

---

# Scaling Vector

## ■ Matrices

```
In[41]:= G[-2] = {{0, 0, 0.02669163201881291`, 0.026188780570349884`},  
              {0, 0, -0.03940748766209954`, -0.040769035522339014`}, {0, 0, 0, 0}, {0, 0, 0, 0}};
```

```
In[42]:= G[-1] = {{-0.11751247435095598`, -0.10652668959666897`, 0.30676124077120465`,  
                0.35964167838854366`}, {0.18731879383595215`, 0.18181954032277048`,  
                -0.4224381824999862`, -0.433225475337907`}, {0, 0, 0, 0}, {0, 0, 0, 0}};
```

```
In[43]:= G[0] = {{0.7071067811865841`, 0, 0.3067612407712861`, -0.3596416783882024`},  
              {0, 0.35355339059336993`, 0.42243818250022613`, -0.43322547533688205`},  
              {0, 0, 0.47106586494422936`, 0.23604093395898632`},  
              {0, 0, -0.5666158791523569`, -0.2916640296146426`}};
```

```
In[44]:= G[1] = {{-0.11751247435904282`, 0.10652668958949803`,  
               0.026691633234707347`, -0.026188779541901065`}, {-0.1873187938600181`,  
               0.18181954030143205`, 0.03940749128037211`, -0.040769032461869345`},  
               {0.6669057455800359`, 0, 0.47106586494422936`, -0.23604093395898632`},  
               {0, 0.4333094490577162`, 0.5666158791523569`, -0.2916640296146426`}};
```

## ■ Function Values

```
In[45]:= Clear[phi];
```

```
In[46]:= phi[0] = {1.7308078457850338`, 0, 0, 0} // N
```

```
Out[46]= {1.730807846, 0., 0., 0.}
```

```
In[47]:= phi[x_] := If[x ≤ -1 || x ≥ 1, {0, 0, 0, 0}, phi[x]];
```

```
In[48]:= phi[3]
```

```
Out[48]= {0, 0, 0, 0}
```

```
In[49]:= fill[j_] := Do[phi[x] =  $\sqrt{2}$  Sum[G[i].phi[2 x - i], {i, -2, 1}], {x, -1, 1, 2-j}};
```

```
In[50]:= fill[1]
```

```
In[51]:= fill[2]
```

```
In[52]:= fill[3]
```

```
In[53]:= fill[4]
```

```
In[54]:= fill[5]
```

```
In[55]:= fill[6]
```

```
In[56]:= fill[7]
```

```
In[57]:= pts[i_] := Table[{x, phi[x][[i]]}, {x, -1, 1, 2-7}};
```

```
In[58]:= phi[-1]
```

```
Out[58]= {0., 0., 0., 0.}
```

In[59]:= **phi**  $\left[-\frac{3}{4}\right]$

Out[59]= {0.04034697722, -0.04927664599, 0., 0.}

In[60]:= **phi**  $\left[-\frac{1}{2}\right]$

Out[60]= {-0.2876390356, 0.4585061926, 0., 0.}

In[61]:= **phi**  $\left[-\frac{1}{4}\right]$

Out[61]= {0.5374179101, -0.9400701714, 0., 0.}

In[62]:= **phi**[0]

