

Laboratorium 12

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Wstęp

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

Pytania

- 1) **W jaki sposób zastosować falki do ekstrakcji cech?** Po wykonaniu transformacji falkowej analizuje się współczynniki.
- 2) **Jakie parametry falek możemy zmieniać w toolboxie?** Rodzaj falki, poziom dekompozycji.
- 3) **Czym różnią się współczynniki a1, d1, d2, d3, d4, d5?** Współczynniki $d_j(k)$ zawierają informację o wysokich częstotliwościach oraz tworzą zbiór detali. Natomiast współczynniki $a_j(k)$ zawierają informację o niskich częstotliwościach, 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, wielomiany drugiego rzędu.

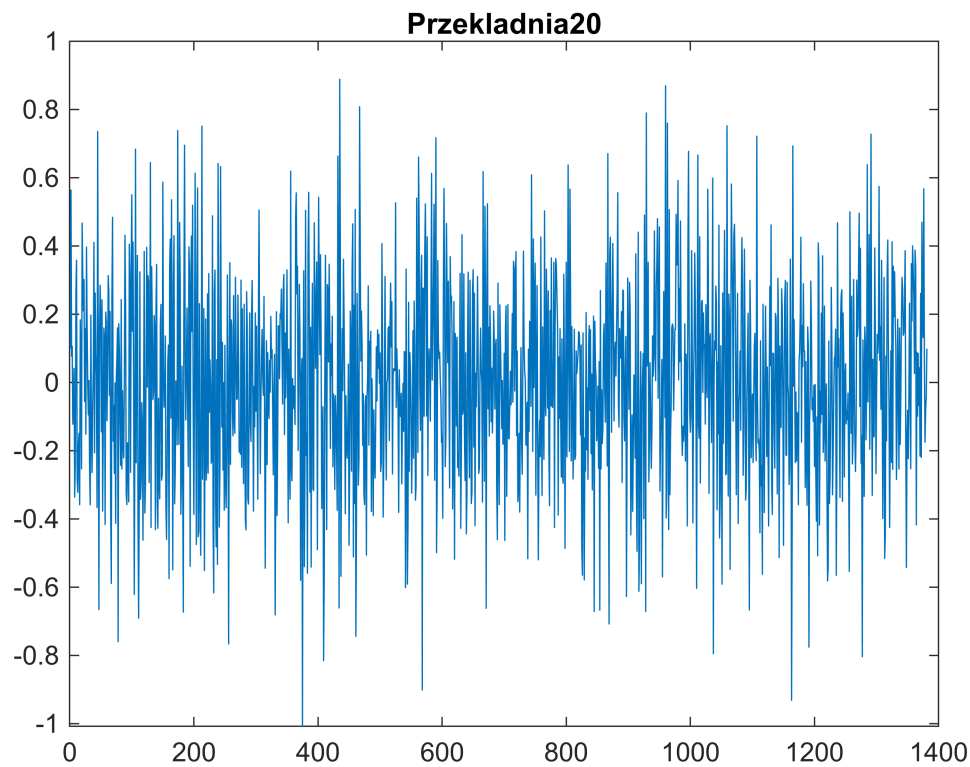
Rozwiązanie zadań

Zadanie 1

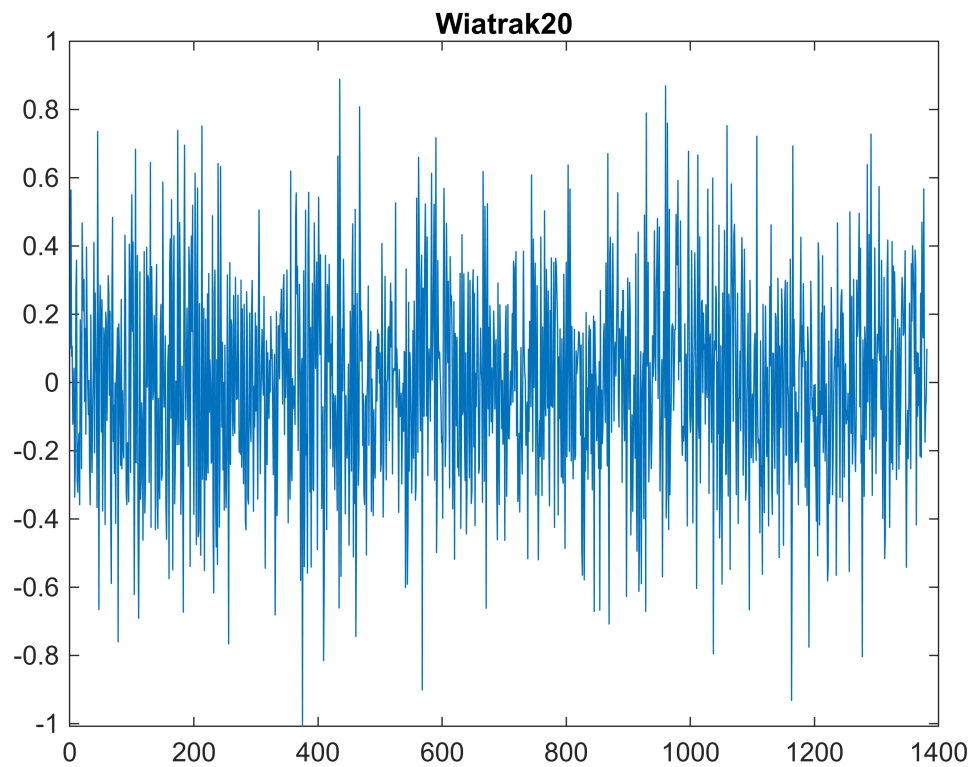
```
clear all;
load falki_ws.mat

falka = 'db2';
num = 5;

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num);
figure(1), plot(d5_P20), title('Przekladnia20');
```



```
% P21
[c, 1] = wavedec(P21, num, falka);
[d5_P21] = detcoef(c, 1, num);
% P23
[c, 1] = wavedec(P23, num, falka);
[d5_P23] = detcoef(c, 1, num);
% P24
[c, 1] = wavedec(P24, num, falka);
[d5_P24] = detcoef(c, 1, num);
% W20
[c, 1] = wavedec(P20, num, falka);
[d5_W20] = detcoef(c, 1, num);
figure(5), plot(d5_W20), title('Wiatrak20');
```

