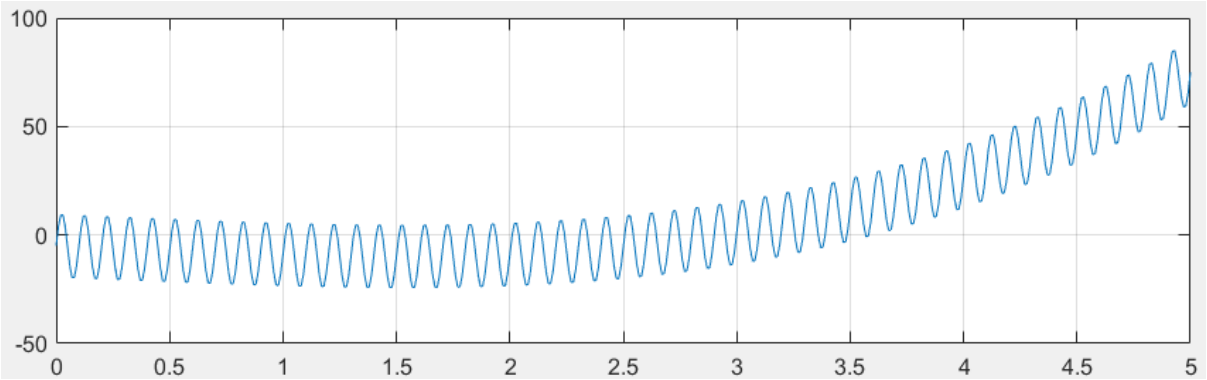
Лабораторна робота №1
з предмету
“Моделювання систем”
студента групи ІПС-31
Самойлича Євгенія

