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% Reconstruction algorithm for digital holographic microscope
% Microscope is set up in 4-f configuration.

% Pull out the recorded hologram to MATLAB workspace.
I = imread('l5_wc.bmp');  % read the image
I = im2double(I);         % Convert the image into double.
Is = I(300:550,300:550); % Region of interest (ROI)
figure, imshow(Is)        % Show the(ROI)image
colormap(gray);           % Gray scale
axis off

% Apply High pass filter and Fourier transform the recorded hologram.
h = fspecial('laplacian', 0.05); % High pass filtered to subtract the
% zero order and the spatial  frequencies are preserved.
% 2-D Fourier tranformed the image and convoluted with the designed high
% pass filtered and frequency shifted.
FT = fftshift(fft2(Is-mean(mean(Is))).*fft2(h, size(Is, 1), size(Is, 2)));
figure, imagesc(abs(FT))    % Show the FT shifted frequencies.
mask=roipoly;               % Create the mask.
fima=FT.*mask;              % Filtered image.
figure, imagesc(abs(fima))  % Show the filtered frequencies.
invf=ifft2(ifftshift(fima));% Inverse FT of the image.
figure, imagesc(abs(invf))  % Show the inverse  Fourier transformed image.

% Calculate the phase of the image.
phase = atan2(imag(invf),real(invf));
figure, imshow(phase)

% If the phase is wrapped, then execute the Phase unwrapping procedure.
save ph2.dat -ascii phase   % Save the phase image in .dat format to execute
%in the unwrapping algorithm
% Import the unwrapped phase image to clear out the 45 degree spatial
% frequencies using import function in matlab.
figure, imshow(uph1)
k=1:251;
for k1=1:251
aa=uph1(k1,:);
f=fit(k,aa,'poly1');
f1=f(k);
uph2(k1,:)=aa-f1;
end
figure,imshow(uph.surf)    % Show the final unwrapped image
```