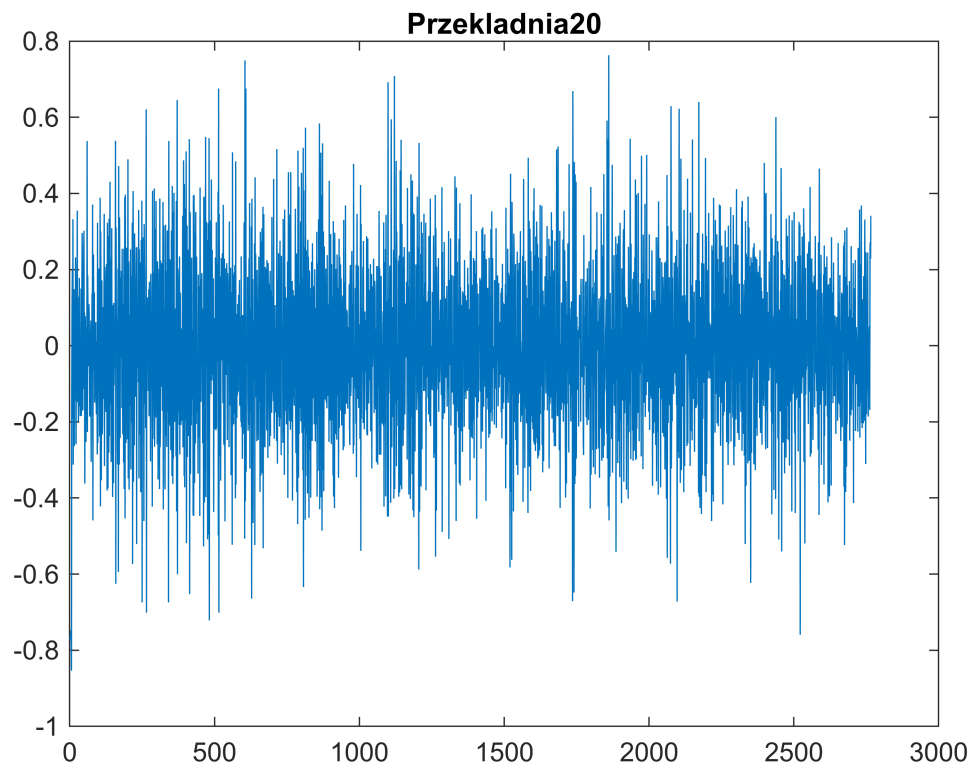


```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = detcoef(c, l, num);
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = detcoef(c, l, num);
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = detcoef(c, l, num);
```

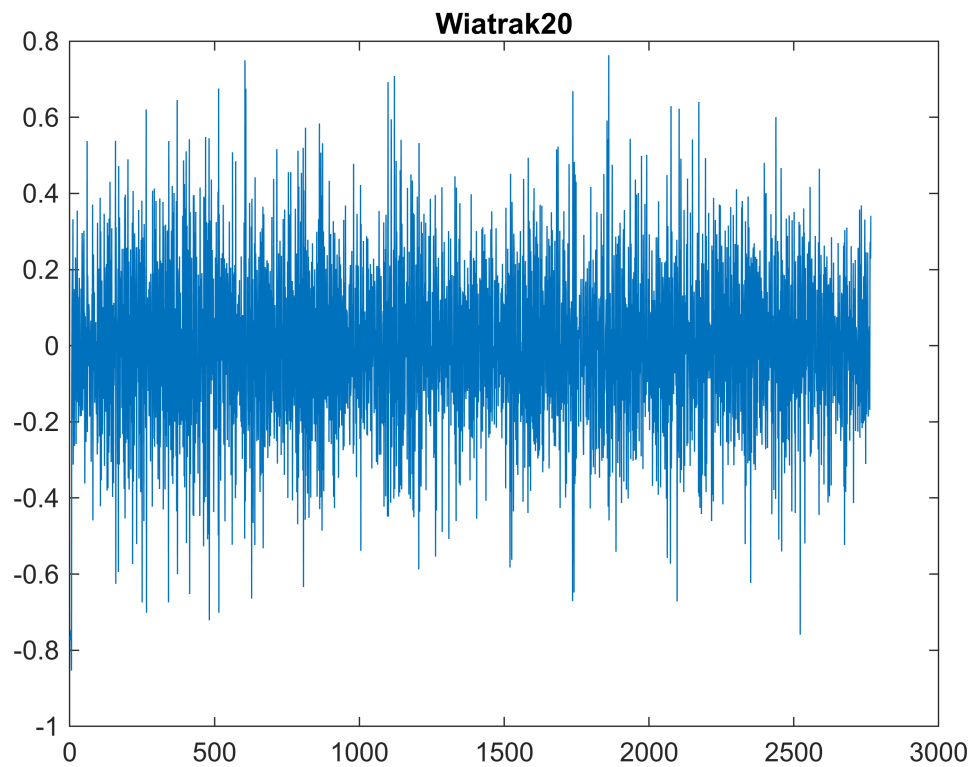
Zadanie 2

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

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = appcoef(c, l, falka, num);
figure(1), plot(d5_P20), title('Przekladnia20');
```