Out[62]= {1.730807846, 0., 0., 0.}

In[63]:= **phi**  $\left[\frac{1}{4}\right]$

Out[63]= {0.5374179101, 0.9400701714, 0.8162032437, -1.027104237}

In[64]:= **phi**  $\left[\frac{1}{2}\right]$

Out[64]= {-0.2876390356, -0.4585061927, 1.632406487, 0.}

In[65]:= **phi**  $\left[\frac{3}{4}\right]$

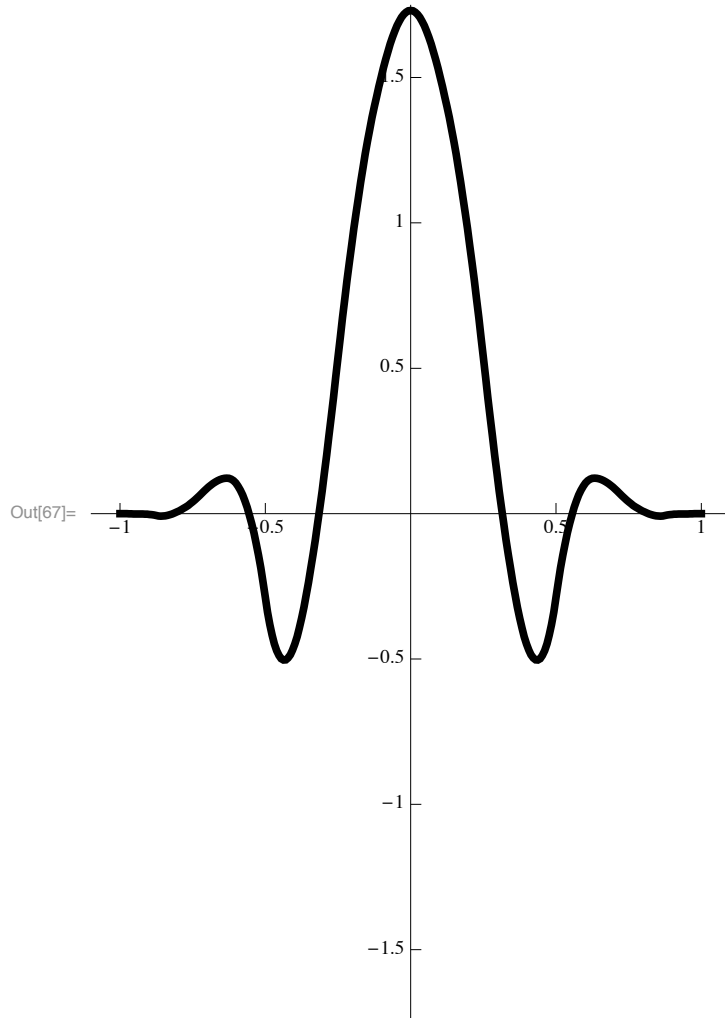
Out[65]= {0.04034698003, 0.04927665435, 0.8162032437, 1.027104237}

In[66]:= **phi**[1]

