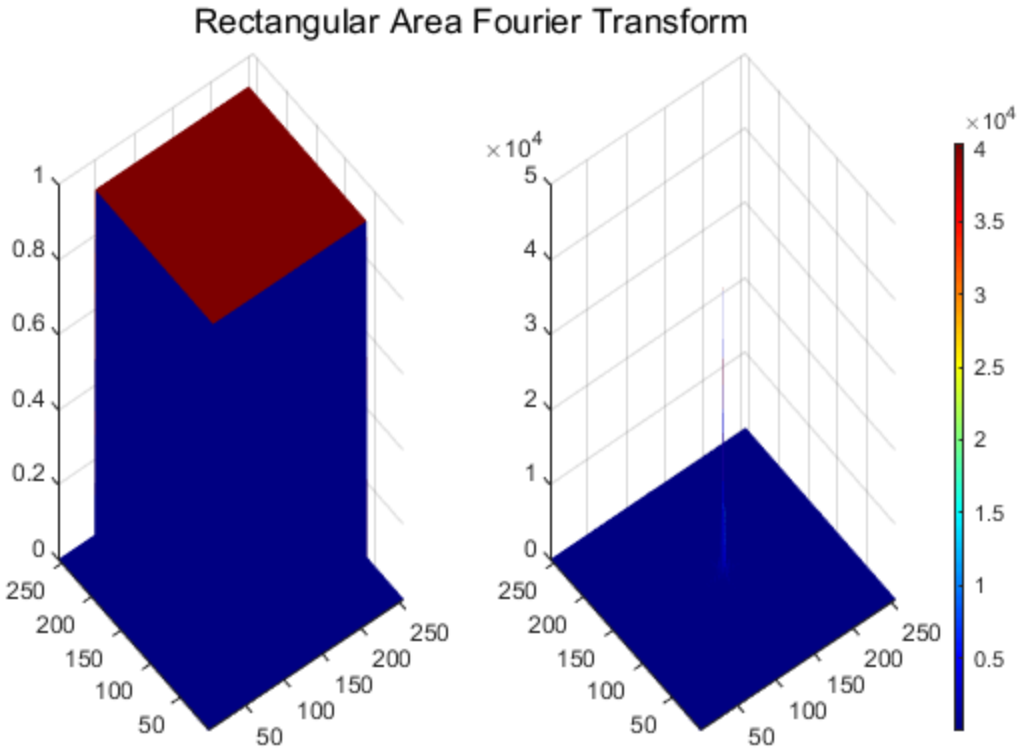
Q1

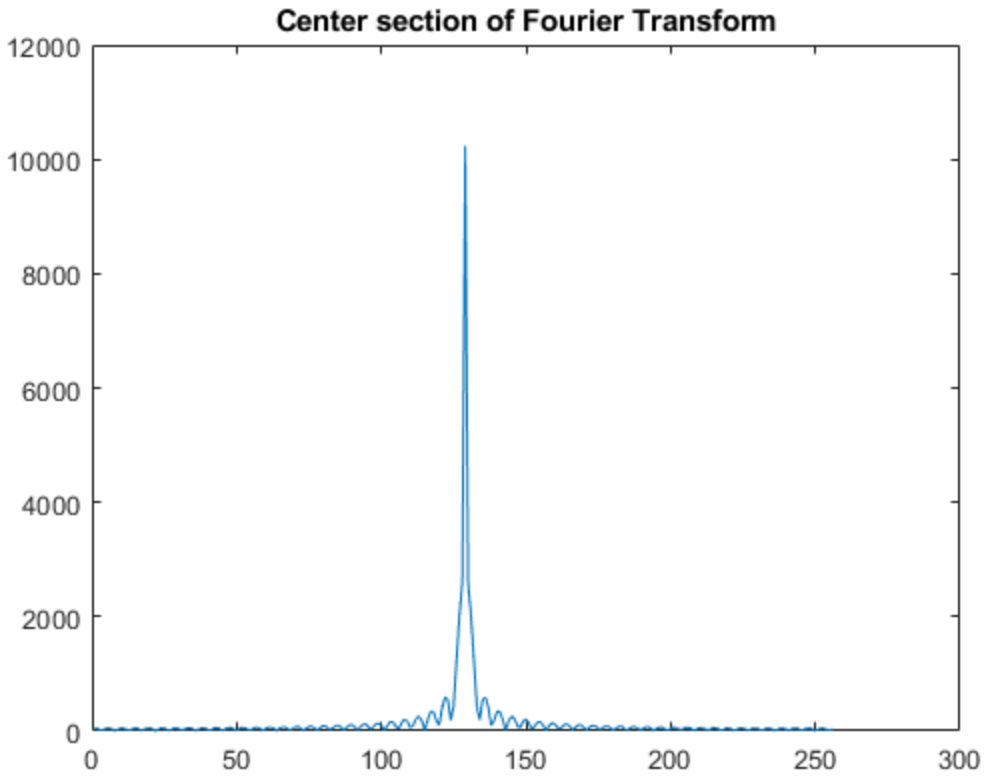
The proposed method created a narrower main lobe in the frequency domain.

