Laboratorium 12

Transformacja falkowa - właściwości i zastosowania

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1. Wstęp

Transformacja Fouriera stosuje w jądrze funkcje sinusoidalne, natomiast transformacja falkowa stosuje funkcje (falki), które spełniają wymagania analizy częstotliwościowej. Funkcje okresowe (sin/cos) sa dobre do określenia częstotliwosci, ale nie w dziedzinie czasu. Transformacja falkowa służy do analizy sygnałów niestacjonarnych, gdyż dostarcza informacji o czasowo-częstotliwosciowych zmianach sygnałów.

2. Przebieg laboratorium

Zad 1

Obliczyć współczynnik d5 z zastosowaniem falki 'db2' dla: wiatrak_20.wav, wiatrak_21.wav, wiatrak_23.wav, wiatrak_24.wav, przekladnia20.wav, przekladnia21.wav, przekladnia23.wav, przekladnia24.wav

```
falka = 'db2';
num = 5;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num)
```

```
d5_P20 = 1381×1
    0.0991
    0.5636
    0.0769
    0.1056
   -0.1228
   -0.0567
    0.0412
   -0.3364
   -0.2354
    0.2691
      ⋮
      ⋮
```

```
% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = detcoef(c, l, num)
```

```
d5_P21 = 1381×1
   -0.0882
    0.4629
   -0.2254
   -0.5982
   -0.2606
    0.5902
   -0.3898
   -0.1755
    0.2412
```

```
    0.0027
      ⋮
```

```
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = detcoef(c, l, num)
```

```
d5_P23 = 1381×1
    0.0201
   -0.1864
    0.2455
   -0.0205
    0.1849
   -0.3301
   -0.0386
   -0.0009
   -0.1847
   -0.2398
      ⋮
```

```
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = detcoef(c, l, num)
```

```
d5_P24 = 1381×1
   -0.0241
    0.0732
   -0.1612
    0.0976
   -0.5347
   -0.3691
   -0.0714
    0.2332
    0.4713
    0.1872
      ⋮
```

```
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = detcoef(c, l, num)
```

```
d5_W20 = 1381×1
    0.0991
    0.5636
    0.0769
    0.1056
   -0.1228
   -0.0567
    0.0412
   -0.3364
   -0.2354
    0.2691
      ⋮
```

```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = detcoef(c, l, num)
```

```
d5_W21 = 1381×1
   -0.0882
    0.4629
   -0.2254
   -0.5982
   -0.2606
    0.5902
   -0.3898
   -0.1755
    0.2412
    0.0027
      ⋮
```

```
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = detcoef(c, l, num)
```

```
d5_W23 = 1381×1
    0.0201
   -0.1864
    0.2455
   -0.0205
    0.1849
   -0.3301
   -0.0386
   -0.0009
   -0.1847
   -0.2398
      ⋮
```

```
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = detcoef(c, l, num)
```

```
d5_W24 = 1381×1
   -0.0241
    0.0732
   -0.1612
    0.0976
   -0.5347
   -0.3691
   -0.0714
    0.2332
    0.4713
    0.1872
      ⋮
```

Zad 2

Obliczyć współczynnik a4 z zastosowaniem falki 'coif2' dla: wiatrak_20.wav, wiatrak_21.wav, wiatrak_23.wav, wiatrak_24.wav, przekladnia20.wav, przekladnia21.wav, przekladnia23.wav, przekladnia24.wav

```
falka = 'coif2';
num = 4;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = appcoef(c, l, falka, num)
```

```
d5_P20 = 2766×1
   -0.7636
   -0.7740
   -0.7559
   -0.7545
   -0.7461
   -0.8531
   -0.1523
    0.0976
    0.1985
   -0.1920
      ⋮
```

```
% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = appcoef(c, l, falka, num)
```

```
d5_P21 = 2766×1
   -0.0077
    0.0898
    0.0782
   -0.0610
    0.0541
    0.0855
    0.0901
    0.1077
   -0.1058
    0.2221
      ⋮
```

```
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = appcoef(c, l, falka, num)
```

```
d5_P23 = 2766×1
    0.4091
    0.3846
    0.3784
    0.4221
    0.3996
    0.4115
    0.1820
   -0.2484
    0.0876
    0.1442
      ⋮
```

```
% P24
```

```
[c, l] = wavedec(P24, num, falka);
[d5_P24] = appcoef(c, l, falka, num)
```

```
d5_P24 = 2766×1
   -0.1909
   -0.2388
   -0.1935
   -0.1828
   -0.2288
   -0.2493
   -0.0736
    0.1137
   -0.1491
   -0.1880
      ⋮
```

```
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = appcoef(c, l, falka, num)
```

```
d5_W20 = 2766×1
   -0.7636
   -0.7740
   -0.7559
   -0.7545
   -0.7461
   -0.8531
   -0.1523
    0.0976
    0.1985
   -0.1920
      ⋮
```

```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = appcoef(c, l, falka, num)
```

```
d5_W21 = 2766×1
   -0.0077
    0.0898
    0.0782
   -0.0610
    0.0541
    0.0855
    0.0901
    0.1077
   -0.1058
    0.2221
      ⋮
```

```
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = appcoef(c, l, falka, num)
```

```
d5_W23 = 2766×1
    0.4091
```

```
    0.3846
    0.3784
    0.4221
    0.3996
    0.4115
    0.1820
   -0.2484
    0.0876
    0.1442
      ⋮
```

```
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = appcoef(c, l, falka, num)
```

```
d5_W24 = 2766×1
   -0.1909
   -0.2388
   -0.1935
   -0.1828
   -0.2288
   -0.2493
   -0.0736
    0.1137
   -0.1491
   -0.1880
      ⋮
```

