

Assignment 2

Computer Vision - IT-524

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1. Given different source positions and find the resulting image of a given sphere.

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% Computer Vision (IT524)
% Assignment 2: Assume different source positions and find the resulting
% image of a given sphere.
% Assume different source positions as (ps,qs) = (0,0), (0.5,0.5) etc in
% the image coordinate system

%% Clear workspace
clear;
close all;
clc;

%% Set Parameters
rds = 200;           % Sphere's radius
sz = 512;           % Image size
p_s = [0,0.5,1];    % Source p_s
q_s = [0,0.5,0];    % Source q_s

%% Circle initialization
if(mod(sz,2)==0)
    mid = sz/2;
else
    mid = floor(sz/2) + 1;
end
sphr = zeros(sz,sz);

%% Draw the sphere
for j = 1:sz
    y = mid - j;
    for i = 1:sz
        x = mid - i;
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        if(x*x + y*y <= rds*rds)
            sphr(i,j) = 1;
        end
    end
end
hdl_sphr = figure; imshow(sphr), title('Sphere in 2D');
print(hdl_sphr, '-v', '-dpng', 'Sphere.png');

%% Calculating p and q and finally R(p(x,y),q(x,y)) = E(x,y)
% Given
% 1. p = -x/(z-z0)
% 2. q = -y/(z-z0)
% 3. (z-z0)^2 + (x^2+y^2) = r^2
% Thus,
% 
$$E(x,y) = \frac{(p*p_s + q*q_s + 1)/(\sqrt{p_s^2+q_s^2+1}*\sqrt{p^2+q^2+1})}{((\sqrt{p_s^2+q_s^2+1}*\sqrt{(-x/(z-z0))^2+(-y/(z-z0))^2+1}))}$$

%
% Therefore,
% 
$$E(x,y) = \frac{(-x*p_s - y*q_s + (z-z0))/(r*\sqrt{p_s*p_s+q_s*q_s+1})}{((\sqrt{p_s^2+q_s^2+1}*\sqrt{(-x/(z-z0))^2+(-y/(z-z0))^2+1}))}$$

for srcs = 1:size(p_s,2)
    E = zeros(sz,sz);
    ps = p_s(srcs);
    qs = q_s(srcs);
    for j = 1:sz
        y = mid - j;
        for i = 1:sz
            x = mid - i;
            if(x*x + y*y <= rds*rds)
                z_z0 = sqrt(rds*rds-(x*x + y*y));
                E(i,j) = (-x*ps-y*qs+z_z0)/(rds*sqrt(ps*ps+qs*qs+1));
            end
        end
    end
end

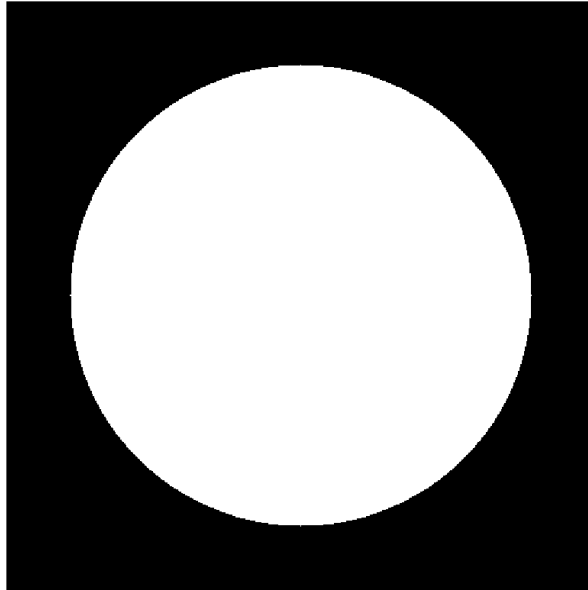
% Display
wintitle = sprintf('E(x,y) for source (ps,qs) = (%.1f,%.1f)',ps,qs);
hdl = figure; imshow(E), title(wintitle);

% Save
print(hdl, '-v', '-dpng', sprintf('Source_%d.png',srcs));
end

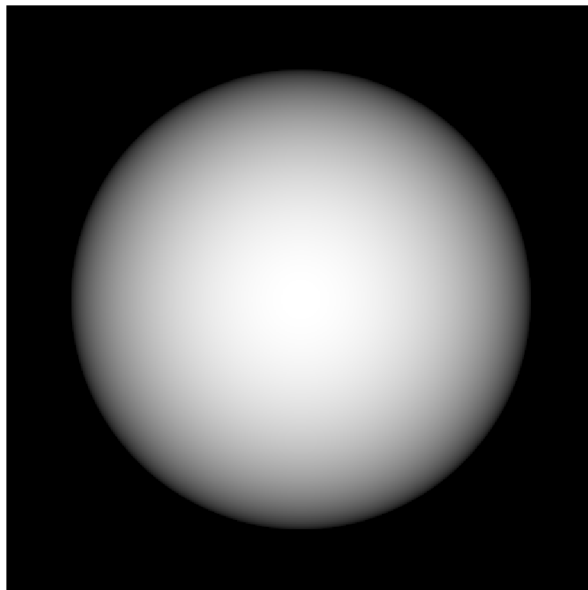
```

Results

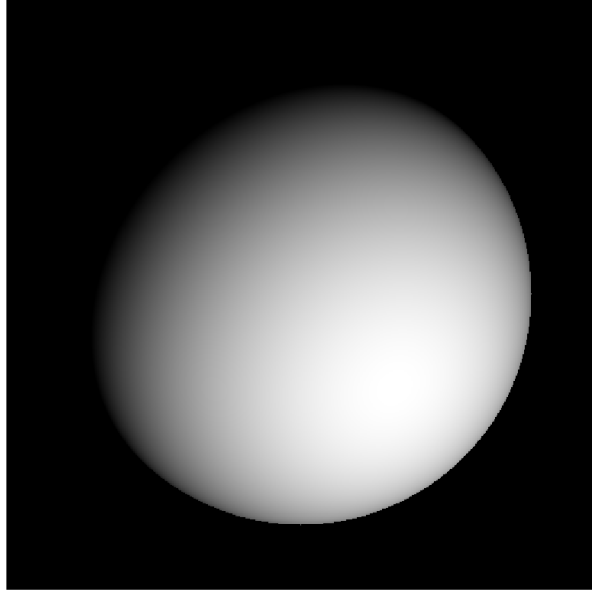
Sphere in 2D



$E(x,y)$ for source $(p_s, q_s) = (0.0, 0.0)$



$E(x,y)$ for source $(p_s,q_s) = (0.5,0.5)$



$E(x,y)$ for source $(p_s,q_s) = (0.0,1.0)$

