

# Activity 2 (Part 2 of 2) - Properties and Applications of the 2D Fourier Transform

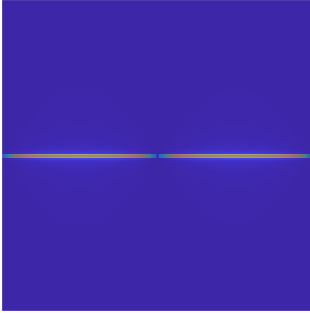
**Jonabel Eleanor B. Baldres**

## 2.2.1. Rotation Property of the FT

```
var = sinuXY(1);  
mesh(sinuXY(1));  
view(2)  
  
axis off;  
% Set the axes limits to fit the data  
xlim([0,250]);  
ylim([0,250]);  
% Set the figure size  
set(gcf, 'Units', 'pixels');  
set(gcf, 'Position', [0, 0, 200, 200]);  
  
% Save the figure  
exportgraphics(gcf, '~/Desktop/sinu_comb_1.png', 'Resolution', 75);
```

```
FFT_var = fftshift(abs(fft(var)));  
log_FFT = rescale(log(FFT_var+1),0,256);  
imagesc(log_FFT);  
axis off;  
axis image;  
% Set the figure size  
set(gcf, 'Units', 'pixels');  
set(gcf, 'Position', [0, 0, 200 , 200]);  
  
% Save the figure  
exportgraphics(gcf, '~/Desktop/sinu_comb_1_fft.png', 'Resolution', 75);
```

Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.

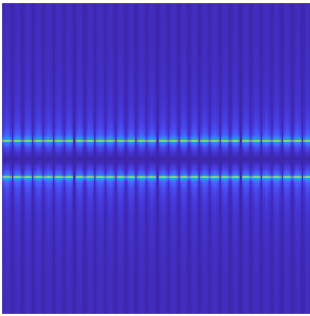


```
var2 = sinuXY(15);  
mesh(sinuXY(15));  
view(2)  
axis off;  
% Set the axes limits to fit the data  
xlim([0,250]);  
ylim([0,250]);  
% Set the figure size  
set(gcf, 'Units', 'pixels');  
set(gcf, 'Position', [0, 0, 200, 200]);  
  
% Save the figure  
exportgraphics(gcf, '~/Desktop/sinu_comb_15.png', 'Resolution', 75);
```

```
FFT_var2 = fftshift(abs(fft(var2)));  
log_FFT_2 =rescale(log(FFT_var2+1),0,256);  
imagesc(log_FFT_2);  
axis off;  
axis image;  
% Set the figure size  
set(gcf, 'Units', 'pixels');  
set(gcf, 'Position', [0, 0, 200, 200]);
```

```
% Save the figure
exportgraphics(gcf, '~/Desktop/sinu_comb_15_fft.png', 'Resolution', 75);
```

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```
var3 = sinuXY(10);
mesh(sinuXY(10));
view(2)
axis off;
% Set the axes limits to fit the data
xlim([0,250]);
ylim([0,250]);
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

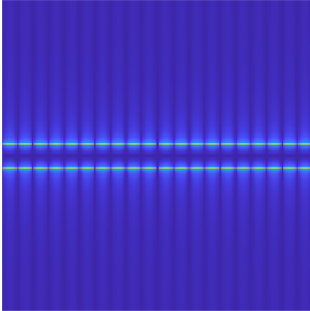
% Save the figure
exportgraphics(gcf, '~/Desktop/sinu_comb_10.png', 'Resolution', 75);
```

```
FFT_var3 = fftshift(abs(fft(var3)));
log_FFT_3 =rescale(log(FFT_var3+1),0,256);
imagesc(log_FFT_3);
axis off;
```

```
axis image;
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/sinu_comb_10_fft.png', 'Resolution', 75);
```

Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.