Zad 3

Obliczyć współczynnik a8 z zastosowaniem falki 'coif2' dla: wiatrak_20.wav, wiatrak_21.wav, wiatrak_23.wav, wiatrak_24.wav, przekladnia20.wav, przekladnia21.wav, przekladnia23.wav, przekladnia24.wav

```
falka = 'coif2';
num = 8;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = appcoef(c, l, falka, num)
```

```
d5_P20 = 183×1
   -2.8530
   -2.9342
   -2.9387
   -2.8723
   -2.9204
   -3.1563
   -1.4812
    0.1652
   -0.0255
   -0.0288
      ⋮
```

```
% P21
[c, l] = wavedec(P21, num, falka);
```

```
[d5_P21] = appcoef(c, l, falka, num)
```

```
d5_P21 = 183×1
    0.1939
    0.1687
    0.1855
    0.1757
    0.1738
    0.1805
    0.1429
    0.0222
   -0.0499
    0.0012
      ⋮
```

```
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = appcoef(c, l, falka, num)
```

```
d5_P23 = 183×1
    1.5128
    1.5246
    1.5520
    1.5102
    1.5247
    1.6618
    0.7708
   -0.0598
   -0.0468
   -0.0584
      ⋮
```

```
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = appcoef(c, l, falka, num)
```

```
d5_P24 = 183×1
   -0.8086
   -0.8031
   -0.8261
   -0.8123
   -0.8037
   -0.8739
   -0.4292
    0.0179
    0.0452
   -0.0725
      ⋮
```

```
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = appcoef(c, l, falka, num)
```

```
d5_W20 = 183×1
   -2.8530
   -2.9342
```

```
   -2.9387
   -2.8723
   -2.9204
   -3.1563
   -1.4812
    0.1652
   -0.0255
   -0.0288
      ⋮
```

```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = appcoef(c, l, falka, num)
```

```
d5_W21 = 183×1
    0.1939
    0.1687
    0.1855
    0.1757
    0.1738
    0.1805
    0.1429
    0.0222
   -0.0499
    0.0012
      ⋮
```

```
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = appcoef(c, l, falka, num)
```

```
d5_W23 = 183×1
    1.5128
    1.5246
    1.5520
    1.5102
    1.5247
    1.6618
    0.7708
   -0.0598
   -0.0468
   -0.0584
      ⋮
```

```
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = appcoef(c, l, falka, num)
```

```
d5_W24 = 183×1
   -0.8086
   -0.8031
   -0.8261
   -0.8123
   -0.8037
   -0.8739
```

```
   -0.4292
    0.0179
    0.0452
   -0.0725
      ⋮
```

