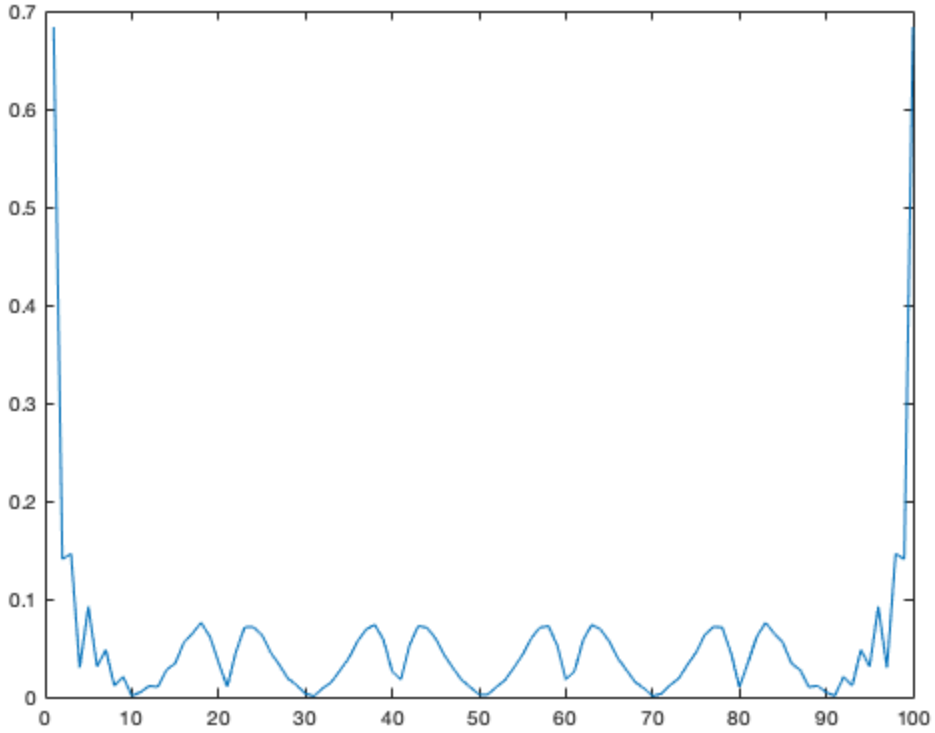
```
N = 100;
k1 = 5;
tp = linspace(0, 2.*pi, N);
tpp = exp(cos(k1.*tp));

D1 = zeros(N,N);
for k=1:N
    for j=1:N
       if k==j
           D1(k,j) = 0;
       else
           D1(k,j) = (((-1).^(k+j))./2).*cot((k-j).*pi./N);
       end
    end
end
D2 = zeros(N,N);
for k=1:N
    for j=1:N
       if k==j
           D2(k,j) = -N.^2./12-1./6;
       else
           D2(k,j) = -(-1).^(k+j)./2.*sin((k-j).*pi./N).^(-2);
       end
    end
end

D1tp = D1*tpp';

f1 = @() D1*tpp';
m1d1 = timeit(f1);

D2tp = D2*tpp';

f1 = @() D2*tpp';
m1d2 = timeit(f1);

D1tpE = k1.*sin(k1.*tp).*(-exp(cos(k1.*tp)));
D2tpE = k1.^2.*(sin(k1.*tp).^2-cos(k1.*tp)).*(exp(cos(k1.*tp)));

figure;
plot(abs(D1tp-D1tpE'));
figure;
plot(abs(D2tp-D2tpE'));


k = [0:N/2-1, 0, -N/2+1:-1];