```
deg_0 = myMeshFunction(4, 0);
deg_30 = myMeshFunction(4, pi/6);
deg_45 = myMeshFunction(4, pi/4);
deg_90 = myMeshFunction(4, pi/2);
deg_combination = deg_0 .* deg_30;
deg_combination_1 = deg_30 .* deg_45;
deg_combination_2 = deg_90 .* deg_45;

FFT_0 = fftshift(abs(fft(deg_0)));
FFT_30 = fftshift(abs(fft(deg_30)));
FFT_45 = fftshift(abs(fft(deg_45)));
FFT_90 = fftshift(abs(fft(deg_90)));
FFT_combination = fftshift(abs(fft(deg_combination)));
FFT_combination_1 = fftshift(abs(fft(deg_combination_1)));
FFT_combination_2 = fftshift(abs(fft(deg_combination_2)));

log_FFT_0 = rescale(log(FFT_0+1), 0, 256);
log_FFT_30 = rescale(log(FFT_30+1), 0, 256);
log_FFT_45 = rescale(log(FFT_45+1), 0, 256);
log_FFT_90 = rescale(log(FFT_90+1), 0, 256);
log_FFT_combination = rescale(log(FFT_combination+1), 0, 256);
log_FFT_combination_1 = rescale(log(FFT_combination_1+1), 0, 256);
log_FFT_combination_2 = rescale(log(FFT_combination_2+1), 0, 256);
```

```
mesh(myMeshFunction(4, 0));
```

```

view(2)
axis off;
% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/rot_0.png', 'Resolution', 75);

```

```

mesh(myMeshFunction(4, pi/6));
view(2)
axis off;
% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/rot_pi6.png', 'Resolution', 75);

```

```

mesh(myMeshFunction(4, pi/4));
view(2)
axis off;
% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/rot_pi4.png', 'Resolution', 75);

```

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```

mesh(myMeshFunction(4, pi/2));
view(2)
axis off;
% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/rot_pi2.png', 'Resolution', 75);

```

Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.

```

mesh(deg_0 .* deg_30);
view(2)
axis off;
% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/rot_0_30.png', 'Resolution', 75);

```

```

mesh(deg_30 .* deg_45);
view(2)
axis off;
% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

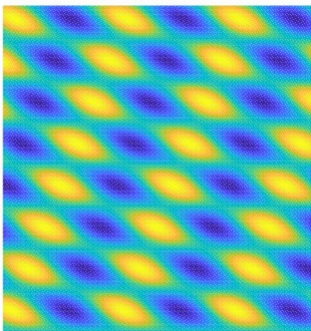
```

```
% Save the figure
exportgraphics(gcf, '~/Desktop/rot_30_45.png', 'Resolution', 75);
```

Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.  
Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.

```
mesh(deg_90 .* deg_45);
view(2)
axis off;
% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/rot_90_45.png', 'Resolution', 75);
```



```
deg_30_1 = myMeshFunction(1, pi/6);
deg_60_1 = myMeshFunction(7, pi);
deg_90_1 = myMeshFunction(20, pi/2);
deg_combination_306090 = deg_30_1 .* deg_60_1 .* deg_90_1;
```



```

mesh(deg_combination_306090)
FFT_306090 = fftshift(abs(fft(deg_combination_306090)));
log_FFT_306090 = rescale(log(FFT_306090+1),0,256);
colormap(hot);
view(2)

% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/rot_30_60_90.png', 'Resolution', 75);

```

Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.

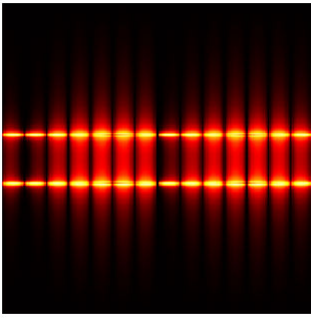
```

imagesc(log_FFT_306090)
axis off;
axis image;
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/fft_30_60_90.png', 'Resolution', 75);

```

Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.  
Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.

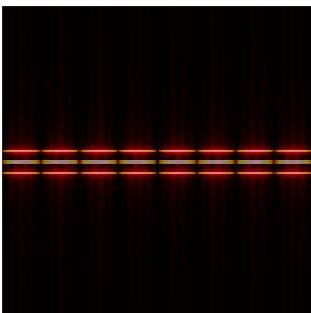


```
deg_0 = myMeshFunction(4, pi);
deg_30 = myMeshFunction(8, pi/6);
deg_45 = myMeshFunction(10, pi/6);
deg_combination_03045 = deg_0 .* deg_30 .* deg_45;
mesh(deg_combination_03045)
FFT_03045 = fftshift(abs(fft(deg_combination_03045)));
log_FFT_03045 =rescale(log(FFT_03045+1),0,256);
colormap(hot);
view(2)

% Set the axes limits to fit the data
xlim([0,250])
ylim([0,250])
imagesc(log_FFT_03045)
axis off;
axis image;
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/rot_0_30_45.png', 'Resolution', 75);
```

Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.