Zad 4

Obliczyć współczynnik d10 z zastosowaniem falki 'haar' dla: wiatrak_20.wav, wiatrak_21.wav, wiatrak_23.wav, wiatrak_24.wav, przekladnia20.wav, przekladnia21.wav, przekladnia23.wav, przekladnia24.wav

```
falka = 'haar';
num = 10;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num)
```

```
d5_P20 = 44×1
   -0.0597
   -0.0083
   -0.0253
    0.0581
   -0.0581
   -0.0466
    0.0830
   -0.0947
   -0.0013
    0.1108
      ⋮
```

```
% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = detcoef(c, l, num)
```

```
d5_P21 = 44×1
    0.0488
   -0.0400
    0.0597
    0.0712
   -0.0028
    0.0540
    0.0235
   -0.0480
   -0.0506
    0.0524
      ⋮
```

```
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = detcoef(c, l, num)
```

```
d5_P23 = 44×1
   -0.0235
```

```
    0.0046
   -0.0487
    0.0381
   -0.0262
   -0.0110
    0.0076
    0.0690
   -0.0208
   -0.0073
      ⋮
```

```
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = detcoef(c, l, num)
```

```
d5_P24 = 44×1
   -0.0924
    0.1219
   -0.0622
   -0.0650
    0.0118
   -0.0445
   -0.1189
    0.0157
    0.1002
   -0.0974
      ⋮
```

```
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = detcoef(c, l, num)
```

```
d5_W20 = 44×1
   -0.0597
   -0.0083
   -0.0253
    0.0581
   -0.0581
   -0.0466
    0.0830
   -0.0947
   -0.0013
    0.1108
      ⋮
```

```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = detcoef(c, l, num)
```

```
d5_W21 = 44×1
    0.0488
   -0.0400
    0.0597
    0.0712
   -0.0028
```

```
    0.0540
    0.0235
   -0.0480
   -0.0506
    0.0524
      ⋮
```

```
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = detcoef(c, l, num)
```

```
d5_W23 = 44×1
   -0.0235
    0.0046
   -0.0487
    0.0381
   -0.0262
   -0.0110
    0.0076
    0.0690
   -0.0208
   -0.0073
      ⋮
```

```
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = detcoef(c, l, num)
```

```
d5_W24 = 44×1
   -0.0924
    0.1219
   -0.0622
   -0.0650
    0.0118
   -0.0445
   -0.1189
    0.0157
    0.1002
   -0.0974
      ⋮
```

Zad 5

Obliczyć współczynnik d10 z zastosowaniem falki 'dmey' dla: wiatrak_20.wav, wiatrak_21.wav, wiatrak_23.wav, wiatrak_24.wav, przekladnia20.wav, przekladnia21.wav, przekladnia23.wav, przekladnia24.wav

```
falka = 'dmey';
num = 10;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num)
```

```
d5_P20 = 143×1
```

```
    0.0492
   -0.0077
    0.0144
   -0.0089
    0.0001
    0.0005
    0.0069
    0.0047
   -0.0002
   -0.0097
      ⋮
```

```
% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = detcoef(c, l, num)
```

```
d5_P21 = 143×1
    0.0430
   -0.0146
   -0.0224
    0.0199
   -0.0094
   -0.0049
    0.0224
   -0.0151
    0.0177
    0.0234
      ⋮
```

```
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = detcoef(c, l, num)
```

```
d5_P23 = 143×1
    0.0030
   -0.0059
    0.0152
   -0.0138
    0.0085
    0.0031
   -0.0166
    0.0096
   -0.0070
   -0.0082
      ⋮
```

```
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = detcoef(c, l, num)
```

```
d5_P24 = 143×1
   -0.0502
    0.0012
   -0.0345
    0.0169
```

```
   -0.0142
   -0.0010
    0.0361
   -0.0034
    0.0231
    0.0272
      ⋮
```

```
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = detcoef(c, l, num)
```

```
d5_W20 = 143×1
    0.0492
   -0.0077
    0.0144
   -0.0089
    0.0001
    0.0005
    0.0069
    0.0047
   -0.0002
   -0.0097
      ⋮
```

```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = detcoef(c, l, num)
```

```
d5_W21 = 143×1
    0.0430
   -0.0146
   -0.0224
    0.0199
   -0.0094
   -0.0049
    0.0224
   -0.0151
    0.0177
    0.0234
      ⋮
```

```
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = detcoef(c, l, num)
```

```
d5_W23 = 143×1
    0.0030
   -0.0059
    0.0152
   -0.0138
    0.0085
    0.0031
   -0.0166
    0.0096
```

```
   -0.0070
   -0.0082
     ⋮
```

```
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = detcoef(c, l, num)
```

```
d5_W24 = 143×1
   -0.0502
    0.0012
   -0.0345
    0.0169
   -0.0142
   -0.0010
    0.0361
   -0.0034
    0.0231
    0.0272
     ⋮
```