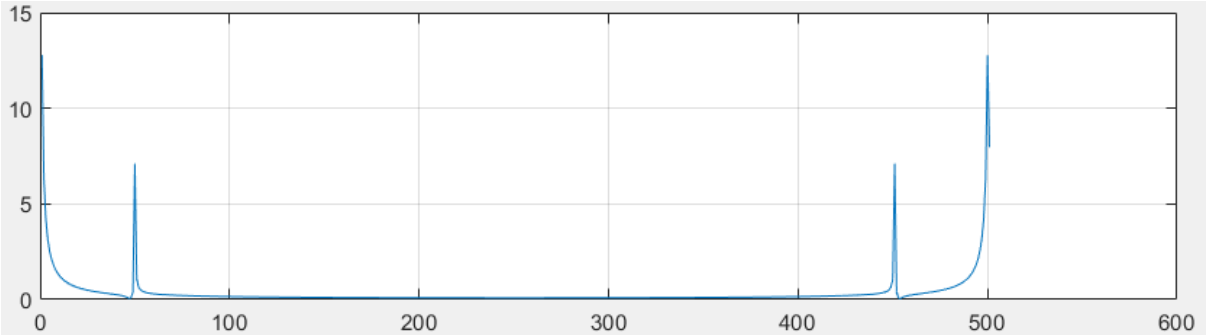
1. Початкові дані та їх графік

-5 3.7767 9.1855 9.145 3.6552 -5.2024 -14.0602 -19.5504 -19.5917 -14.1841 -5.409 3.366 8.7732 8.7311 3.2399 -5.6191
-14.4783 -19.9698 -20.0124 -14.606 -5.832 2.9419 8.3481 8.3051 2.813 -6.0469 -14.9068 -20.3991 -20.4423 -15.0365 -6.263
2.5105 7.9162 7.8729 2.3805 -6.4796 -15.3397 -20.8321 -20.8754 -15.4696 -6.696 2.0776 7.4835 7.4405 1.9484 -6.9114
-15.771 -21.2629 -21.3057 -15.8992 -7.125 1.6493 7.0561 7.0138 1.5226 -7.3361 -16.1948 -21.6856 -21.7271 -16.3195 -7.544
1.2317 6.6398 6.599 1.1093 -7.7479 -16.6049 -22.094 -22.1338 -16.7244 -7.947 0.83059 6.2407 6.202 0.7144 -8.1406
-16.9954 -22.4822 -22.5197 -17.1078 -8.328 0.45212 5.8648 5.8287 0.34388 -8.5084 -17.3603 -22.8442 -22.8788 -17.4639
-8.681 0.10225 5.5181 5.4853 0.0037628 -8.8451 -17.6936 -23.1741 -23.2051 -17.7866 -9 -0.21302 5.2067 5.1777 -0.29996
-9.1449 -17.9894 -23.4657 -23.4925 -18.0698 -9.279 -0.48769 4.9364 4.9118 -0.56128 -9.4016 -18.2415 -23.7131 -23.7352
-18.3077 -9.512 -0.71576 4.7133 4.6938 -0.7742 -9.6094 -18.444 -23.9104 -23.9271 -18.4942 -9.693 -0.89123 4.5434 4.5296
-0.93272 -9.7621 -18.5909 -24.0514 -24.0622 -18.6233 -9.816 -1.0081 4.4327 4.4252 -1.0308 -9.8539 -18.6762 -24.1302
-24.1345 -18.6889 -9.875 -1.0604 4.3873 4.3865 -1.0626 -9.8786 -18.694 -24.1409 -24.1379 -18.6852 -9.864 -1.042 4.413
4.4197 -1.0219 -9.8304 -18.6381 -24.0773 -24.0666 -18.6061 -9.777 -0.94711 4.5159 4.5307 -0.9028 -9.7031 -18.5026
-23.9335 -23.9145 -18.4455 -9.608 -0.76958 4.702 4.7254 -0.69932 -9.4909 -18.2815 -23.7035 -23.6756 -18.1976 -9.351
-0.50345 4.9773 5.01 -0.40544 -9.1876 -17.9688 -23.3814 -23.3439 -17.8563 -9 -0.14272 5.3479 5.3904 -0.015157 -8.7874
-17.5586 -22.961 -22.9133 -17.4155 -8.549 0.31861 5.8196 5.8725 0.47752 -8.2841 -17.0447 -22.4364 -22.378 -16.8694
-7.992 0.88654 6.3985 6.4625 1.0786 -7.6719 -16.4212 -21.8017 -21.7319 -16.2119 -7.323 1.5671 7.0906 7.1663 1.7941
-6.9446 -15.6821 -21.0507 -20.969 -15.437 -6.536 2.3662 7.9019 7.9899 2.63 -6.0964 -14.8214 -20.1775 -20.0833 -14.5386
-5.625 3.2899 8.8385 8.9392 3.5922 -5.1211 -13.8332 -19.1762 -19.0687 -13.5109 -4.584 4.3443 9.9062 10.0204 4.6869
-4.0129 -12.7113 -18.0406 -17.9194 -12.3478 -3.407 5.5352 11.1111 11.2394 5.92 -2.7656 -11.4498 -16.7648 -16.6293
-11.0432 -2.088 6.8687 12.4592 12.6021 7.2975 -1.3734 -10.0427 -15.3428 -15.1924 -9.5913 -0.621 8.3508 13.9565 14.1147
8.8254 0.16987 -8.484 -13.7687 -13.6027 -7.986 1 9.9876 15.6091 15.7831 10.5096 1.8701 -6.7678 -12.0363 -11.8541
-6.2212 2.781 11.7849 17.4228 17.6132 12.3563 3.7334 -4.8879 -10.1397 -9.9408 -4.2911 4.728 13.7488 19.4037 19.6112
14.3714 5.7656 -2.8384 -8.073 -7.8567 -2.1896 6.847 15.8854 21.5578 21.783 16.5609 7.9729 -0.61332 -5.83 -5.5958
0.08934 9.144 18.2005 23.8911 24.1346 18.9308 10.3611 1.7934 -3.4048 -3.1521 2.5517 11.625 20.7002 26.4097 26.6719
21.487 12.9364 4.3876 -0.79145 -0.51954 5.2034 14.296 23.3906 29.1194 29.4011 24.2357 15.7046 7.1755 2.0161 2.3078
8.0505 17.163 26.2775 32.0263 32.3281 27.1828 18.6719 10.163 5.0239 5.3359 11.0991 20.232 29.367 35.1364 35.4588
30.3343 21.8441 13.3561 8.2379 8.5708 14.355 23.509 32.6651 38.4557 38.7994 33.6962 25.2274 16.7608 11.664 12.0185
17.8243 27 36.1779 41.9903 42.3558 37.2744 28.8276 20.383 15.3084 15.6851 21.5131 30.711 39.9112 45.746 46.1339
41.0751 32.6509 24.2289 19.177 19.5764 25.4272 34.648 43.8711 49.7289 50.1399 45.1042 36.7031 28.3044 23.2757
23.6985 29.5727 38.817 48.0637 53.945 54.3797 49.3677 40.9904 32.6155 27.6107 28.0574 33.9556 43.224 52.4948 58.4003
58.8593 53.8716 45.5186 37.1682 32.1879 32.6591 38.582 47.875 57.1705 63.1009 63.5846 58.6218 50.2939 41.9684
37.0132 37.5097 43.4577 52.776 62.0969 68.0526 68.5618 63.6245 55.3221 47.0223 42.0928 42.615 48.5888 57.933 67.2798
73.2615 73.7968 68.8856 60.6094 52.3358 47.4326 47.9811 53.9814 63.352 72.7253 78.7336 79.2955 74.4111 66.1616
57.9149 53.0386 53.614 59.6413 69.039 78.4394 84.4749 85.0641 80.207 71.9849 63.7656 58.9167 59.5197 65.5746 75