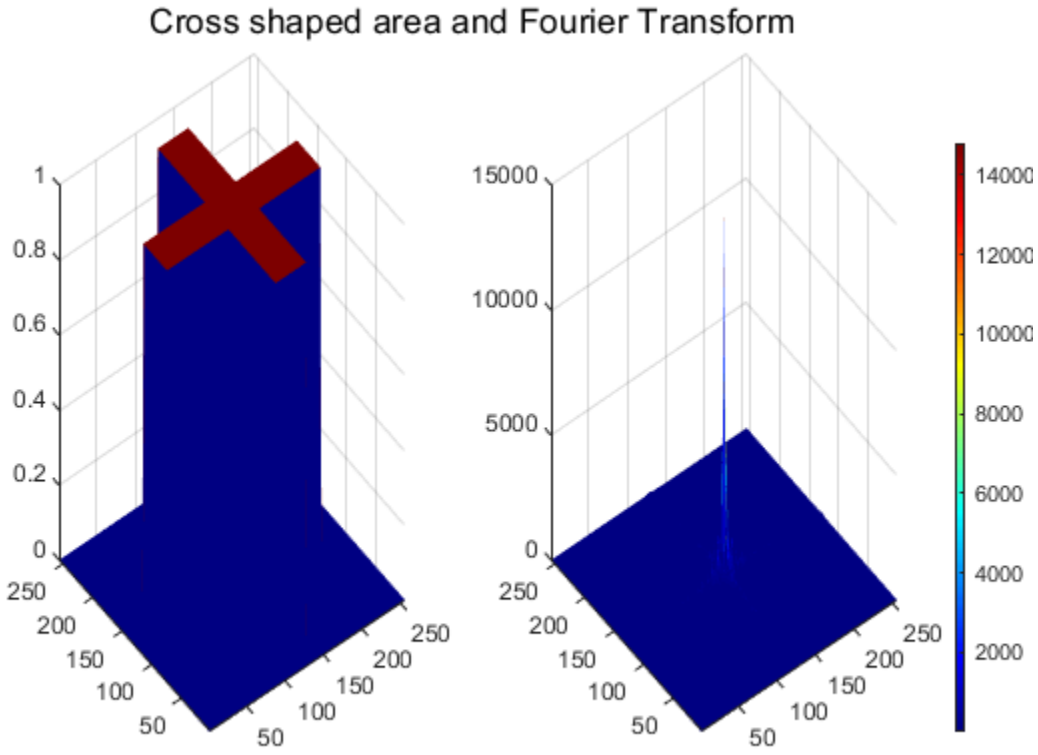
```
close all; clear; clc;
s = 256; ks = 20;
A = zeros(s,s);
A(0.5*s-5*ks:0.5*s+5*ks,0.5*s-5*ks:0.5*s+5*ks) = 1;
[X,Y] = meshgrid(1:s,1:s);
f = figure
subplot(1,2,1)
surf(X,Y,A,'EdgeColor','none'), colormap jet
xlim([1,s])
ylim([1,s])
h = subplot(1,2,2);
fft_mag = abs(fftshift(fft2(A)));
surf(X,Y,fft_mag,fft_mag,'EdgeColor','none'), colormap jet
xlim([1,s])
ylim([1,s])
c = colorbar(h,'Position',[0.93 0.11 0.01 0.7]);
sgtitle('Rectangular Area Fourier Transform')
figure
plot(fft_mag(128,:))
title('Center section of Fourier Transform')
s = 256; ks = 20;
A = zeros(s,s);
A(0.5*s-5*ks:0.5*s+5*ks,0.5*s-ks:0.5*s+ks) = 1;
A(0.5*s-ks:0.5*s+ks,0.5*s-5*ks:0.5*s+5*ks) = 1;
[X,Y] = meshgrid(1:s,1:s);
f = figure
subplot(1,2,1)
surf(X,Y,A,'EdgeColor','none'), colormap jet
xlim([1,s])
ylim([1,s])
h = subplot(1,2,2);
fft_mag = abs(fftshift(fft2(A)));
surf(X,Y,fft_mag,fft_mag,'EdgeColor','none'), colormap jet
xlim([1,s])
ylim([1,s])
c = colorbar(h,'Position',[0.93 0.11 0.01 0.7]);
sgtitle('Cross shaped area and Fourier Transform')
figure
plot(fft_mag(128,:))
title('Center section of Fourier Transform')
```