```
% P21
[c, 1] = wavedec(P21, num, falka);
[d5_P21] = appcoef(c, 1, falka, num);
% P23
[c, 1] = wavedec(P23, num, falka);
[d5_P23] = appcoef(c, 1, falka, num);
% P24
[c, 1] = wavedec(P24, num, falka);
[d5_P24] = appcoef(c, 1, falka, num);
% W20
[c, 1] = wavedec(P20, num, falka);
[d5_W20] = appcoef(c, 1, falka, num);
figure(5), plot(d5_W20), title('Wiatrak20');
```

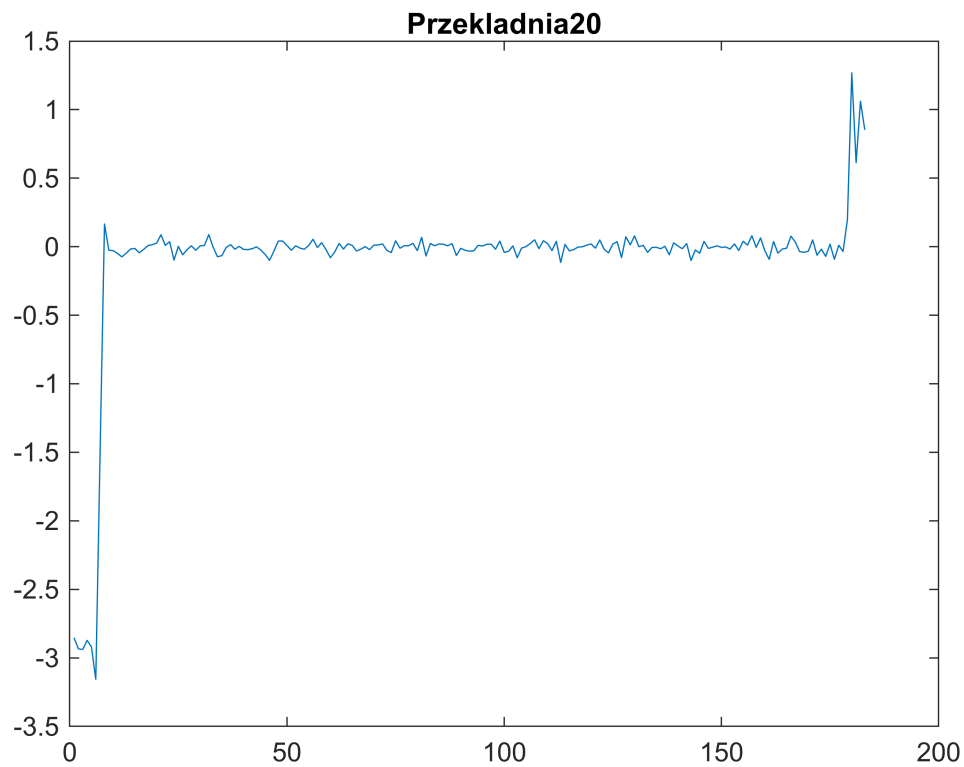


```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = appcoef(c, l, falka, num);
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = appcoef(c, l, falka, num);
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = appcoef(c, l, falka, num);
```

Zadanie 3

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

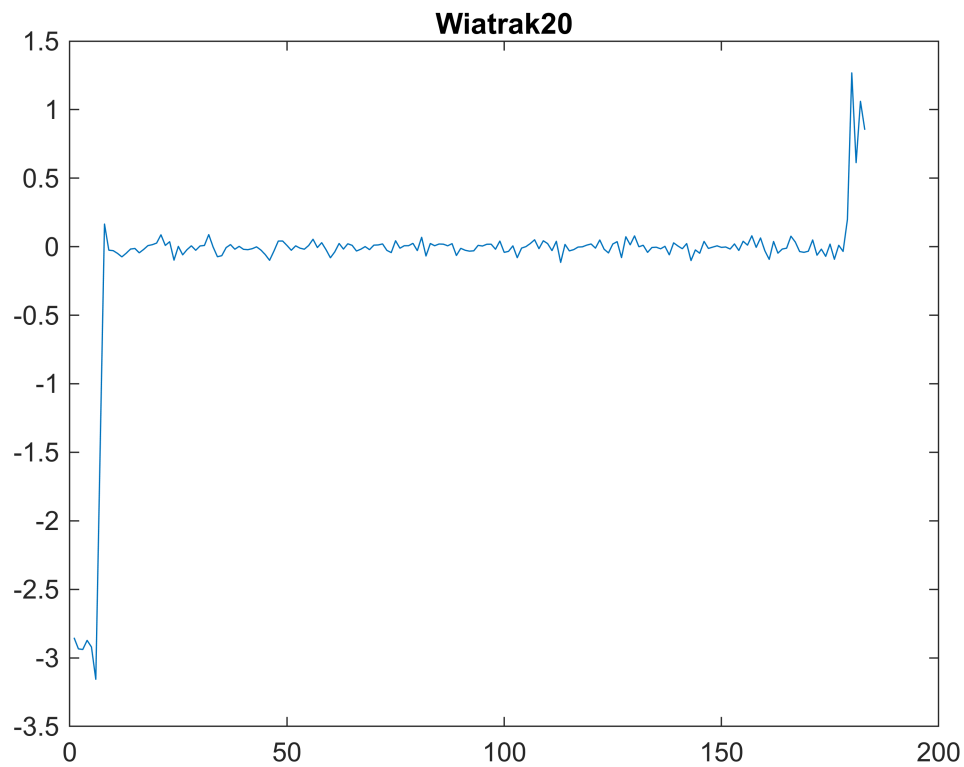
% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = appcoef(c, l, falka, num);
figure(1), plot(d5_P20), title('Przekladnia20');
```



```

% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = appcoef(c, l, falka, num);
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = appcoef(c, l, falka, num);
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = appcoef(c, l, falka, num);
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = appcoef(c, l, falka, num);
figure(5), plot(d5_W20), title('Wiatrak20');

```

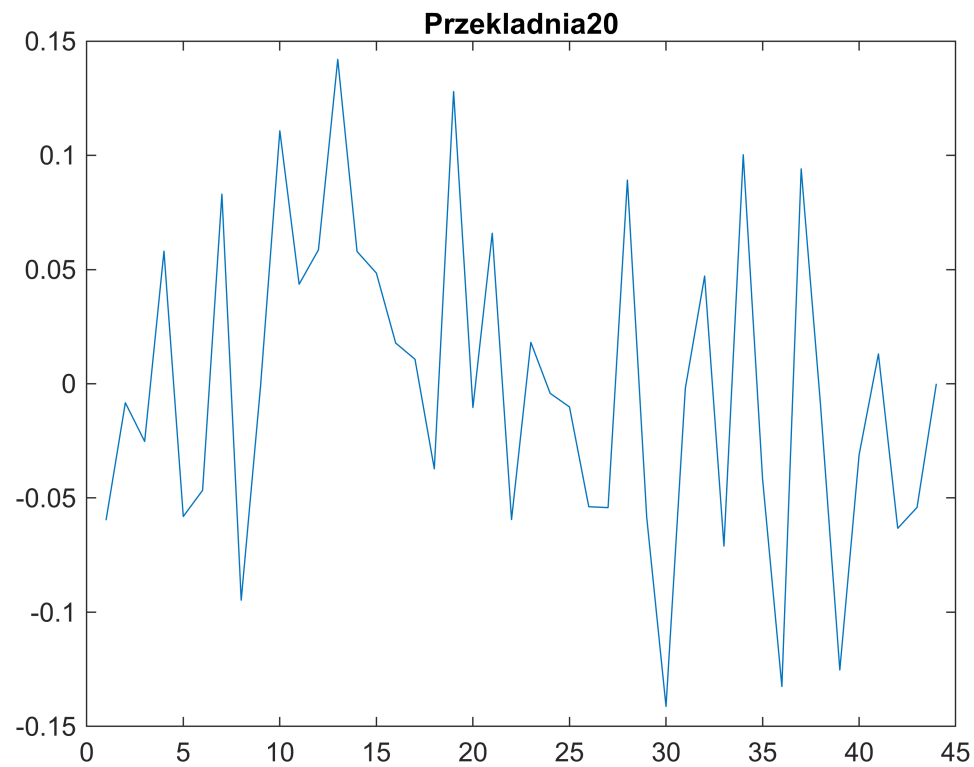


```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = appcoef(c, l, falka, num);
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = appcoef(c, l, falka, num);
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = appcoef(c, l, falka, num);
```