Zad 6

Obliczyć współczynnik a8 z zastosowaniem falki 'bior3.5' dla: wiatrak_20.wav, wiatrak_21.wav, wiatrak_23.wav, wiatrak_24.wav, przekladnia20.wav, przekladnia21.wav, przekladnia23.wav, przekladnia24.wav

```
falka = 'bior3.5';
num = 8;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num)
```

```
d5_P20 = 183×1
    1.2580
    0.5708
   -0.0000
   -0.5708
   -1.2580
   -1.4479
   -0.5166
   -0.4096
   -0.2229
    0.0471
     ⋮
```

```
% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = detcoef(c, l, num)
```

```
d5_P21 = 183×1
    0.4123
    0.2233
   -0.0000
```

```
   -0.2233
   -0.4123
   -0.3349
    0.0551
    0.2735
    0.2800
    0.0655
      ⋮
```

```
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = detcoef(c, l, num)
```

```
d5_P23 = 183×1
   -0.6191
   -0.1924
    0.0000
    0.1924
    0.6191
    0.5697
   -0.3632
   -0.1160
    0.0246
   -0.4330
      ⋮
```

```
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = detcoef(c, l, num)
```

```
d5_P24 = 183×1
    0.8077
    0.4799
    0.0000
   -0.4799
   -0.8077
   -0.7261
   -0.3478
   -0.5390
   -0.3152
    0.1298
      ⋮
```

```
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = detcoef(c, l, num)
```

```
d5_W20 = 183×1
    1.2580
    0.5708
   -0.0000
   -0.5708
   -1.2580
   -1.4479
   -0.5166
```

```
   -0.4096
   -0.2229
    0.0471
      ⋮
```

```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = detcoef(c, l, num)
```

```
d5_W21 = 183×1
    0.4123
    0.2233
   -0.0000
   -0.2233
   -0.4123
   -0.3349
    0.0551
    0.2735
    0.2800
    0.0655
      ⋮
```

```
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = detcoef(c, l, num)
```

```
d5_W23 = 183×1
   -0.6191
   -0.1924
    0.0000
    0.1924
    0.6191
    0.5697
   -0.3632
   -0.1160
    0.0246
   -0.4330
      ⋮
```

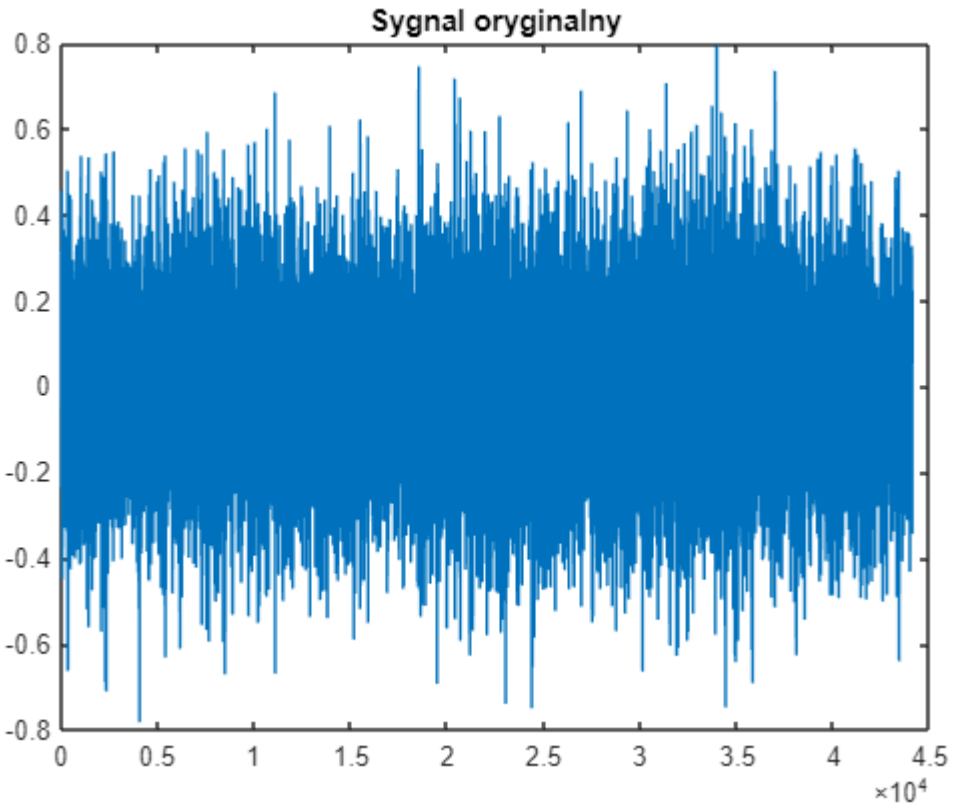
```
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = detcoef(c, l, num)
```

```
d5_W24 = 183×1
    0.8077
    0.4799
    0.0000
   -0.4799
   -0.8077
   -0.7261
   -0.3478
   -0.5390
   -0.3152
    0.1298
```