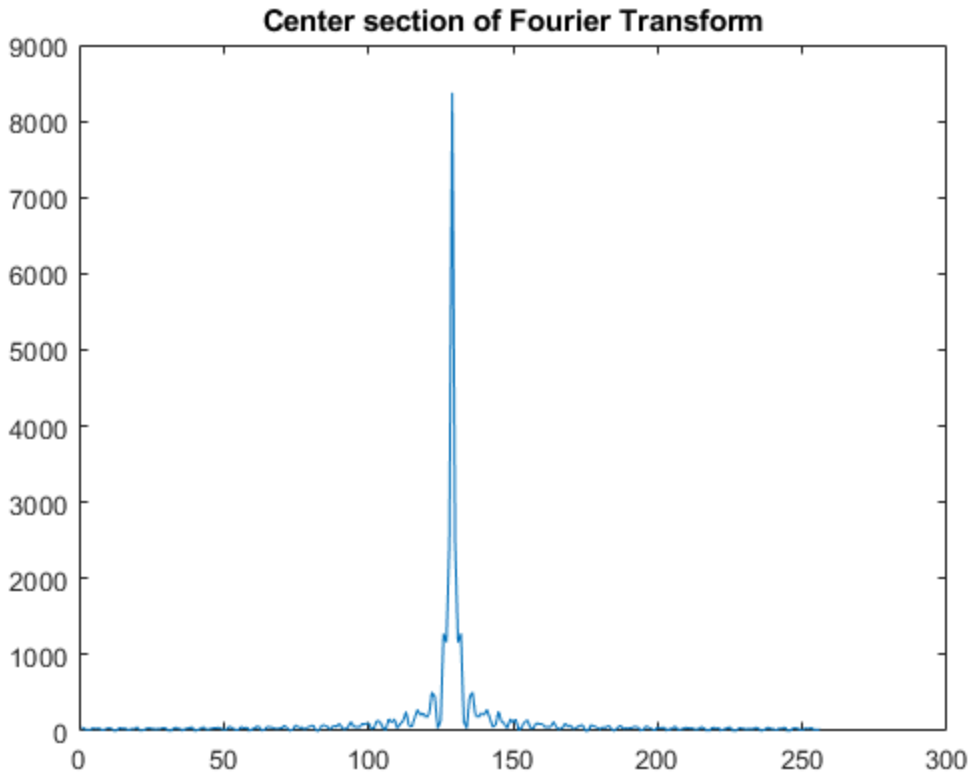
```
f =

  Figure (1) with properties:

      Number: 1
        Name: ''
```

```
      Color: [0.9400 0.9400 0.9400]
   Position: [680 558 560 420]
      Units: 'pixels'

  Use GET to show all properties


f =

  Figure (3) with properties:

      Number: 3
        Name: ''
      Color: [0.9400 0.9400 0.9400]
   Position: [680 558 560 420]
      Units: 'pixels'

  Use GET to show all properties
```




