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% 202201472 - Kaushik Prajapati

% Task 1: Demonstrate the significance of phase spectrum of an
% image for reconstructing the image using magnitude spectrum
% and phase.

% Loading an image
original_Image = imread('202201472.jpg');
% original_Image = rgb2gray(original_Image);

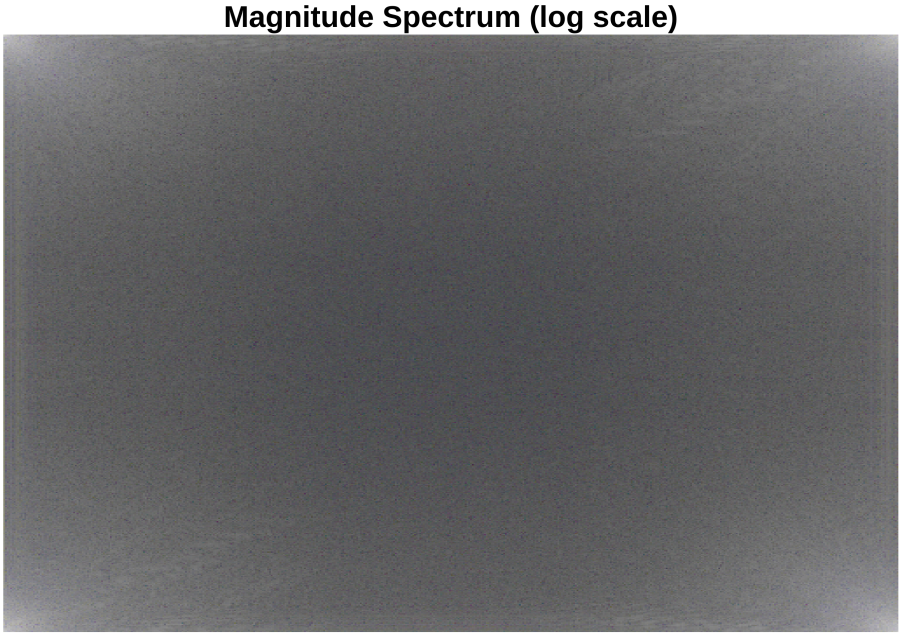
% Displaying the original image
figure;
imshow(original_Image);
title('Original Image');
```


```
% Computing the Fourier Transform of the image
fftImage = fft2(double(original_Image));

% Extracting magnitude and phase spectra
magnitudeSpectrum = abs(fftImage); % Magnitude
phaseSpectrum = angle(fftImage); % Phase

% Displaying Magnitude Spectrum
figure;
```

```
normalizedMagnitude = mat2gray(log(1 + magnitudeSpectrum));
imshow(normalizedMagnitude, []);
title('Magnitude Spectrum (log scale)');
```

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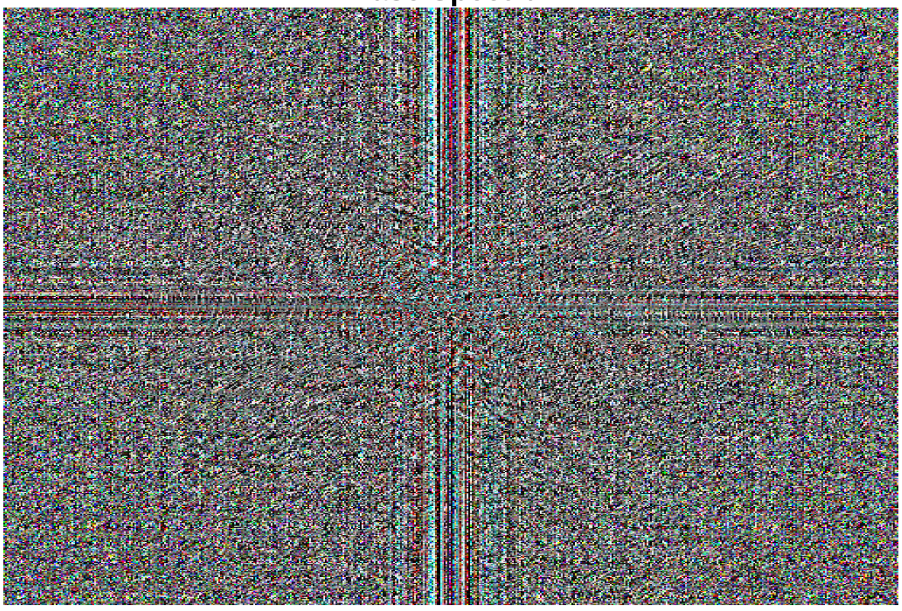
% Displaying Phase Spectrum
figure;
imshow(fftshift(phaseSpectrum), []);
title('Phase Spectrum');
```

