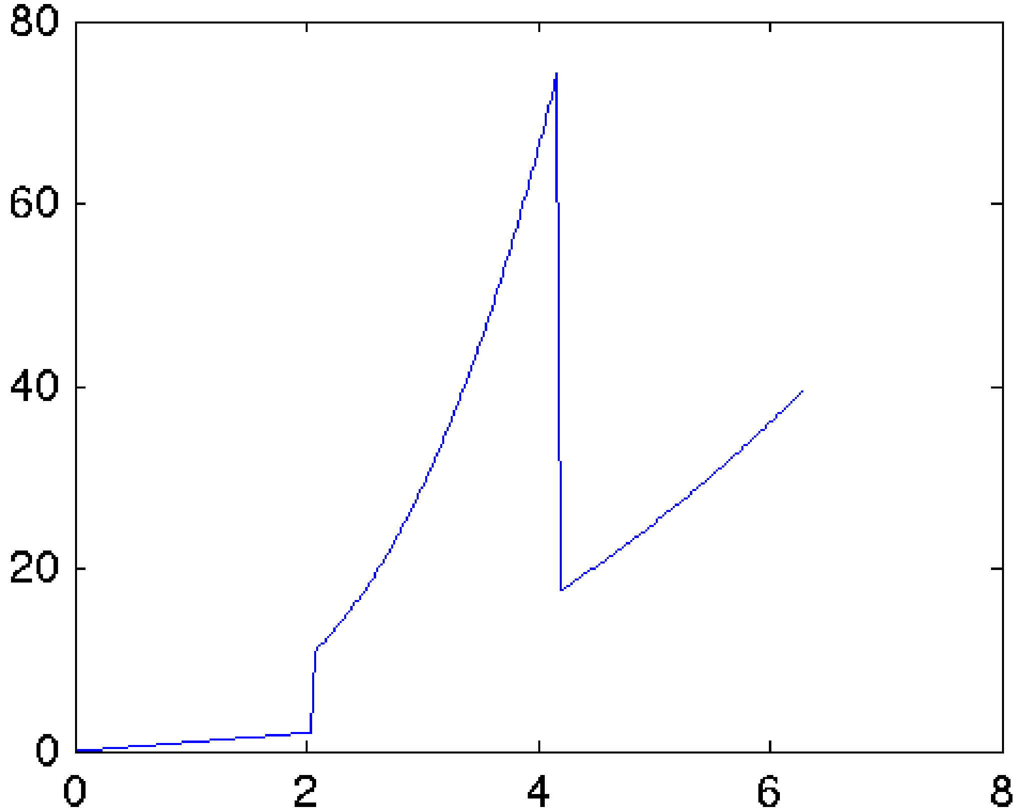
In [40]:
```
fwtf=FWT_PO(f,2,h);
plot(x,abs(fwtf))
```



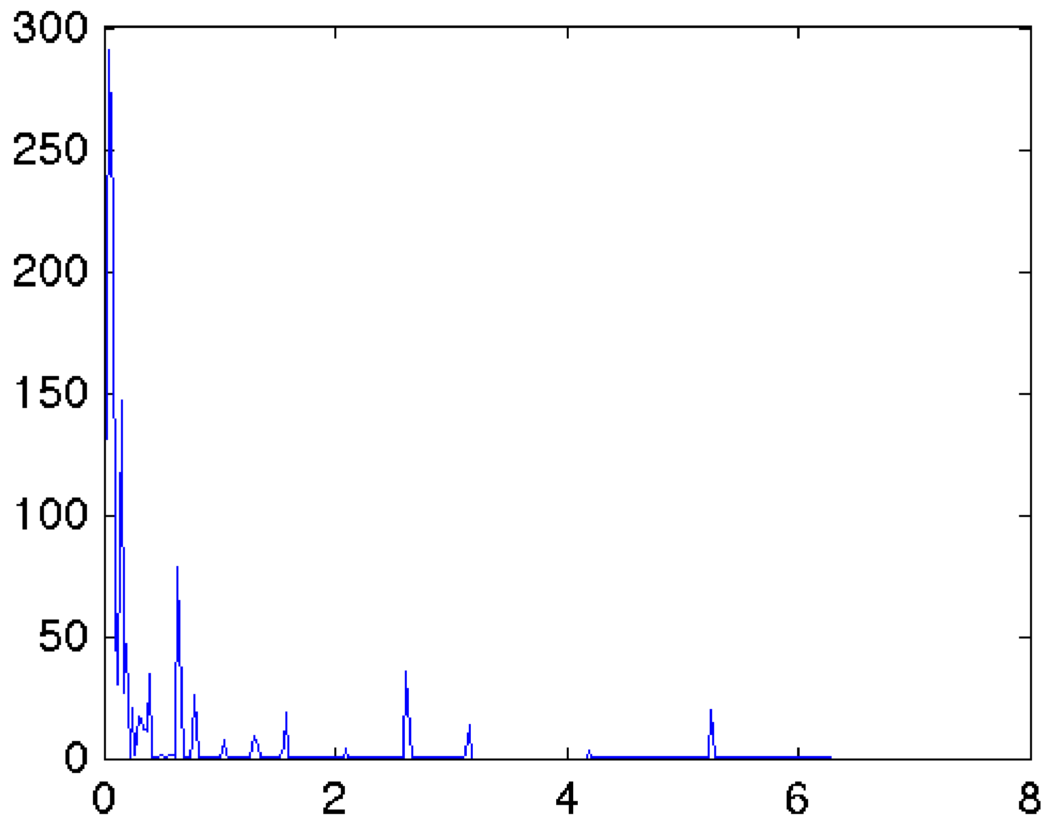
Lets define a smooth function g and plot its wavelet coefficients.