Center section of Fourier Transform
12000
10000
8000
6000
4000
2000
0
0
50
100
150
200
250
300

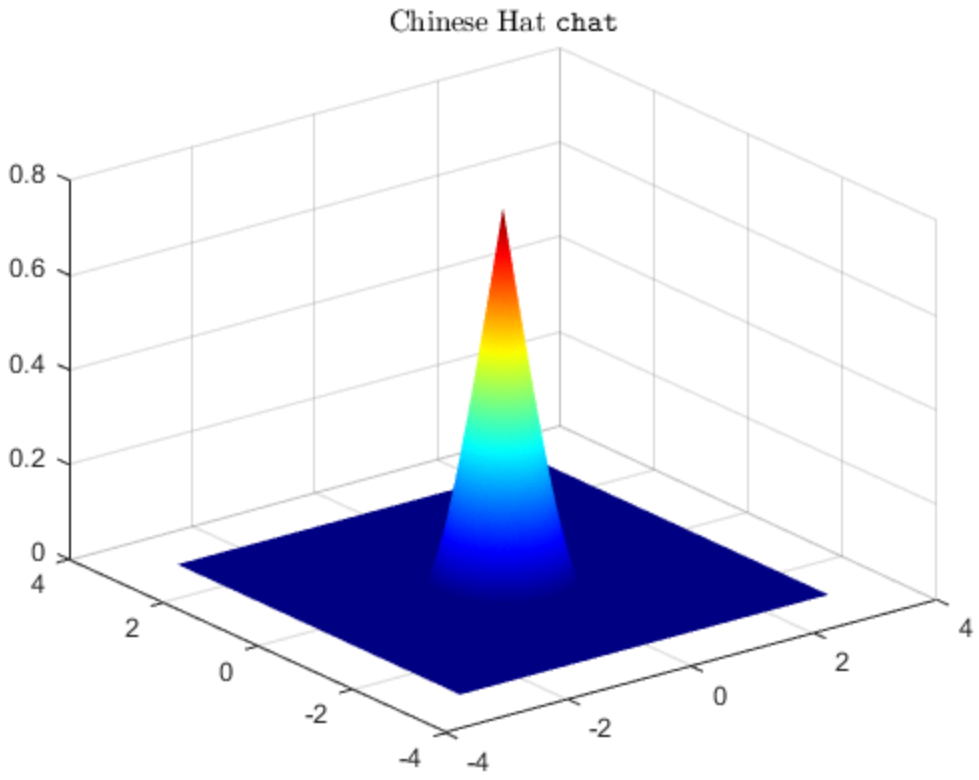

Cross shaped area and Fourier Transform
1
0.8
0.6
0.4
0.2
0
250
200
150
100
50
15000
10000
5000
14000
12000
8000
6000
4000
2000



Chinese Hat

```
[X,Y] = meshgrid(-3:0.01:3,-3:0.01:3);
s = 256; ks = 20;
f = figure
D = (X.^2+Y.^2);
A = zeros(size(D));
A(D<=1) = 0.5*(acos(sqrt(D(D<=1))) - sqrt(D(D<=1)).*sqrt(1-D(D<=1)));
surf(X,Y,A,'EdgeColor','none'), colormap jet
title('Chinese Hat \texttt{chat}','Interpreter','latex')
```

```
f =

  Figure (5) with properties:

      Number: 5
        Name: ''
       Color: [0.9400 0.9400 0.9400]
    Position: [680 558 560 420]
       Units: 'pixels'

  Use GET to show all properties
```



Published with MATLAB® R2022a