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ETCS 105 Career Discovery

MatLab Project 3

Two 150-Watt Bulbs

In this case, we need to decide where to put the two bulbs. Common sense tells us to arrange the bulbs symmetrically along a line down the center of a room in the long direction; that is along the line y=2. Define a function that gives the intensity of light at a point (x, y) on the floor due to a 150-watt bulb at a position (d, 2) on the ceiling.

Answer:

Intensity = Power / (4π * Distance^2)

- Distance = distance between the bulb and the point on the floor, thus

  Distance= D = $\sqrt{(x - d)^2 + (y - 2)^2 + (0 - 3)^2}$

Therefore,

Intensity(x, y) = $\frac{150}{4\pi \times ((x-d)^2 + (y-2)^2 + (0-3)^2)}$

However, since we have two bulbs, one in (d,2) and another one in (x, 2), intensity is the total illumination intensity produced by all bulbs combined at each point on the floor.

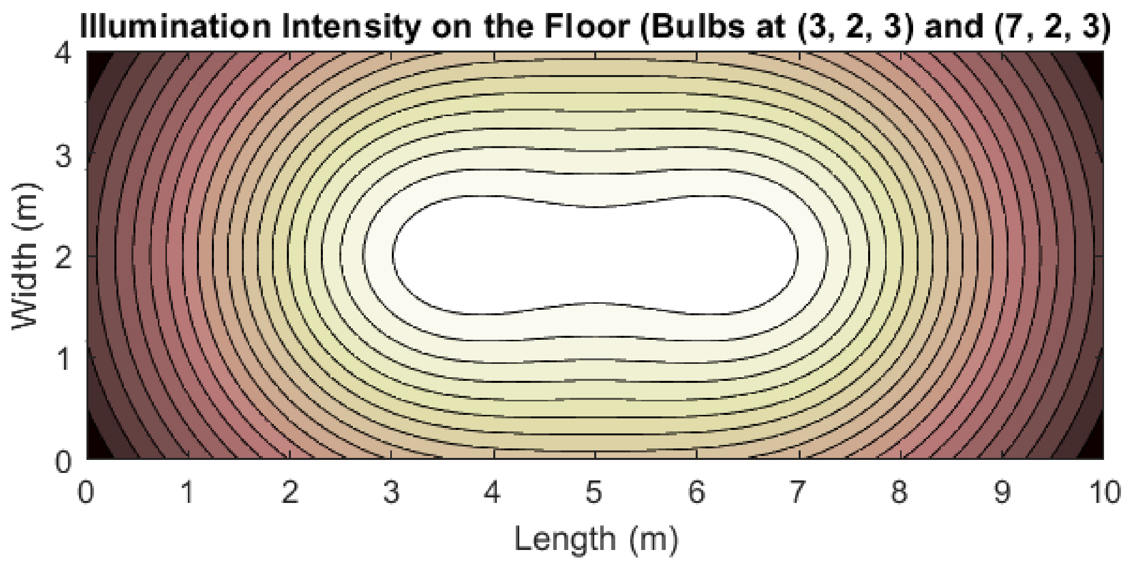
Intensity total = Intensity of first bulb(d, y) + Intensity of second bulb(x, y)

Let's get an idea of the illumination pattern if we put one light at d=3 and the other at d=7. We specify the drawings of 20 contours in this and the following plots

Answer:

```
% room dimensions
l=10; % length
w=4; % width

% bulbs on the x-axis
d1=3;
d2=7;

% positions and powers of the bulbs
bulb_pos=[d1, 2, 3; d2, 2, 3];
bulb_pow=[150; 150];

% grid for plotting
[X, Y] = meshgrid(0:0.1:10, 0:0.1:4);
```

```
% function to calculate the total intensity from all bulbs
intensity_total = @(X, Y) intensity_single(X, Y, bulb_pos(1, 1), bulb_pos(1, 2),
bulb_pos(1, 3), bulb_pow(1)) + ...
                  intensity_single(X, Y, bulb_pos(2, 1), bulb_pos(2, 2), bulb_pos(2,
3), bulb_pow(2));

% plot illumination
figure;
contourf(X, Y, intensity_total(X, Y), 20); % 20 contours
colormap('pink'); % 'pink' suits the best to imitate light bulbs
xlabel('Length (m)');
ylabel('Width (m)');
title("Illumination Intensity on the Floor (Bulbs at (" + d1 +", 2, 3) and (" + d2 + ",
2, 3))");
axis equal tight;

% function to calculate intensity from a single bulb
function intensity = intensity_single(X, Y, bulb_x, bulb_y, bulb_z, p)
  intensity = p./(4*pi*((X-bulb_x).^2 + (Y-bulb_y).^2 + bulb_z^2));
end
```