2. Будуємо дискретне перетворення Фур'є та його графік

```
fourier_func = zeros(1, N);
for m = 1:N
  for j = 1:N
    fourier_func(m) = fourier_func(m) + 1 / N * y(j) * exp(1) ^ (-1i * 2 * pi  * m * j / N);
  end
end
```



3. Визначаємо суттєві внески частот за спостереженнями

```
df = 1 / T;
f = 0:df:round(N / 2) * df;
counter = 0;
extr = zeros(2,1);
for k = 3:round(N / 2) - 1
  if (fourier_func(k) > fourier_func(k + 1) && ...
        fourier_func(k) > fourier_func(k - 1) && ...
        abs(fourier_func(k) - fourier_func(k + 1)) > 1)
    counter = counter + 1;
    extr(counter) = k * df;
  end
end
```

Отримали, що частота найбільшого впливу — 10.

4. За методом найменших квадратів будуємо та розв'язуємо систему рівнянь для визначення параметрів a_i.

```
sn = sin(2 * pi * extr(1) * time);
A = [sum(time .^ 6), sum(time .^ 5), sum(time .^ 4), sum(sn .* time .^ 3), sum(time .^ 3);
     sum(time .^ 5), sum(time .^ 4), sum(time .^ 3), sum(sn .* time .^ 2), sum(time .^ 2);
     sum(time .^ 4), sum(time .^ 3), sum(time .^ 2), sum(sn .* time), sum(time);
     sum(sn .* time .^ 3), sum(sn .* time .^ 2), sum(sn .* time), sum(sn .* sn), sum(N * sn);
     sum(time .^ 3), sum(time .^ 2), sum(time), sum(N * sn), N];
b = [sum(y .* time.^ 3), sum(y .* time .^ 2), sum(y .* time), sum(y .* sn),  sum(y)];
a = A \ b';
```

Отримали

```
a =

    1.0000
   -1.0000
   -4.0000
   15.0000
   -5.0000
```

5. За отриманими параметрами будуємо апроксимуючу функцію та її графік.

```
approx = a(1) .* time .^ 3 + a(2) .* time .^ 2 + a(3) .* time + a(4) .* sn + a(5);
```