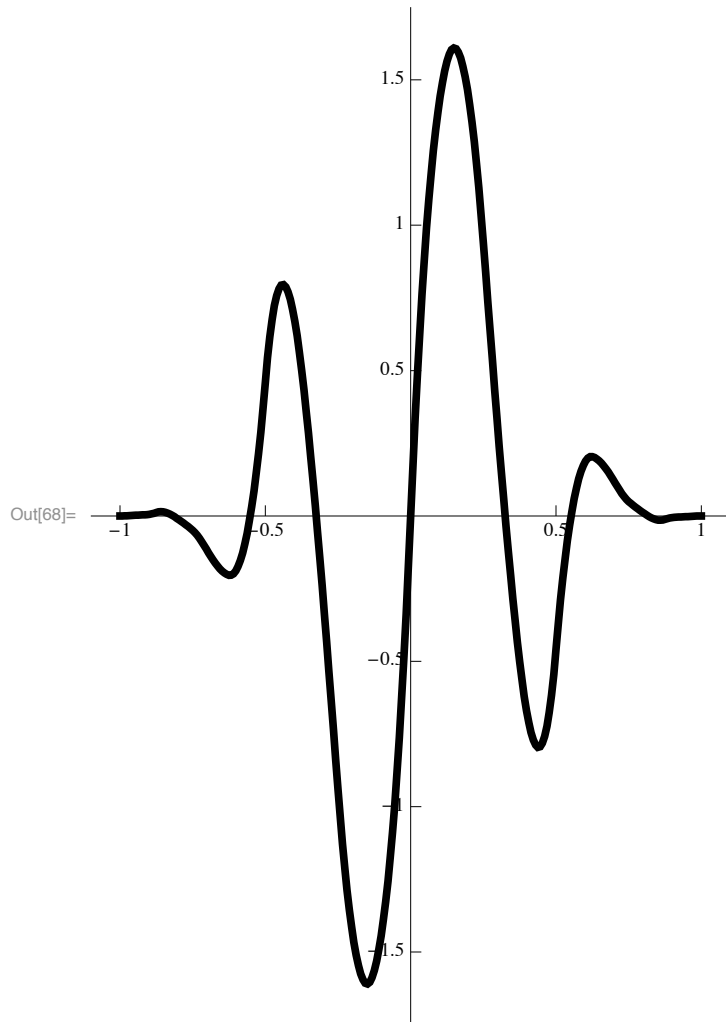
Out[66]= {0., 0., 0., 0.}

## ■ Graphs

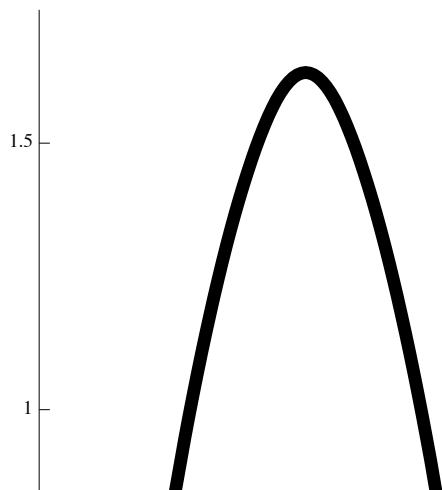
```
In[67]:= Show[Graphics[{Black, Thickness[.012], Line[pts[1]]}],  
  Axes → True, PlotRange → {{-1.1, 1.1}, {-1.75, 1.75}},  
  Ticks → {{-1, -.5, .5, 1}, {-1.5, -1, -.5, .5, 1, 1.5, 2, 2.5, 3}}]
```

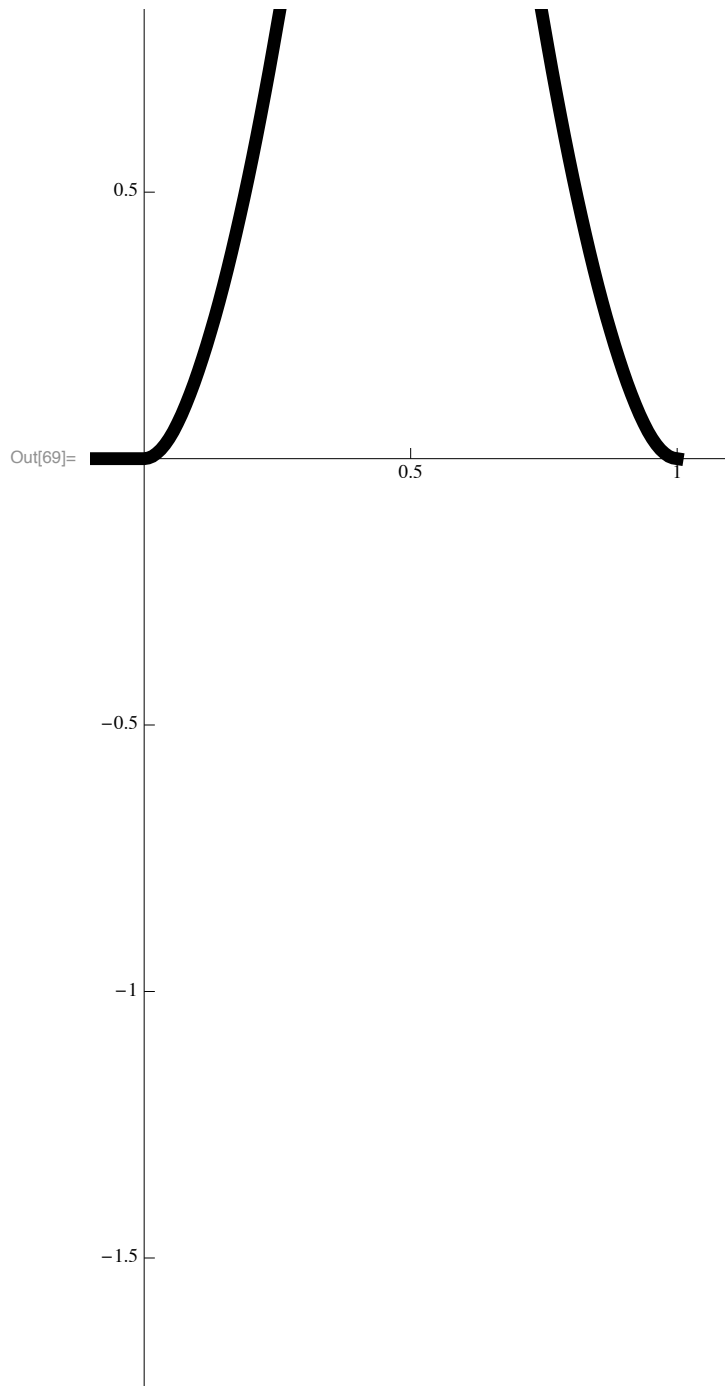


```
In[68]:= Show[Graphics[{Black, Thickness[.012], Line[pts[2]]}],  
  Axes → True, PlotRange → {{-1.1, 1.1}, {-1.75, 1.75}},  
  Ticks → {{-1, -.5, .5, 1}, {-1.5, -1, -.5, .5, 1, 1.5, 2, 2.5, 3}}]
```