Zad 7

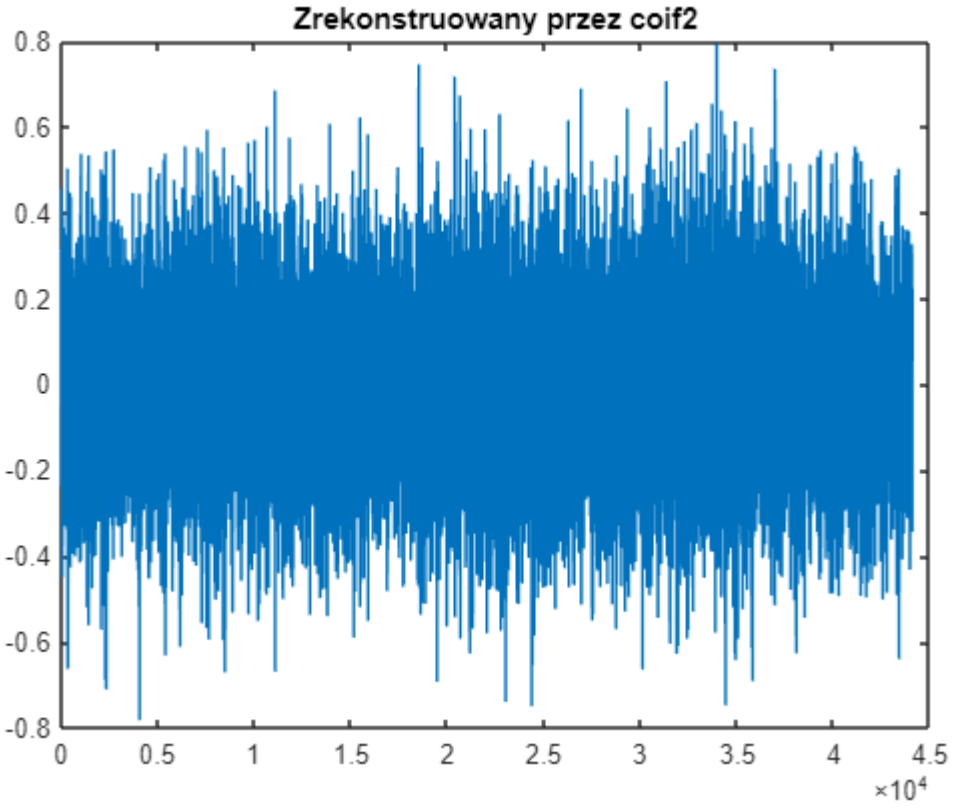
Wykonać dekompozycję obrazu 'wiatrak_20.wav' funkcją `wavedec(), waverec()`. Do tego celu zastosować falkę 'coif2'. Następnie zrekonstruować obraz falką 'coif2'. Proszę zaobserwować różnice. Proszę użyć 12 stopnia dekompozycji.

```
figure(1), plot(W20), title('Sygnal oryginalny');
```

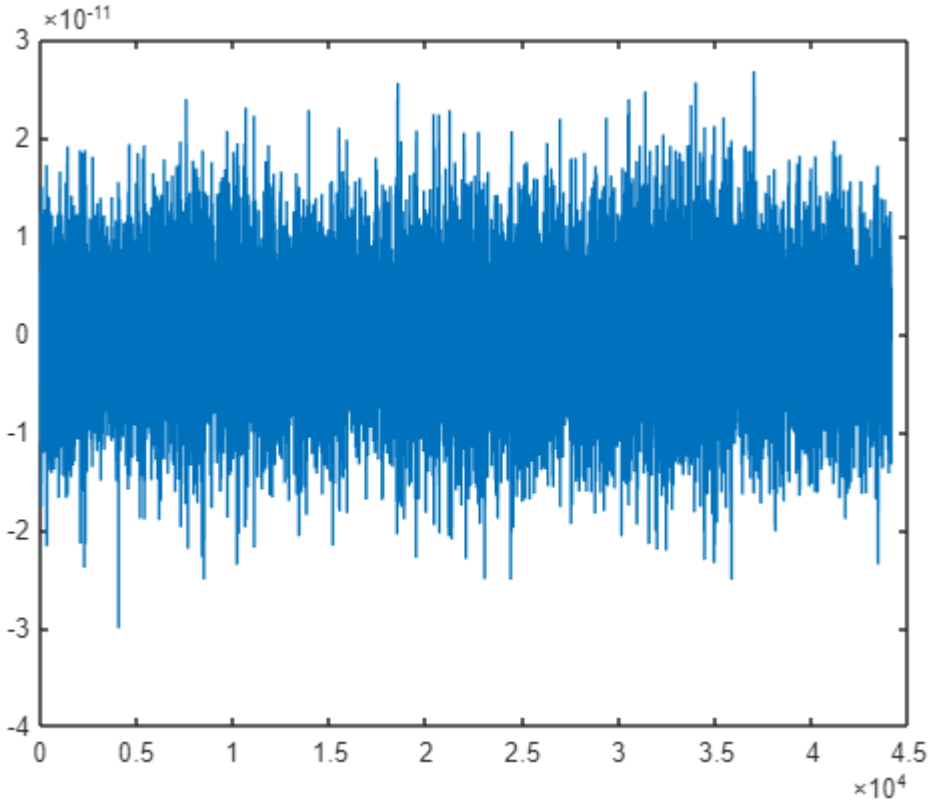



```
[c,l] = wavedec(W20,6, 'coif2');

Rec = waverec(c,l,'coif2');
figure(2), plot(Rec), title('Zrekonstruowany przez coif2');
```