In [10]:
```
g=zeros(1,N);
for i=1:int64(N/3)
    g(i)=x(i);
end
for i=int64(N/3):int64(2*N/3)
    g(i)=x(int64(N/3))+x(i)^3;
end
for i=int64(2*N/3):N
    g(i)=x(i)^2;
end
```

In [11]:
```
plot(x,g)
```



In [30]:
```
fwtg=FWT_PO(g,2,h);
plot(x,abs(fwtg))
```

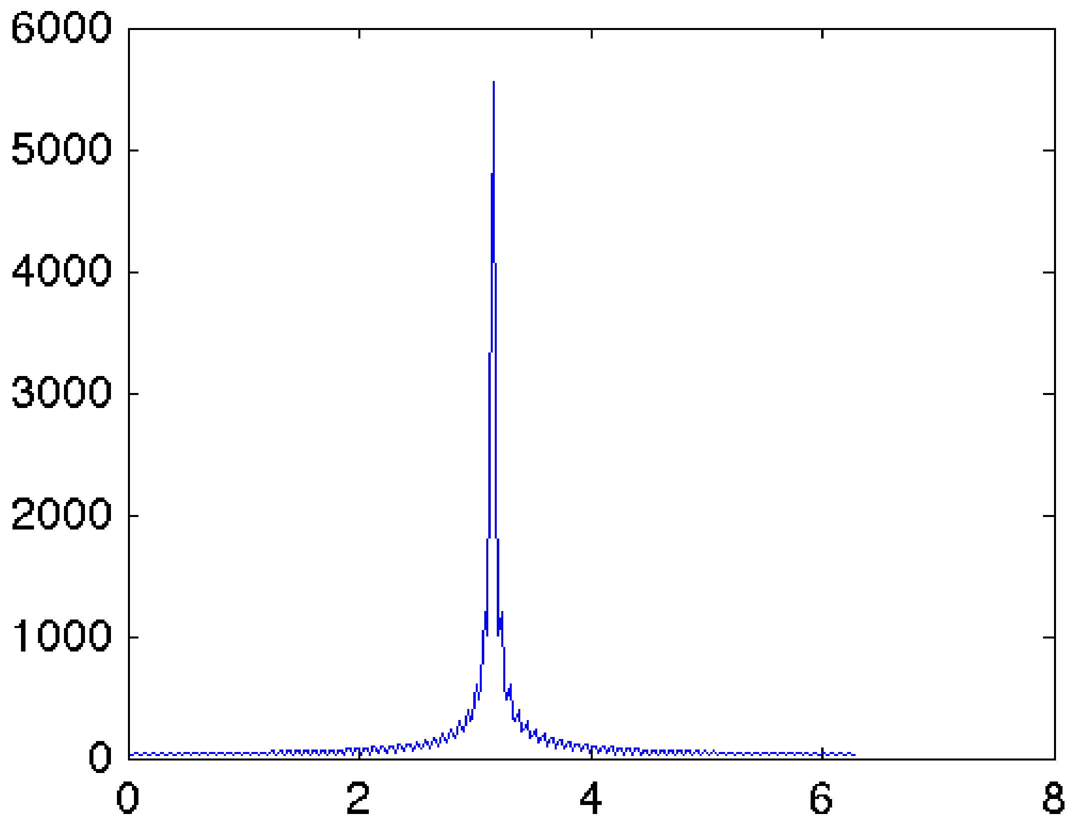


The wavelet coefficients in the smooth function decay rapidly and the wavelet coefficients in the non-smooth function have importan coefficients even for N big (does not recay rapidly), regular functions are more compressible.