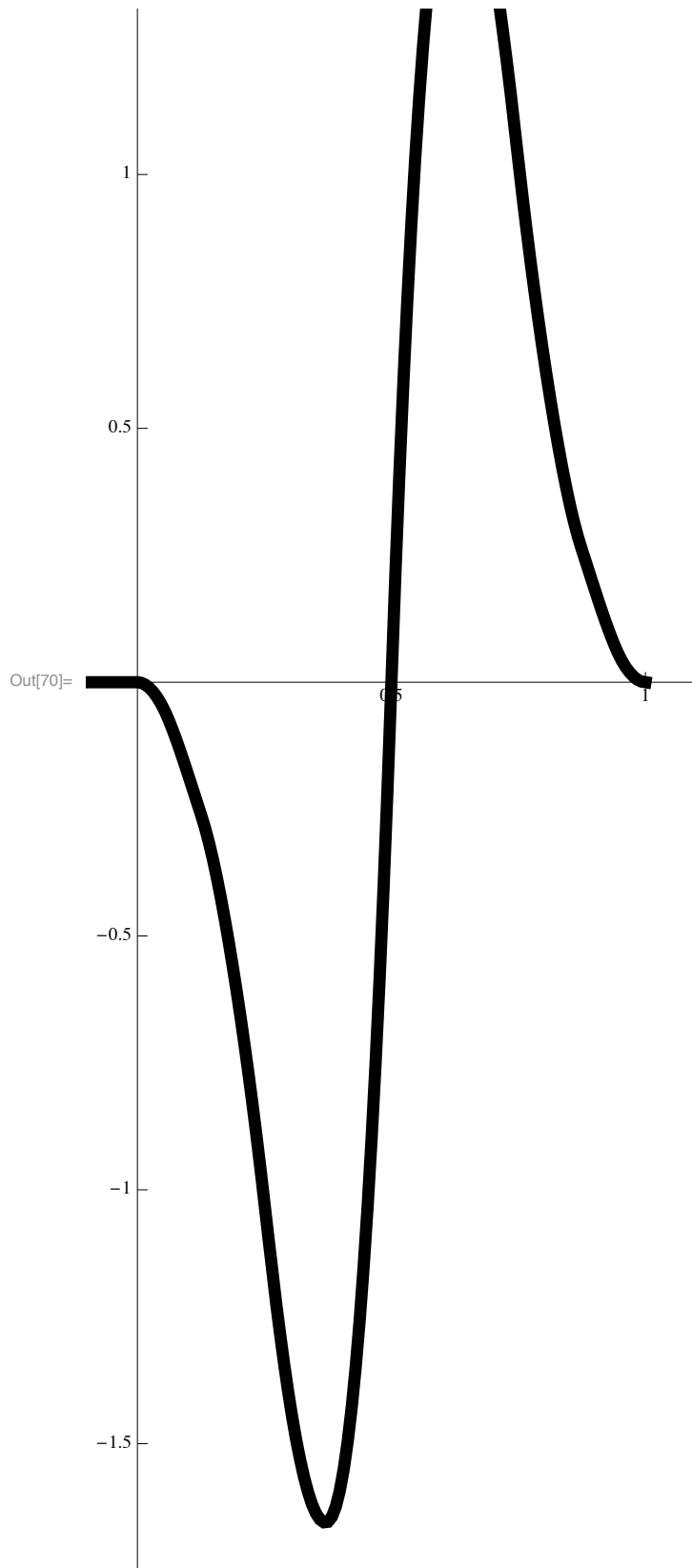
```
In[69]:= Show[Graphics[{Black, Thickness[.02], Line[pts[3]]}],  
  Axes → True, PlotRange → {{-0.1, 1.1}, {-1.75, 1.75}},  
  Ticks → {{-1, -.5, .5, 1}, {-1.5, -1, -.5, .5, 1, 1.5, 2, 2.5, 3}}]
```





```
In[70]= Show[Graphics[{Black, Thickness[.02], Line[pts[4]]}],  
  Axes → True, PlotRange → {{-0.1, 1.1}, {-1.75, 1.75}},  
  Ticks → {{-1, -.5, .5, 1}, {-1.5, -1, -.5, .5, 1, 1.5, 2, 2.5, 3}}]
```