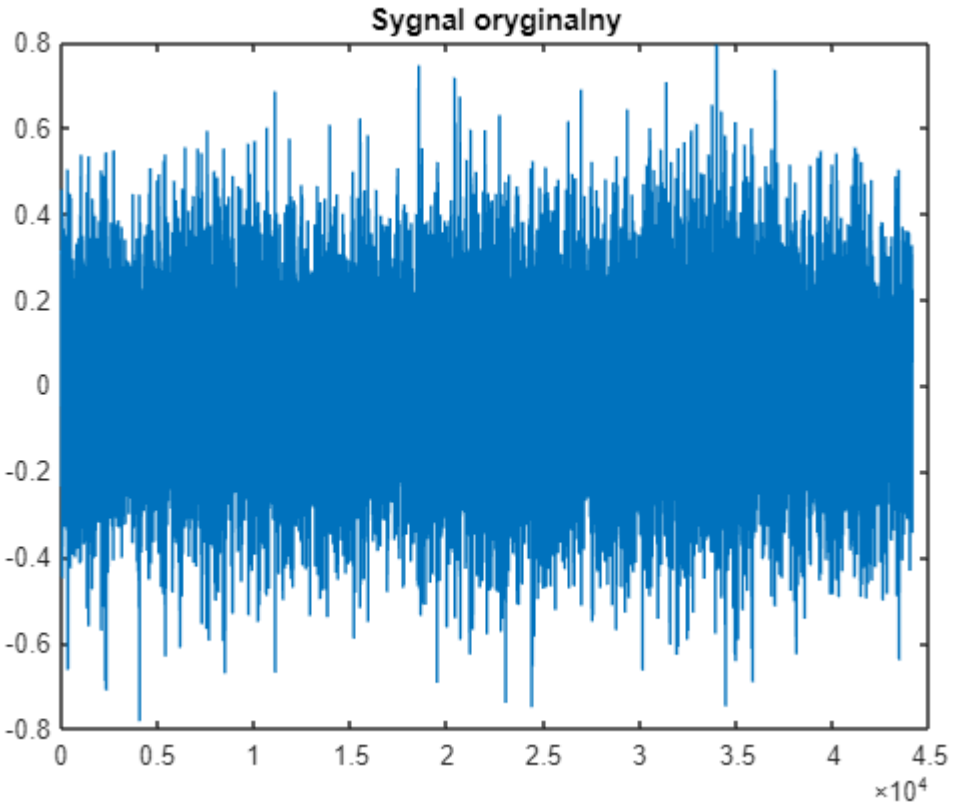

```
roznica = W20 - Rec;
figure(3), plot(roznica);
```



Zad 8

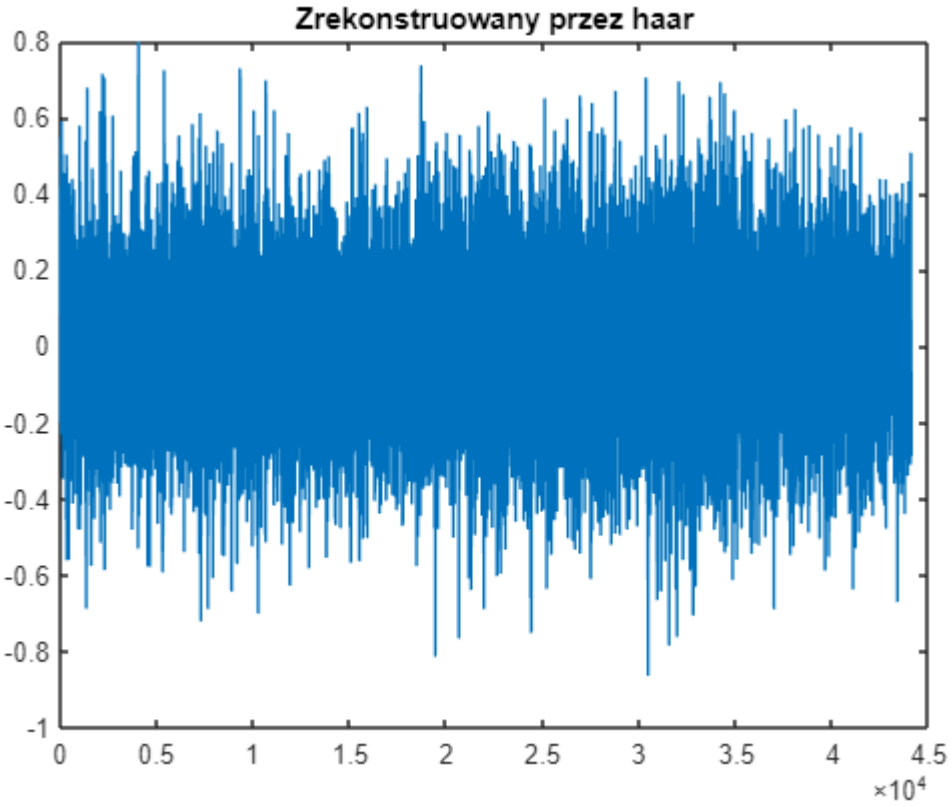
Wykonać dekompozycję obrazu 'wiatrak_20.wav' funkcjami `wavedec(), waverec().` Do tego celu zastosować falkę 'coif2'. Następnie zrekonstruować obraz falką 'haar'. Proszę zaobserwować różnice. Proszę użyć 12 stopnia dekompozycji.

```
figure(1), plot(W20), title('Sygnal oryginalny');
```