Zadanie 4

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

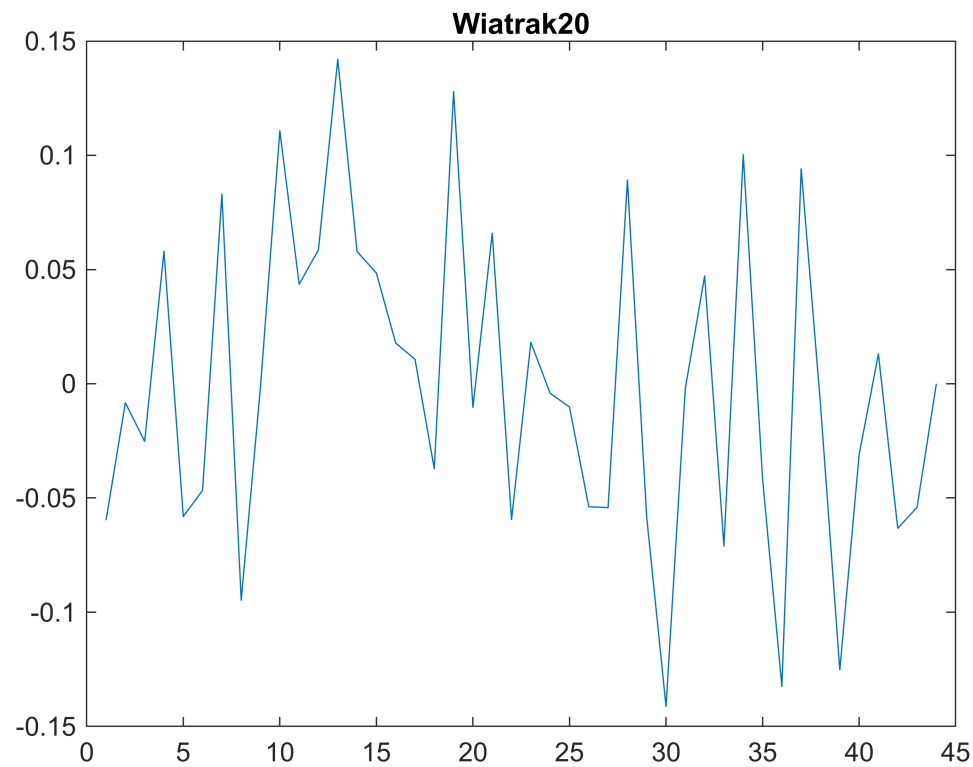
% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num);
figure(1), plot(d5_P20), title('Przekladnia20');
```



```

% P21
[c, l] = wavedec(P21, num, falka);
[d5_P21] = detcoef(c, l, num);
% P23
[c, l] = wavedec(P23, num, falka);
[d5_P23] = detcoef(c, l, num);
% P24
[c, l] = wavedec(P24, num, falka);
[d5_P24] = detcoef(c, l, num);
% W20
[c, l] = wavedec(P20, num, falka);
[d5_W20] = detcoef(c, l, num);
figure(5), plot(d5_W20), title('Wiatrak20');

```

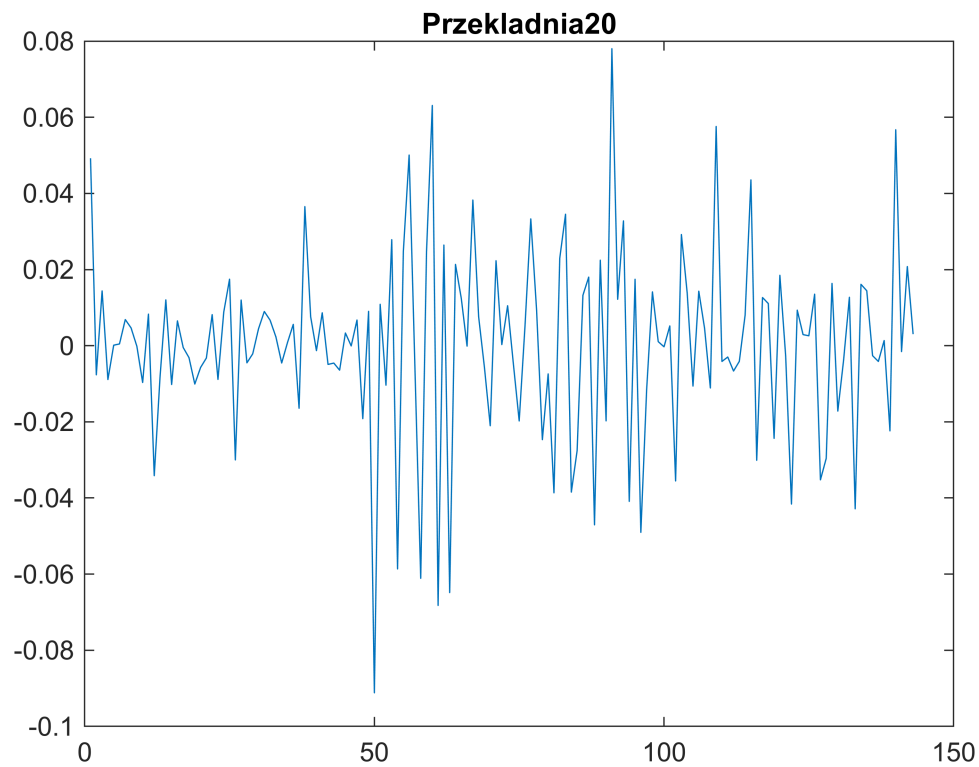