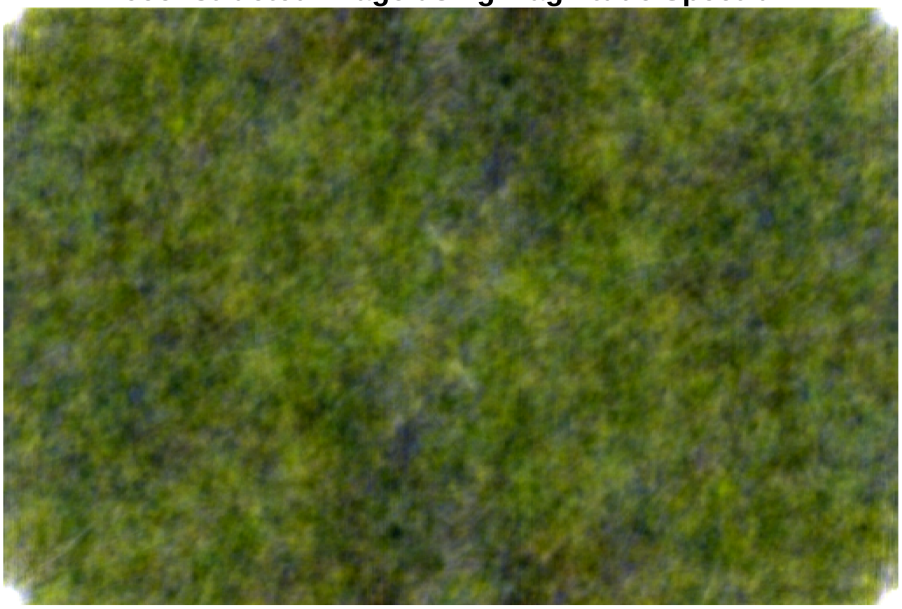
Phase Spectrum



```
% Reconstructing the image using only magnitude spectrum
magnitudeOnly = ifft2(magnitudeSpectrum .* exp(1i *
zeros(size(phaseSpectrum))));
magnitudeOnly = real(magnitudeOnly);

% Displaying the reconstructed image using only magnitude spectrum
figure;
imshow(uint8(magnitudeOnly));
title('Reconstructed Image using Magnitude Spectrum');
```

Reconstructed Image using Magnitude Spectrum



```
% Reconstructing the image using both magnitude and phase spectrum
reconstructedImage = ifft2(magnitudeSpectrum .* exp(1i * phaseSpectrum));
reconstructedImage = real(reconstructedImage);

% Displaying the reconstructed image using both magnitude and phase spectrum
figure;
imshow(uint8(reconstructedImage));
title('Reconstructed Image');
```

Reconstructed Image

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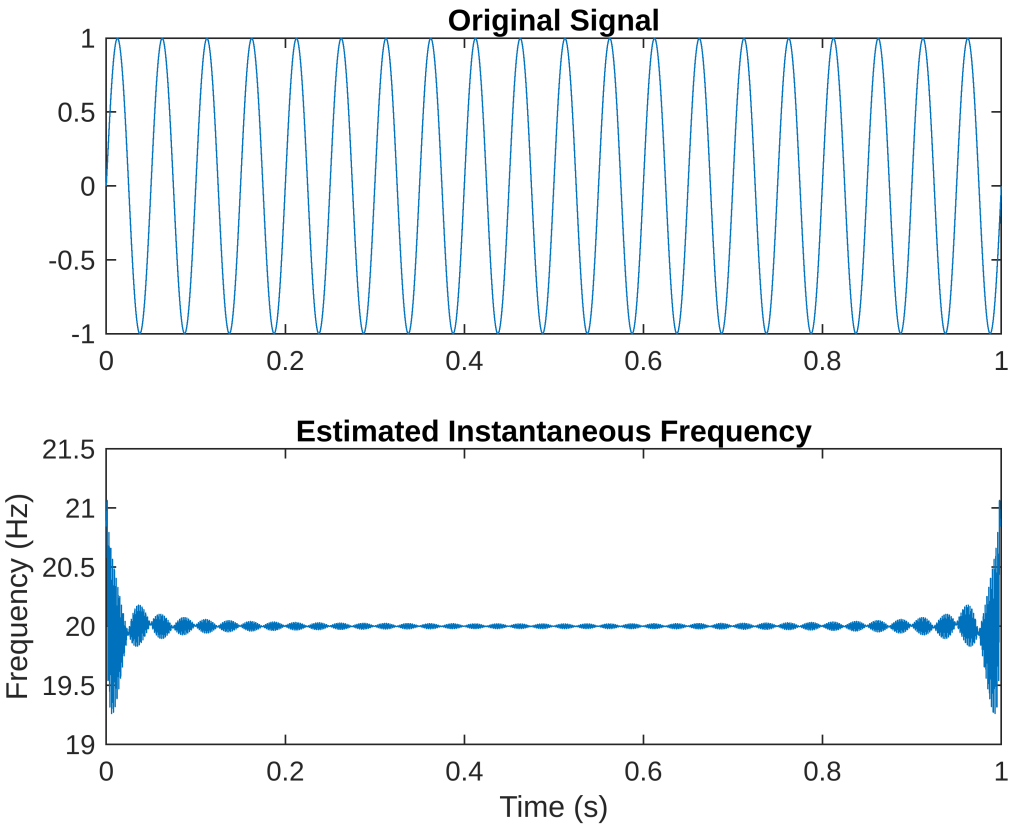
% Task 2: Demonstrate that Instantaneous frequency of a signal can be
% estimated using the differential of phase estimated through the
% analytical signal of an input signal.

fs = 1000;
t = 0:1/fs:1;
f1 = 20;
signal = sin(2*pi*f1*t);
analyticalSignal = hilbert(signal);
phase = angle(analyticalSignal);
instFreq = diff(unwrap(phase)) * fs / (2*pi);

figure;
subplot(2, 1, 1);
plot(t, signal);
title('Original Signal');

subplot(2, 1, 2);
plot(t(1:end-1), instFreq);
title('Estimated Instantaneous Frequency');

xlabel('Time (s)');
ylabel('Frequency (Hz)');
```


Original Signal
1
0.5
0
-0.5
-1
0
0.2
0.4
0.6
0.8
1
Estimated Instantaneous Frequency
Frequency (Hz)
21.5
21
20.5
20
19.5
19
0
0.2
0.4
0.6
0.8
1
Time (s)