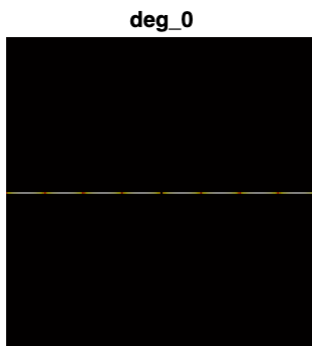


```
deg0_mesh = imread('deg0.jpg');
deg30_mesh = imread('deg30.jpg');
deg45_mesh = imread('deg45.jpg');
deg90_mesh = imread('deg90.jpg');
degcomb_mesh = imread('deg_comb.jpg');
degcomb1_mesh = imread('deg_comb1.jpg');
degcomb2_mesh = imread('deg_comb2.jpg');
```

```
%
montage({deg0_mesh,deg30_mesh,deg45_mesh,deg90_mesh,degcomb_mesh,degcomb1_me
sh,degcomb2_mesh}, 'size', [1 NaN])
```

```
%subplot(1,7,1)
imagesc(log_FFT_0)
title('deg\_0')
axis image;
axis off;
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/fft_0.png', 'Resolution', 75);
```



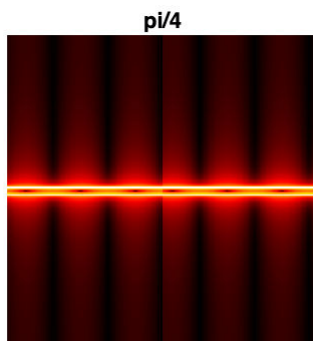
```
%subplot(1,7,2)
imagesc(log_FFT_30)
title('pi/6')
axis image;
axis off;
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);
```

```
% Save the figure
exportgraphics(gcf, '~/Desktop/fft_pi6.png', 'Resolution', 75);
```



```
%subplot(1,7,3)
imagesc(log_FFT_45)
title('pi/4')
axis image;
axis off;
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

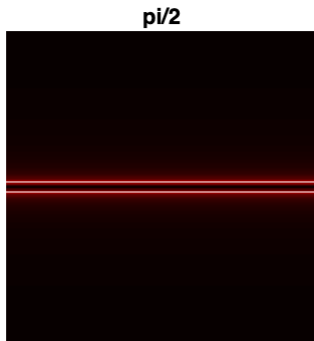
% Save the figure
exportgraphics(gcf, '~/Desktop/fft_deg_45.png', 'Resolution', 75);
```



```
%subplot(1,7,4)
imagesc(log_FFT_90)
title('pi/2')
axis image;
axis off;
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);
```

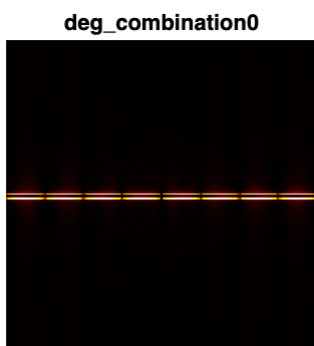
```
% Save the figure
exportgraphics(gcf, '~/Desktop/fft_pi2.png', 'Resolution', 75);
```

Warning: Graphics timeout occurred. To share details of this issue with MathWorks technical support, please include that this is an unresponsive graphics client with your service request.



```
%subplot(1,7,5)
imagesc(log_FFT_combination)
title('deg\_combination0')
axis image;
axis off;
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/fft_comb.png', 'Resolution', 75);
```



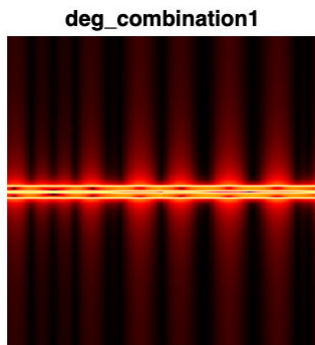
```
%subplot(1,7,6)
imagesc(log_FFT_combination_1)
title('deg\_combination1')
axis image;
axis off;
% Set the figure size
```

```

set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/fft_comb2.png', 'Resolution', 75);