```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = detcoef(c, l, num);
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = detcoef(c, l, num);
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = detcoef(c, l, num);
```

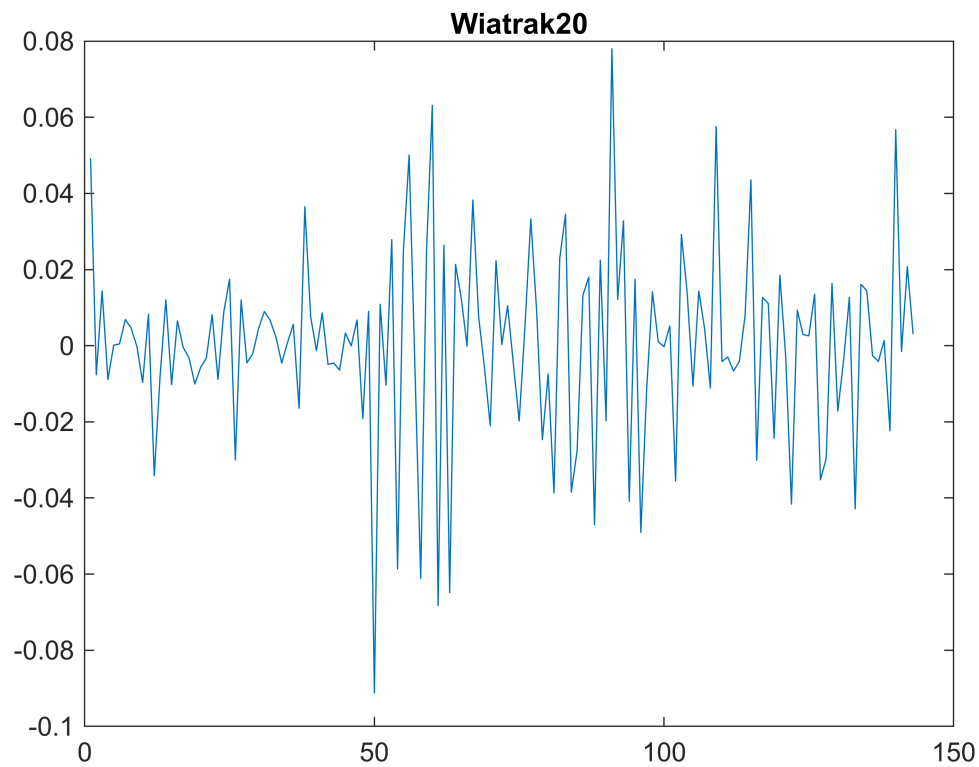
Zadanie 5

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

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num);
figure(1), plot(d5_P20), title('Przekladnia20');
```



```
% P21
[c, 1] = wavedec(P21, num, falka);
[d5_P21] = detcoef(c, 1, num);
% P23
[c, 1] = wavedec(P23, num, falka);
[d5_P23] = detcoef(c, 1, num);
% P24
[c, 1] = wavedec(P24, num, falka);
[d5_P24] = detcoef(c, 1, num);
% W20
[c, 1] = wavedec(P20, num, falka);
[d5_W20] = detcoef(c, 1, num);
figure(5), plot(d5_W20), title('Wiatrak20');
```

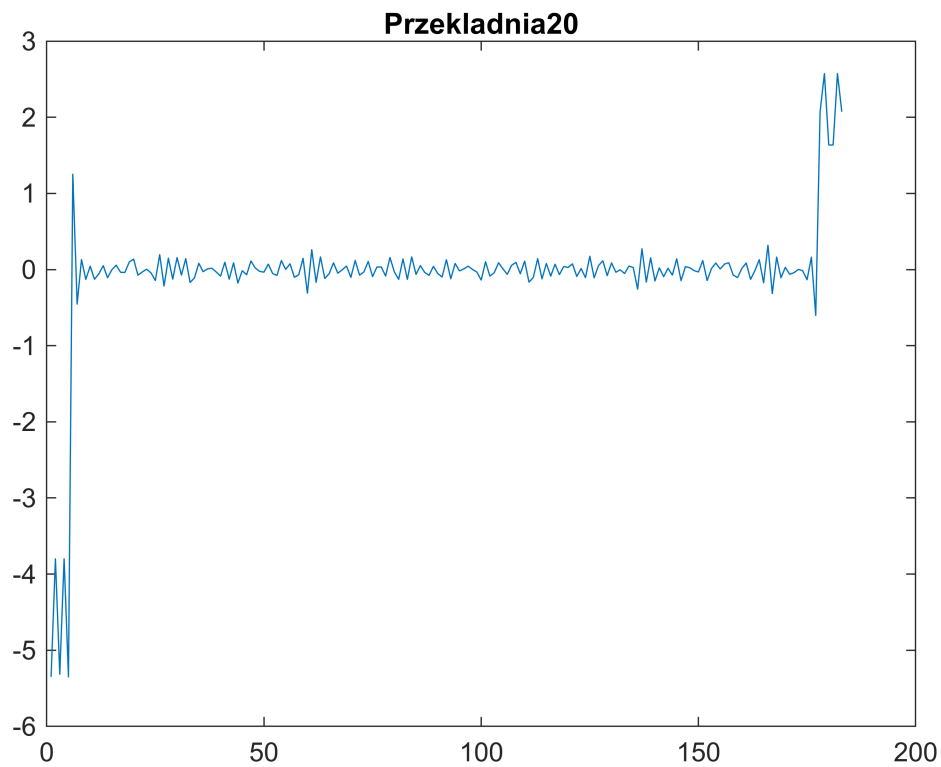


```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = detcoef(c, l, num);
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = detcoef(c, l, num);
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = detcoef(c, l, num);
```