The signal g is piecewise, lets recover the signals, with wavelet coefficients and fourier coefficients, setting to zero the coefficients with value less than 10% of the largest coefficient.

Lets compute first, the fft coefficients

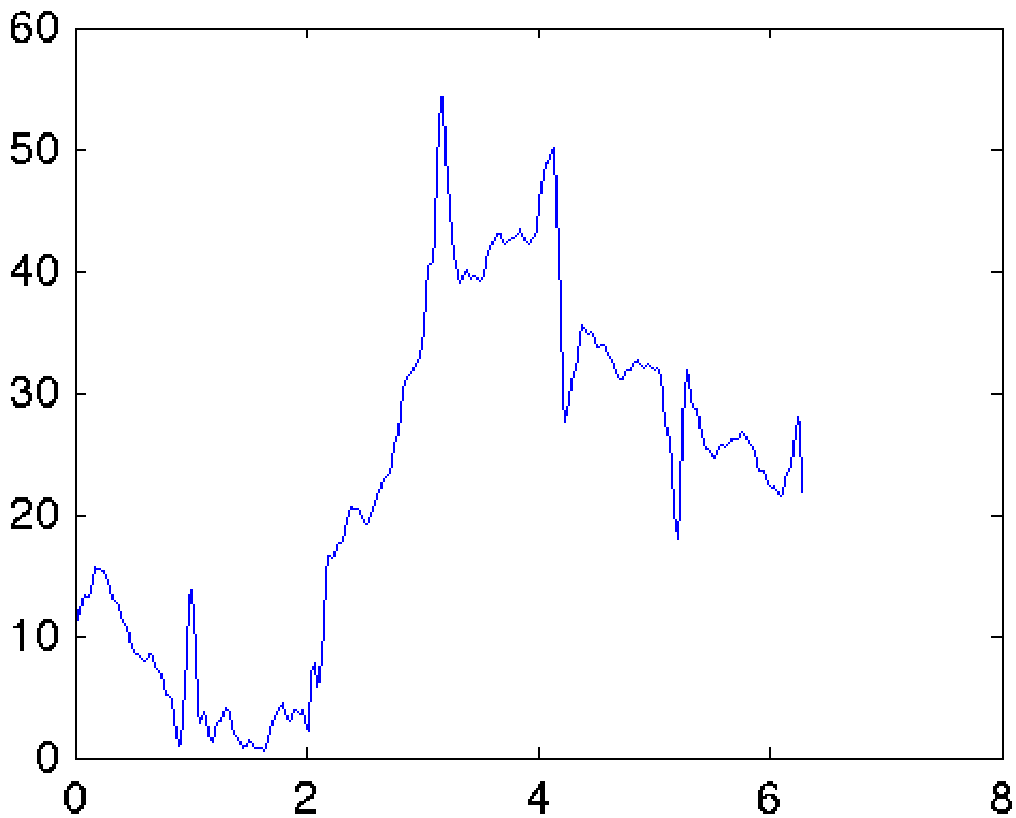
In [31]:
```
fftg=ifftshift(fft2(fftshift(g)));
plot(x,abs(fftg))
```



Lets set to zero the values less than the 10% of the maximum value

In [32]:
```
threshold=max(fftg)*0.01;
for i=1:N
    if fftg(i)<=threshold
        fftg(i)=0;
    end
end
```