# Multiwavelet

## ■ Matrices

```

In[71]:= H[-2] = {{0, 0, 0.026691631350082096`, 0.026188779914217485`},
  {0, 0, 0.043743653006003906`, 0.06435982959198171`}, {0, 0, -0.013410540810749855`,
  -0.013157895717088848`}, {0, 0, -0.04006995259666773`, -0.060651857618035654`}};

In[72]:= H[-1] = {{-0.11751247140680432`, -0.10652668692775462`, 0.30676123308562386`,
  0.35964166937809905`}, {-0.3334538093583894`, -0.4246928494631754`,
  0.1922977905008767`, -0.4067067810936163`}, {0.05904119433180234`,
  0.053521662417019424`, -0.15412448873935367`, -0.18069293784197155`},
  {0.31660009019953533`, 0.4088238959496059`, -0.15157506646288071`, 0.45139832417009795`}};

In[73]:= H[0] = {{-0.707106787091808`, 0, 0.3067612330857053`, -0.35964166937775777`},
  {0, 0, 0.1922977905022298`, 0.4067067810994858`},
  {0, -0.9347644627208598`, 0.15412448873939458`, -0.18069293784180007`},
  {0, -0.034862829700229456`, 0.15157506646421662`, 0.4513983241758947`}};

In[74]:= H[1] =
  {{-0.11751247141489116`, 0.10652668692058367`, 0.0266916325659765`, -0.02618877888576869`},
  {-0.3334538094952176`, 0.42469284934186313`, 0.04374367357717413`, -0.06435981219212035`},
  {-0.05904119433586537`, 0.05352166241341656`,
  0.013410541421645506`, -0.013157895200370542`},
  {-0.316600090334654`, 0.4088238958298094`, 0.04006997291081931`, -0.060651840435570196`}};