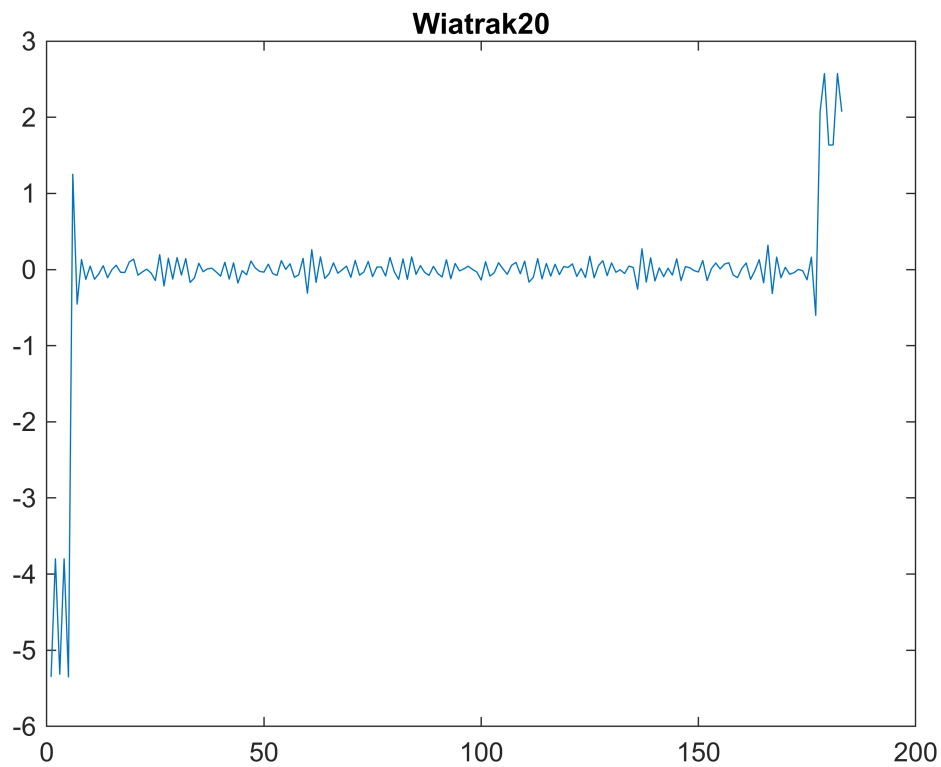
Zadanie 6

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

% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = appcoef(c, l, falka, num);
figure(1), plot(d5_P20), title('Przekladnia20');
```



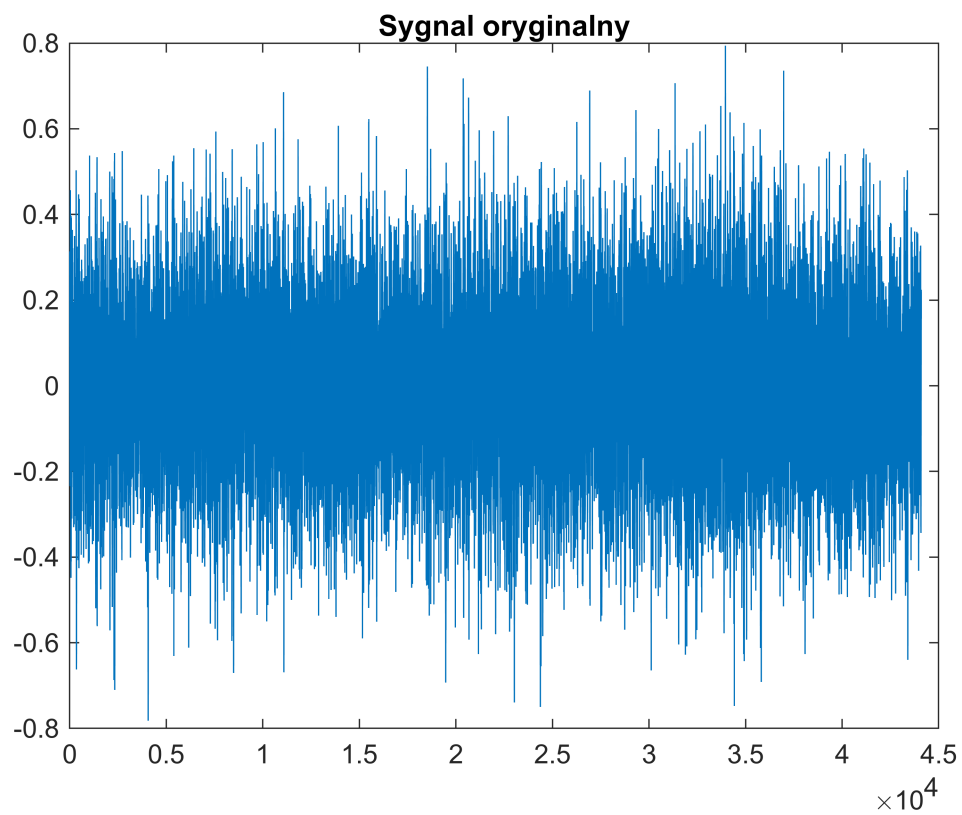
```
% P21
[c, 1] = wavedec(P21, num, falka);
[d5_P21] = appcoef(c, 1, falka, num);
% P23
[c, 1] = wavedec(P23, num, falka);
[d5_P23] = appcoef(c, 1, falka, num);
% P24
[c, 1] = wavedec(P24, num, falka);
[d5_P24] = appcoef(c, 1, falka, num);
% W20
[c, 1] = wavedec(P20, num, falka);
[d5_W20] = appcoef(c, 1, falka, num);
figure(5), plot(d5_W20), title('Wiatrak20');
```



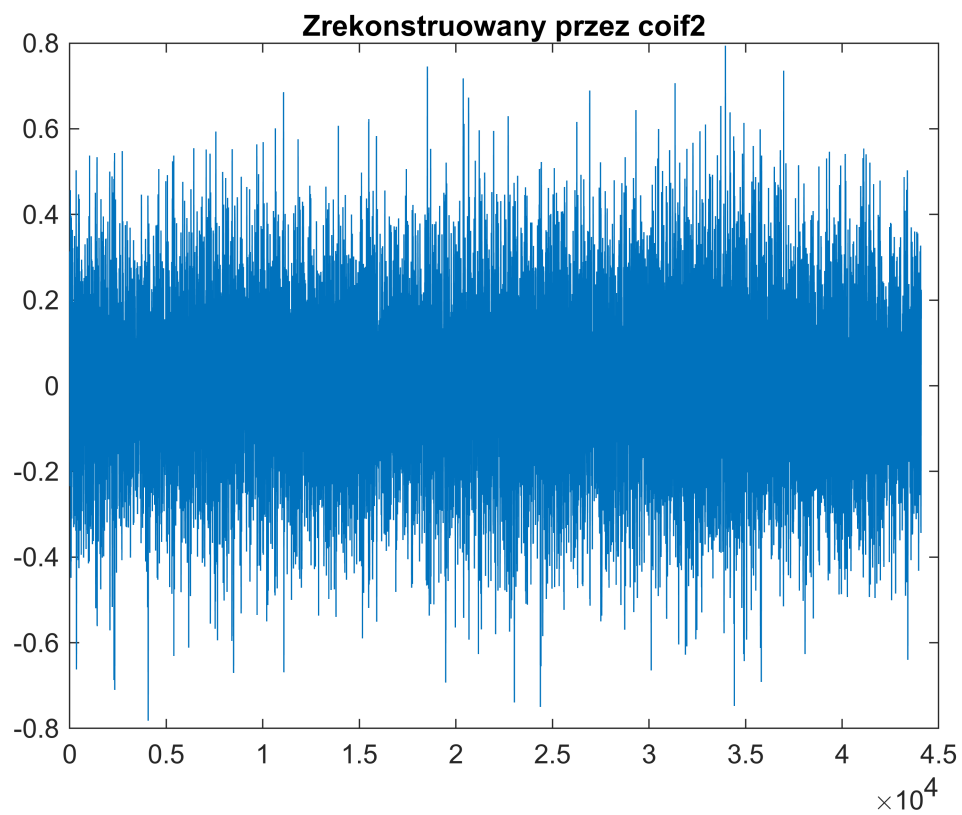
```
% W21
[c, l] = wavedec(P21, num, falka);
[d5_W21] = appcoef(c, l, falka, num);
% W23
[c, l] = wavedec(P23, num, falka);
[d5_W23] = appcoef(c, l, falka, num);
% W24
[c, l] = wavedec(P24, num, falka);
[d5_W24] = appcoef(c, l, falka, num);
```

Zadanie 7

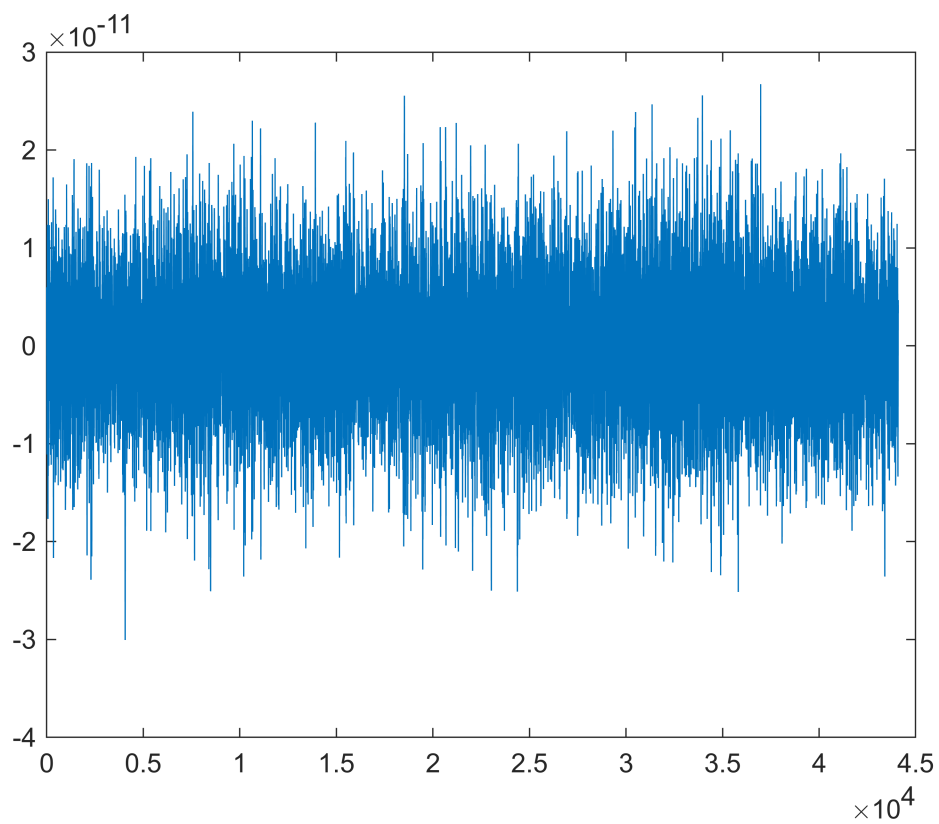
```
figure(1), plot(W20), title('Sygnal oryginalny');
```