```

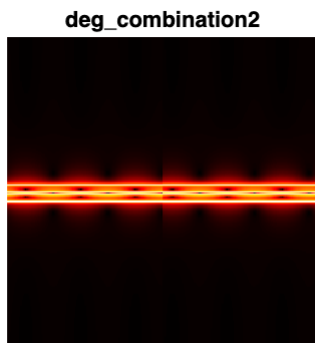


```

%subplot(1,7,7)
imagesc(log_FFT_combination_2)
title('deg\_combination2')
axis image;
axis off;
hold off
% Set the figure size
set(gcf, 'Units', 'pixels');
set(gcf, 'Position', [0, 0, 200, 200]);

% Save the figure
exportgraphics(gcf, '~/Desktop/fft_comb3.png', 'Resolution', 75);

```



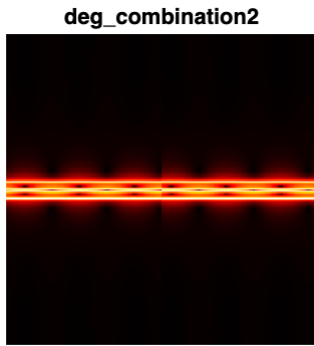
```

colormap('hot');
images = {log_FFT_0, log_FFT_30, log_FFT_45, log_FFT_90,
log_FFT_combination, log_FFT_combination_1, log_FFT_combination_2};

montage = imtile(images, 'GridSize', [1 numel(images)]);

```

```
% Set the colormap to hot
colormap('hot');
```



```
imwrite(montage, fullfile(pwd, 'montage.jpg'));
```

```
% Save mesh of sinuXY(1)
%mesh(sinuXY(1));
%saveas(gcf, 'sinuXY_1_mesh.png');

% Save mesh of sinuXY(15)
%mesh(sinuXY(15));
%saveas(gcf, 'sinuXY_15_mesh.png');

% Save mesh of myMeshFunction(4, 0)
%mesh(myMeshFunction(4, 0));
%saveas(gcf, 'myMeshFunction_4_0_mesh.png');

% Save mesh of myMeshFunction(4, pi/6)
%mesh(myMeshFunction(4, pi/6));
%saveas(gcf, 'myMeshFunction_4_pi6_mesh.png');

% Save mesh of myMeshFunction(4, pi/4)
%mesh(myMeshFunction(4, pi/4));
%saveas(gcf, 'myMeshFunction_4_pi4_mesh.png');

% Save mesh of myMeshFunction(4, pi/2)
%mesh(myMeshFunction(4, pi/2));
%saveas(gcf, 'myMeshFunction_4_pi2_mesh.png');

% Save mesh of deg_0 .* deg_30
%mesh(deg_0 .* deg_30);
%saveas(gcf, 'deg_0_30_mesh.png');

% Save mesh of deg_30 .* deg_45
%mesh(deg_30 .* deg_45);
```

```

%saveas(gcf, 'deg_30_45_mesh.png');

% Save mesh of deg_90 .* deg_45
%mesh(deg_90 .* deg_45);
%saveas(gcf, 'deg_90_45_mesh.png');

% Save mesh of deg_combination_306090
%mesh(deg_combination_306090);
%saveas(gcf, 'deg_combination_306090_mesh.png');

% Save mesh of deg_combination_03045
%mesh(deg_combination_03045);
%saveas(gcf, 'deg_combination_03045_mesh.png');

```

```

function Z = myMeshFunction(f,theta)
    N = 256;
    x = linspace(0,pi,N);
    y = x;
    [X,Y] = meshgrid(x,y);
    Z = sin(2*f*(Y*sin(theta)+X*cos(theta)));
end

```

```

function Z = sinuXY(f)
    N = 256;
    x = linspace(0,pi,N);
    y = x;
    [X,Y] = meshgrid(x,y);
    Z = sin(2*f*X) .* sin(2*f*Y);
end

```