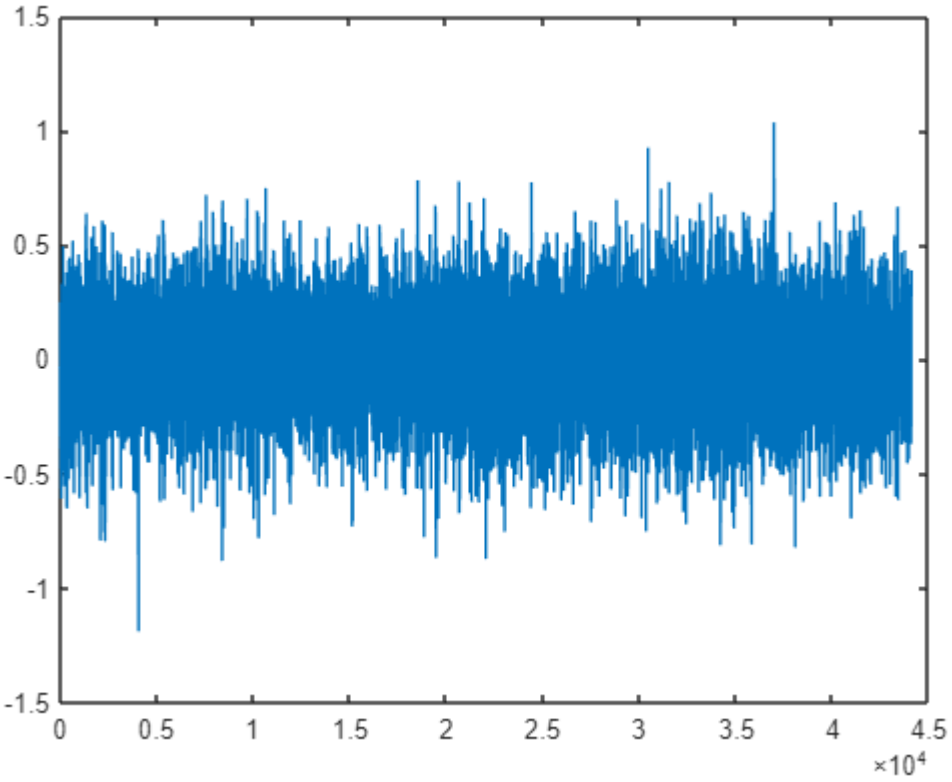



```
[c,l] = wavedec(W20,6, 'coif2');

Rec = waverec(c,l,'haar');
figure(2), plot(Rec), title('Zrekonstruowany przez haar');
```




```
roznica = W20 - Rec;
figure(3), plot(roznica);
```