```
[c,1] = wavedec(W20,6, 'coif2');  
  
Rec = waverec(c,1,'coif2');  
figure(2), plot(Rec), title('Zrekonstruowany przez coif2');
```

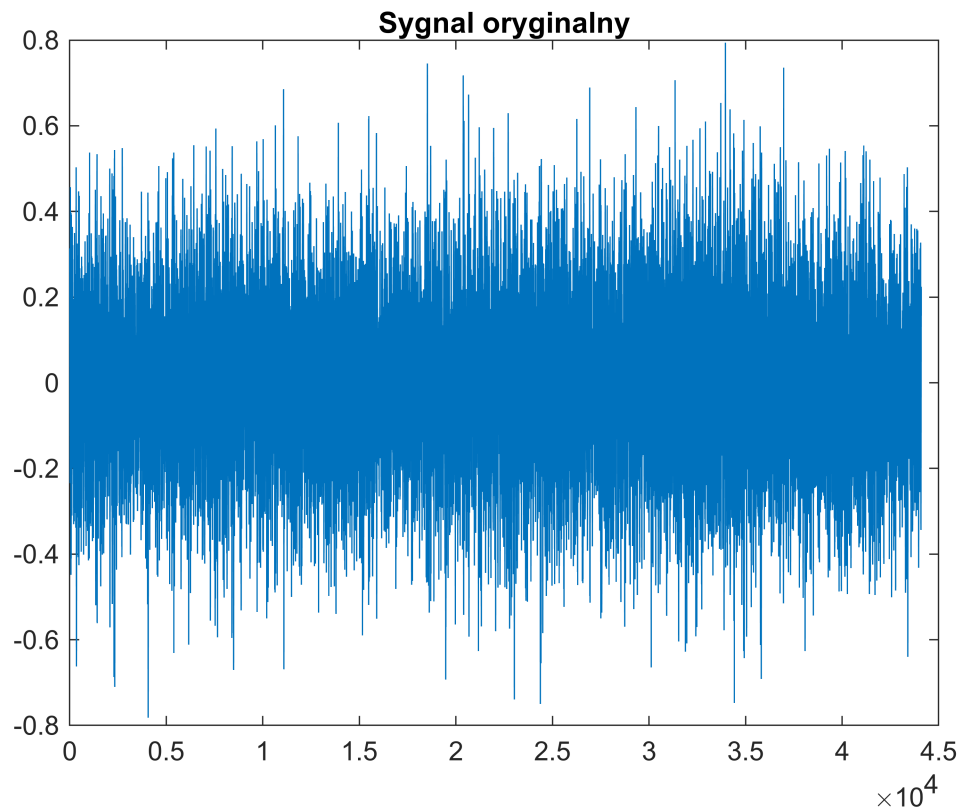