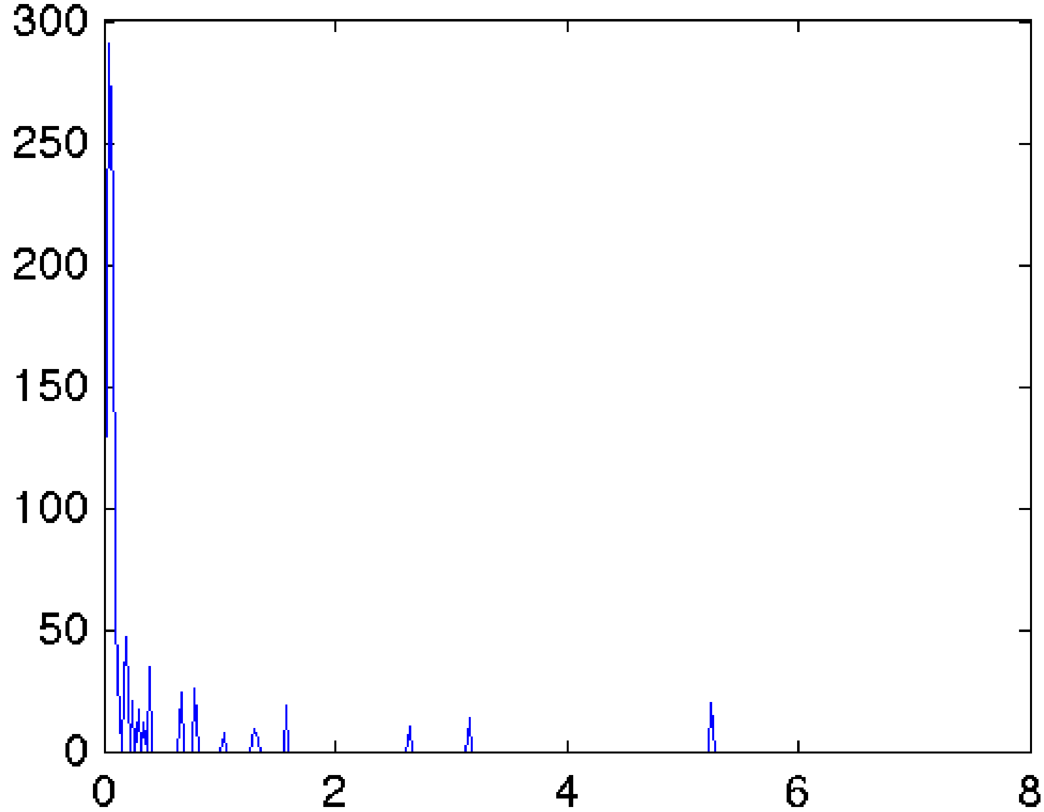
In [33]:
```
% Recovery of g with fft
plot(x,abs(fftshift(ifft2(ifftshift(fftg)))))
```



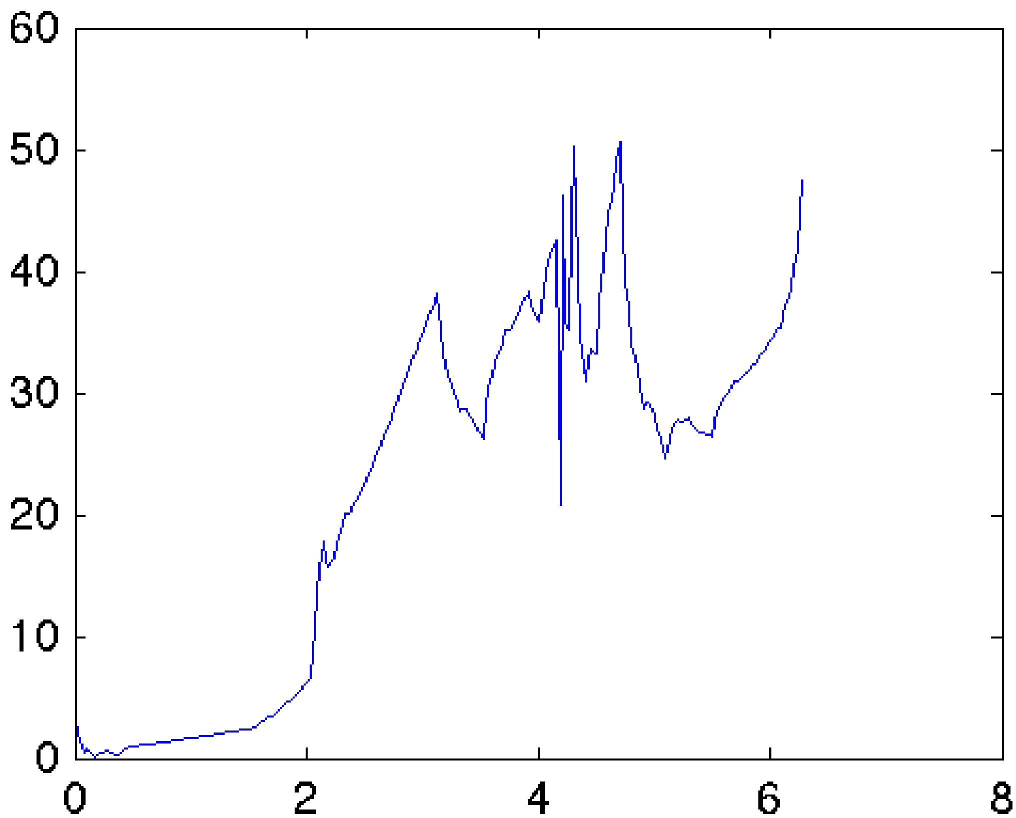
Now with wavelets

In [34]:
```
threshold=max(fwtg)*0.01;
for i=1:N
    if fwtg(i)<=threshold
        fwtg(i)=0;
    end
end
```

In [35]:
```
plot(x,fwtg)
```



In [41]:
```
% Recovery of g with wavelets
plot(x,abs(IWT_PO(fwtg,2,h)))
```



The recovery via wavelets is more accurate