Zad 9

Obliczyć współczynnik a12 z zastosowaniem falki 'sym2' dla: wiatrak_20.wav, wiatrak_21.wav, wiatrak_23.wav, wiatrak_24.wav, przekladnia20.wav, przekladnia21.wav, przekladnia23.wav, przekladnia24.wav

```
falka = 'sym2';
num = 12;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = appcoef(c, l, falka, num)
```

```
d5_P20 = 13×1
   -6.0615
   -5.4489
   -0.0280
   -0.0563
   -0.0351
   -0.0220
    0.0180
   -0.0464
   -0.0022
    0.0116
      ⋮
```

```
% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = appcoef(c, l, falka, num)
```

```
d5_P21 = 13×1
  -10.4008
   -9.2888
   -0.0588
   -0.0549
    0.0850
   -0.0106
   -0.0371
   -0.0272
   -0.0633
   -0.0020
      ⋮
```

```
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = appcoef(c, l, falka, num)
```

```
d5_P23 = 13×1
   10.5749
    9.4315
   -0.0491
    0.0030
    0.0188
    0.0083
    0.0023
   -0.0364
```

```
   -0.0107
   -0.0195
     ⋮
```

```
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = appcoef(c, l, falka, num)
```

```
d5_P24 = 13×1
   -2.9775
   -2.6853
    0.0101
    0.0134
    0.0200
    0.0414
    0.0212
   -0.0261
   -0.0198
   -0.0244
     ⋮
```

```
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = appcoef(c, l, falka, num)
```

```
d5_W20 = 13×1
   -6.0615
   -5.4489
   -0.0280
   -0.0563
   -0.0351
   -0.0220
    0.0180
   -0.0464
   -0.0022
    0.0116
     ⋮
```

```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = appcoef(c, l, falka, num)
```

```
d5_W21 = 13×1
  -10.4008
   -9.2888
   -0.0588
   -0.0549
    0.0850
   -0.0106
   -0.0371
   -0.0272
   -0.0633
   -0.0020
     ⋮
```

```
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = appcoef(c, l, falka, num)
```

```
d5_W23 = 13×1
   10.5749
    9.4315
   -0.0491
    0.0030
    0.0188
    0.0083
    0.0023
   -0.0364
   -0.0107
   -0.0195
      ⋮
```

```
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = appcoef(c, l, falka, num)
```

```
d5_W24 = 13×1
   -2.9775
   -2.6853
    0.0101
    0.0134
    0.0200
    0.0414
    0.0212
   -0.0261
   -0.0198
   -0.0244
      ⋮
```

Zad 10

Obliczyć współczynnik d12 z zastosowaniem falki 'sym2' dla: wiatrak_20.wav, wiatrak_21.wav, wiatrak_23.wav, wiatrak_24.wav, przekladnia20.wav, przekladnia21.wav, przekladnia23.wav, przekladnia24.wav

```
falka = 'sym2';
num = 12;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num)
```

```
d5_P20 = 13×1
   -0.2829
    1.3502
    0.0033
   -0.0617
   -0.0143
   -0.0035
    0.0055
    0.0433
```

```
   -0.0019
   -0.0346
     ⋮
```

```
% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = detcoef(c, l, num)
```

```
d5_P21 = 13×1
   -0.4967
    2.5062
    0.0001
   -0.0533
    0.0399
   -0.0138
    0.0137
    0.0289
   -0.0295
   -0.0063
     ⋮
```

```
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = detcoef(c, l, num)
```

```
d5_P23 = 13×1
    0.4978
   -2.6198
    0.0496
   -0.0595
    0.0168
    0.0487
   -0.0051
    0.0044
    0.0325
    0.0574
     ⋮
```

```
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = detcoef(c, l, num)
```

```
d5_P24 = 13×1
   -0.1423
    0.6197
    0.0059
   -0.0146
    0.0474
    0.0419
   -0.0730
   -0.0190
   -0.1116
    0.0176
     ⋮
```

```
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = detcoef(c, l, num)
```

```
d5_W20 = 13×1
   -0.2829
    1.3502
    0.0033
   -0.0617
   -0.0143
   -0.0035
    0.0055
    0.0433
   -0.0019
   -0.0346
      ⋮
```

```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = detcoef(c, l, num)
```

```
d5_W21 = 13×1
   -0.4967
    2.5062
    0.0001
   -0.0533
    0.0399
   -0.0138
    0.0137
    0.0289
   -0.0295
   -0.0063
      ⋮
```

```
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = detcoef(c, l, num)
```

```
d5_W23 = 13×1
    0.4978
   -2.6198
    0.0496
   -0.0595
    0.0168
    0.0487
   -0.0051
    0.0044
    0.0325
    0.0574
      ⋮
```

```
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = detcoef(c, l, num)
```

```
d5_W24 = 13×1
   -0.1423
    0.6197
    0.0059
   -0.0146
    0.0474
    0.0419
   -0.0730
   -0.0190
   -0.1116
    0.0176
      ⋮
      ⋮
```

3. Pytania

1) W jaki sposób zastosować falki do ekstrakcji cech?

Robi sie transofmacje falkowa i analizuje wspolczynniki - bierze sie wysokie wspolczynniki, zeby miec mniej cech do analizy.

2) Jakie parametry falek możemy zmieniać w toolboxie?

W samym toolboxie _waveletAnalyzer_ mozemy wybrac rodzaj falki i poziom dekompozycji.

3) Czym różnią się współczynniki a1, d1, d2, d3, d4, d5?

Współczynniki dj(k) zawierają informację o wysokich częstotliwościach oraz tworzą zbiór detali. Natomiast współczynniki aj(k) zawierają informację dolnoprzepustową, czyli stanowią aproksymację sygnału.

4) Czym różni się transformacja falkowa od filtrów?

Są w stanie doskonale zrekonstruować funkcje o kształtach wielomianów liniowych i wyższych rzędów takich jak prostokąt, ciasto, wielomiany drugiego rzędu