```

## ■ Graphs

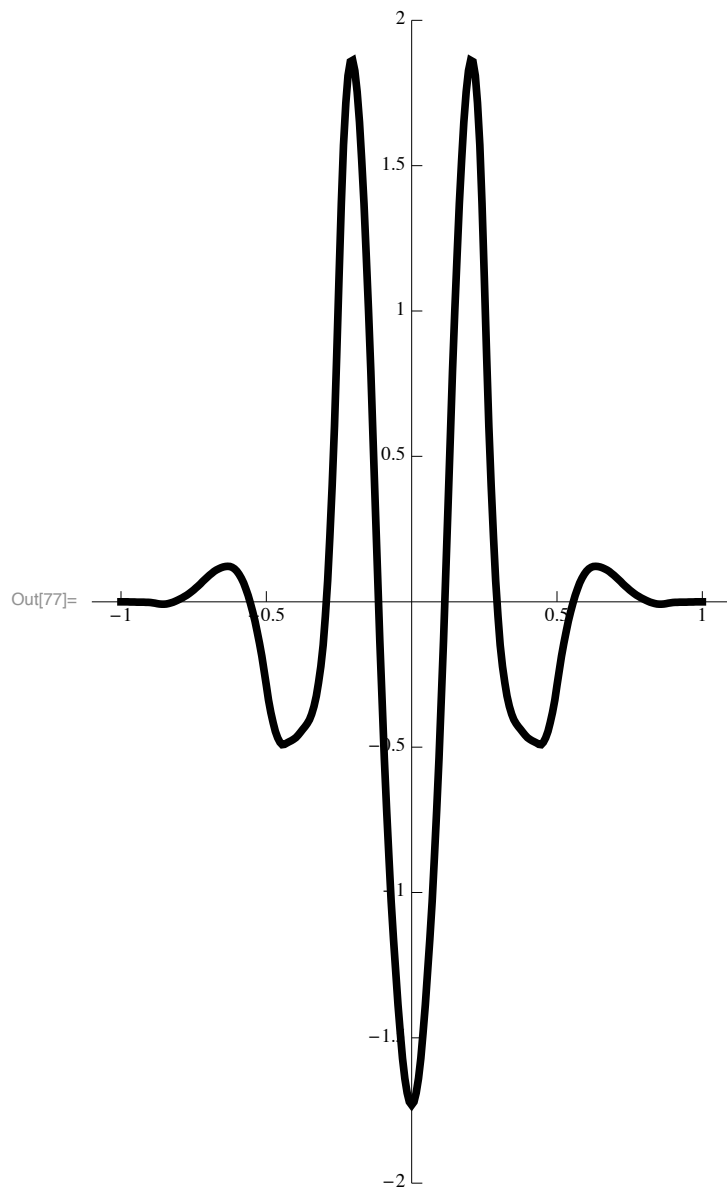
```

In[75]:= Do[psi[x] = Sqrt[2] Sum[H[i].phi[2 x - i], {i, -2, 1}], {x, -1, 1, 2^-7}];

In[76]:= pts[i_] := Table[{x, psi[x][[i]]} // N, {x, -1, 1, 2^-7}];

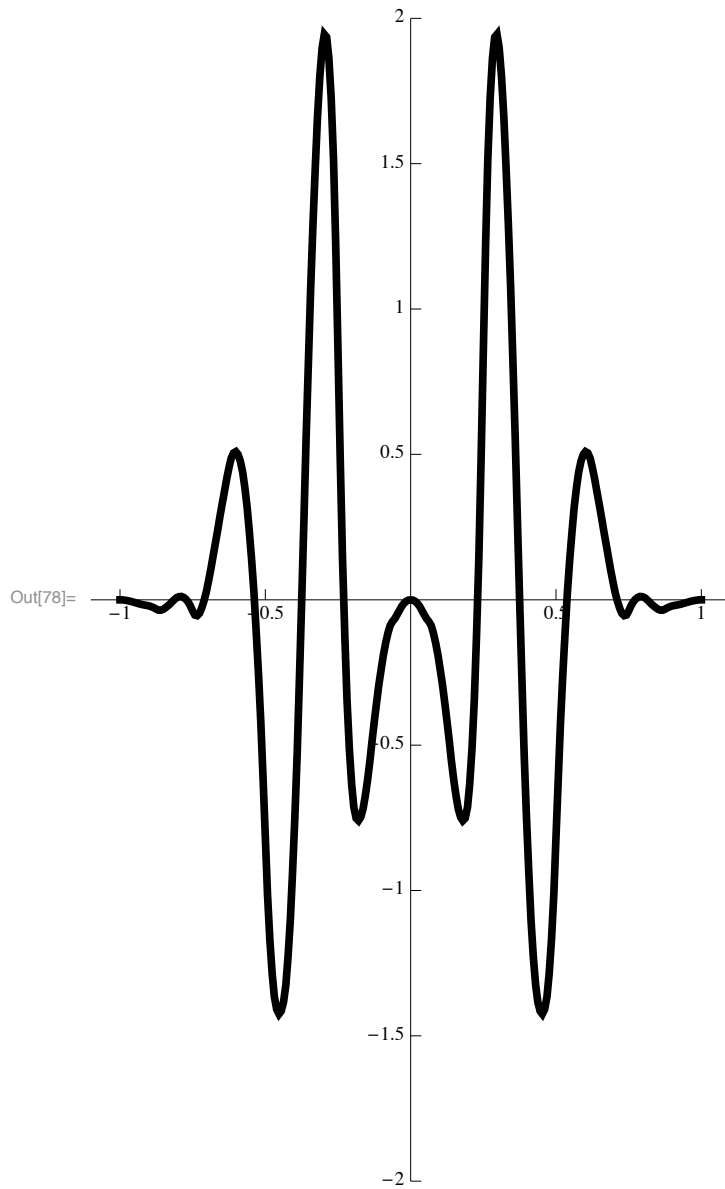
```

```
In[77]:= Show[Graphics[{Black, Thickness[.012], Line[pts[1]]}],  
  Axes → True, PlotRange → {{-1.1, 1.1}, {-2, 2}},  
  Ticks → {{-1, -.5, .5, 1}, {-2, -1.5, -1, -.5, .5, 1, 1.5, 2, 2.5, 3}}]
```