vt = fft(tpp);
vt1 = (1i.*k).*vt;
dt1 = ifft(vt1);

f1 = @() fft(tpp);
```

```
f2 = @() (i.*k).*vt;
f3 = @() ifft(vt1);
m2d1 = timeit(f1) + timeit(f2) + timeit(f3);

vt = fft(tpp);
vt2 = -(k.^2).*vt;
dt2 = ifft(vt2);

f1 = @() fft(tpp);
f2 = @() -(k.^2).*vt;
f3 = @() ifft(vt2);
m2d2 = timeit(f1) + timeit(f2) + timeit(f3);

figure;
dt1 = real(dt1);
plot(abs(dt1-D1tpE));
figure;
plot(abs(dt2-D2tpE));

m1d1./m2d1
m1d2./m2d2


ans =

    2.3096


ans =

    1.4859
```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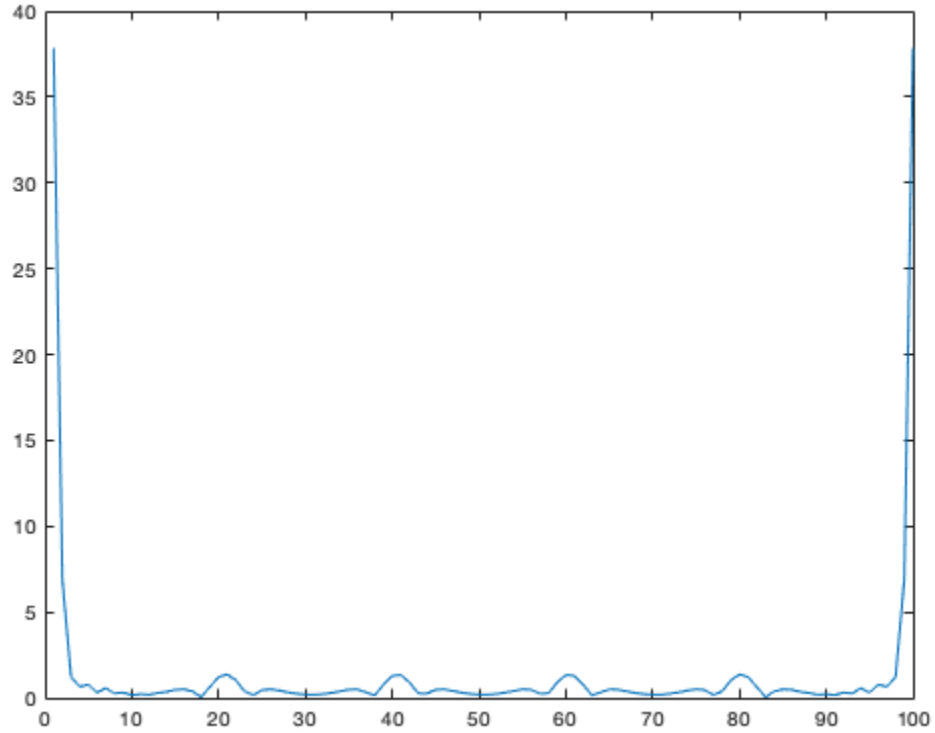
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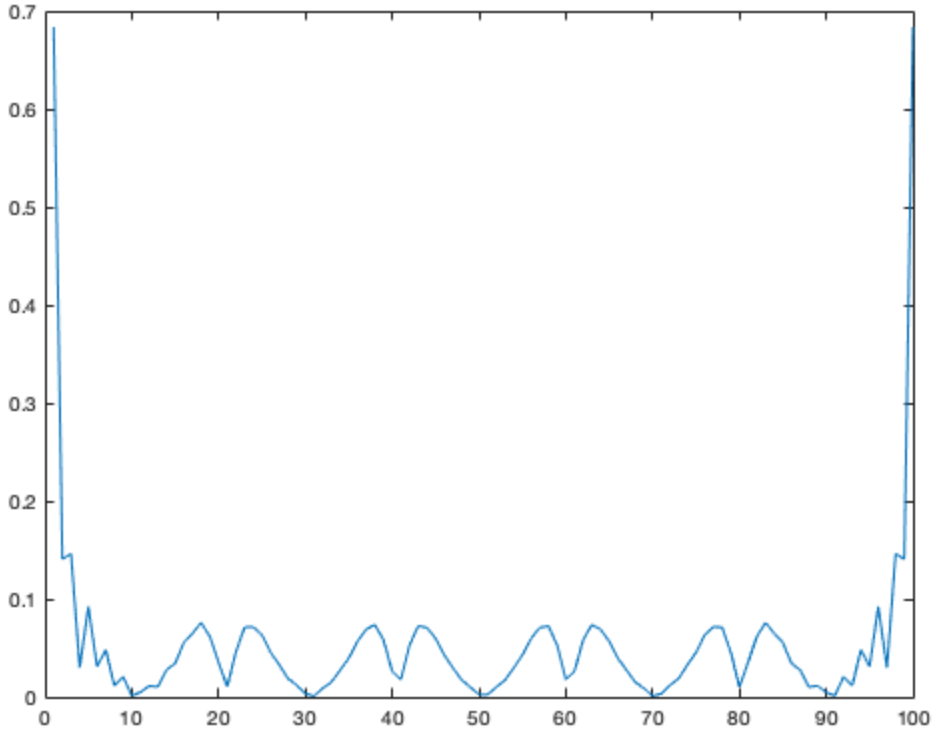
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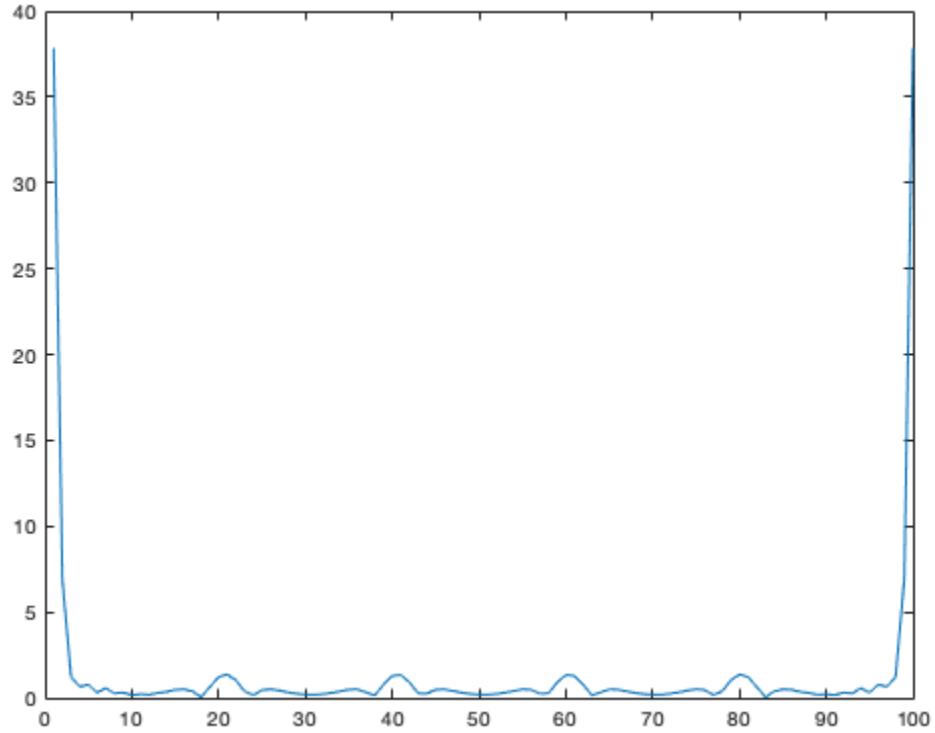
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