```
roznica = W20 - Rec;  
figure(3), plot(roznica);
```

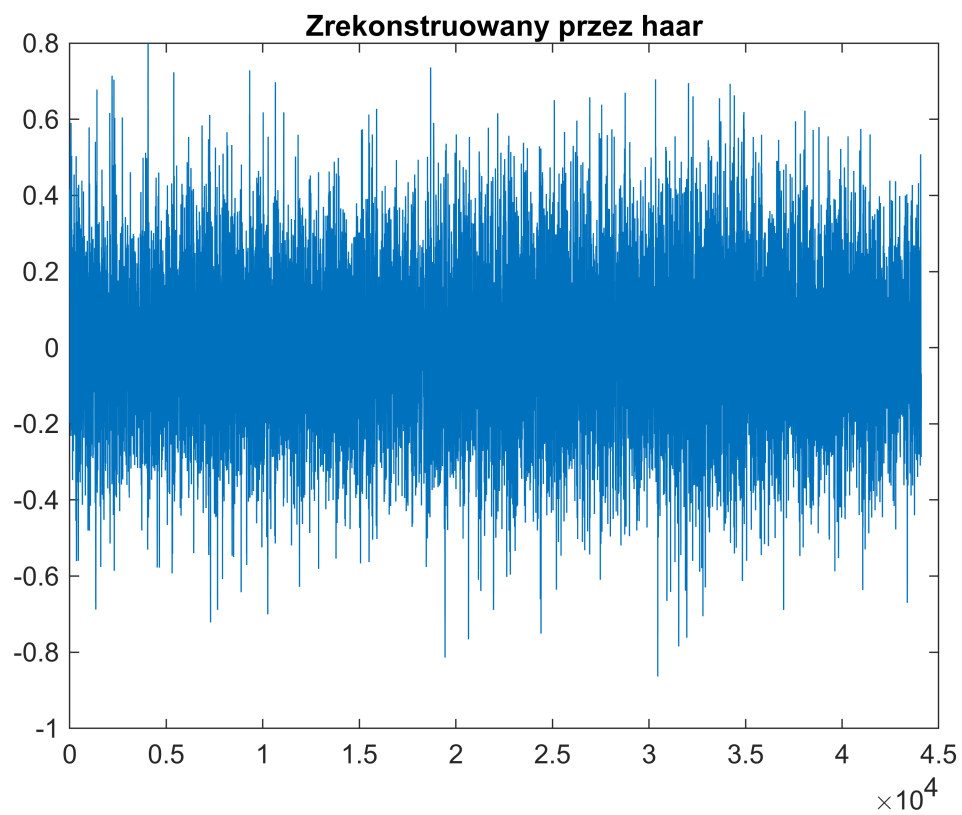


Zadanie 8

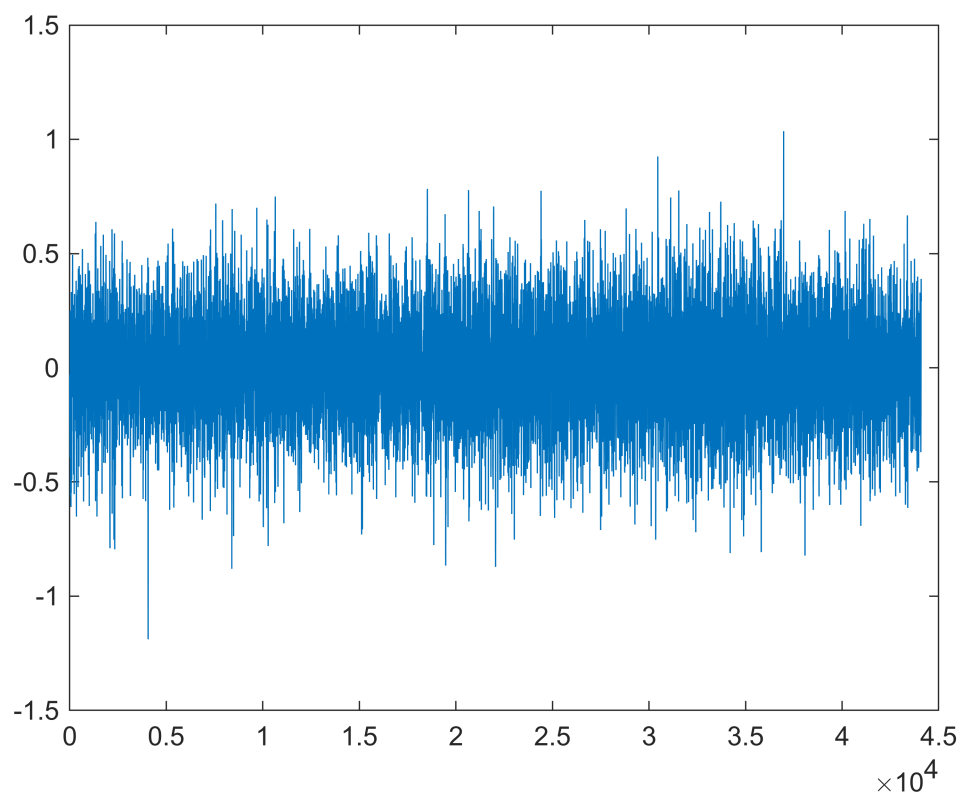
```
figure(1), plot(W20), title('Sygnal oryginalny');
```



```
[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);
```



Zadanie 9

```
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 = 13x1
-2.9775
-2.6853
0.0101
0.0134
0.0200
0.0414
0.0212
-0.0261
-0.0198
-0.0244
:

```

Zadanie 10

```

falka = 'sym2';
num = 12;
% P20
[c, l] = wavedec(P20, num, falka);
[d5_P20] = detcoef(c, l, num)

```

```

d5_P20 = 13x1
-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 = 13x1
-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 = 13x1
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 = 13x1
-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 = 13x1
-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  
⋮
```