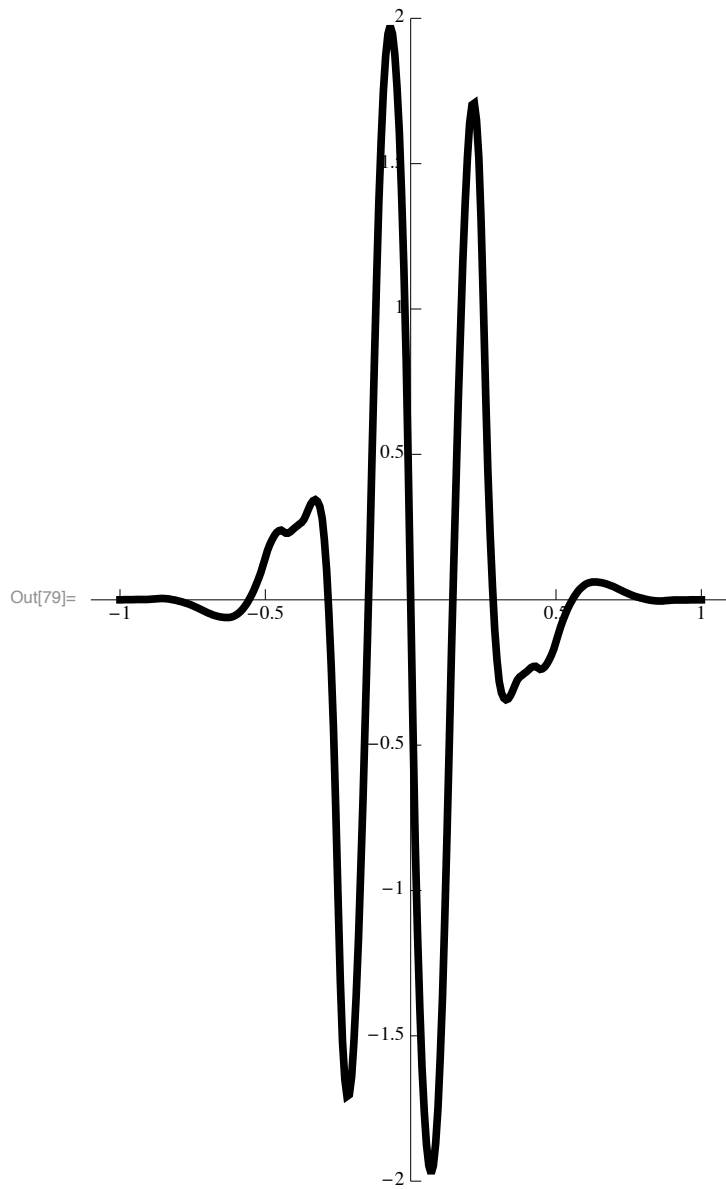




```
In[78]:= Show[Graphics[{Black, Thickness[.012], Line[pts[2]]}],  
  Axes → True, PlotRange → {{-1.1, 1.1}, {-2, 2}},  
  Ticks → {{-1, -.5, .5, 1}, {-2, -1.5, -1, -.5, .5, 1, 1.5, 2, 2.5, 3}}]
```



```
In[79]:= Show[Graphics[{Black, Thickness[.012], Line[pts[3]]}],  
  Axes → True, PlotRange → {{-1.1, 1.1}, {-2, 2}},  
  Ticks → {{-1, -.5, .5, 1}, {-2, -1.5, -1, -.5, .5, 1, 1.5, 2, 2.5, 3}}]
```



```
In[80]:= Show[Graphics[{Black, Thickness[.012], Line[pts[4]]}],  
  Axes → True, PlotRange → {{-1.1, 1.1}, {-2, 2}},  
  Ticks → {{-1, -.5, .5, 1}, {-2, -1.5, -1, -.5, .5, 1, 1.5, 2, 2.5, 3}}]
```