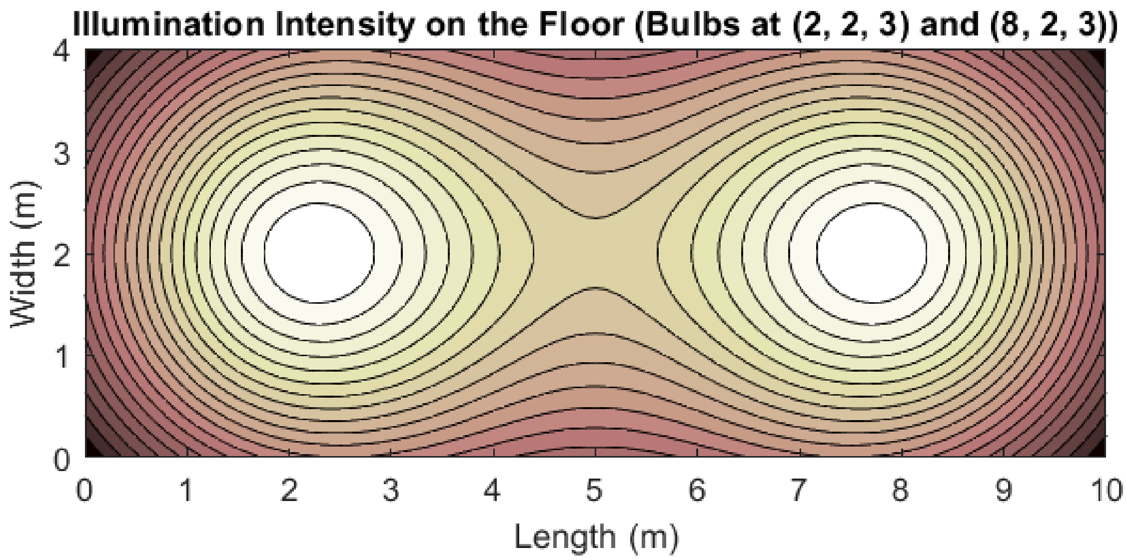


The floor is more evenly lit with one bulb, it looks as if the bulbs are closer together as they should be. If we move the bulbs further apart, the center of the room will get dimmer, but the corners will get brighter. Let's try changing the location of the lights to d=2 and d=8.

Answer:

Just adjust the d1 and d2 variables from the previous code:

```
% bulbs on x-axis
d1=2;
d2=8;
```



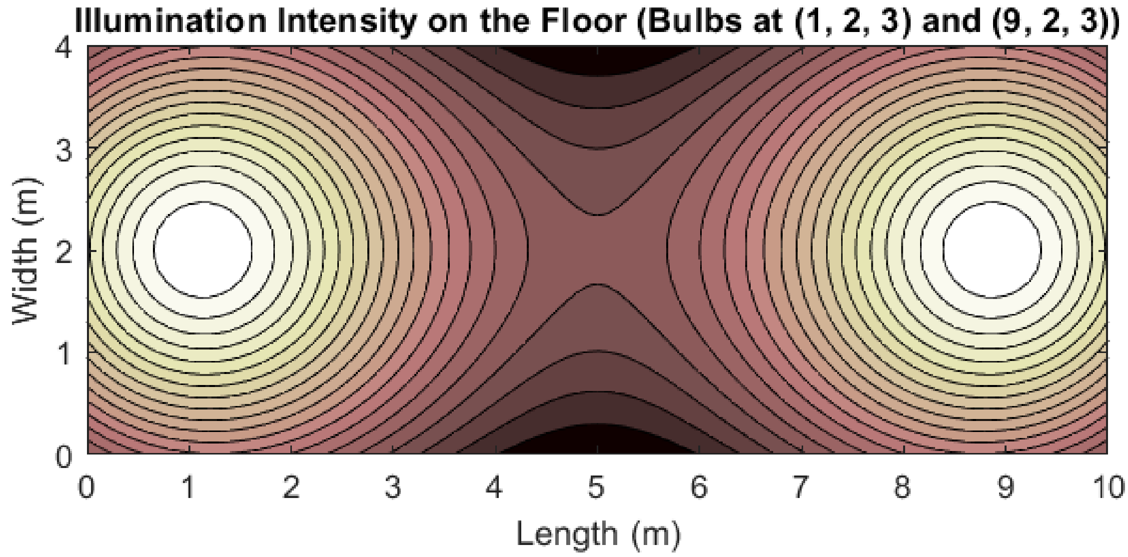
This is an improvement. The corners are the darkest spots of the room, though the light intensity along the walls toward the middle of the room near (x=5) is diminishing as we move the bulbs further apart. Still, to better illuminate the darkest spots we should keep moving the bulbs apart. Let's try lights at d=1 and d=9.

Answer:

Just adjust the d1 and d2 variables from the previous code:

```
% bulbs on the x-axis
```

```
d1=1;
d2=9;
```



Using two 150-watt bulbs. Placing these bulbs equidistant from each other and from the walls could improve the spread of light. By dividing the ceiling into two sections and positioning the bulbs towards the center of each section, we can achieve better coverage, reducing the intensity of shadows in the room's corners and sides.

Answer:

We have two sections: the first one is from (0, 5) and the second one is from (5, 10) of room length. The middle point for each of the sections will be d1=2.5 and d2=7.5 respectively. Let's adjust our variable in the initial code to those values.

```
% bulbs on the x-axis
d1=2.5;
d2=7.5;
```

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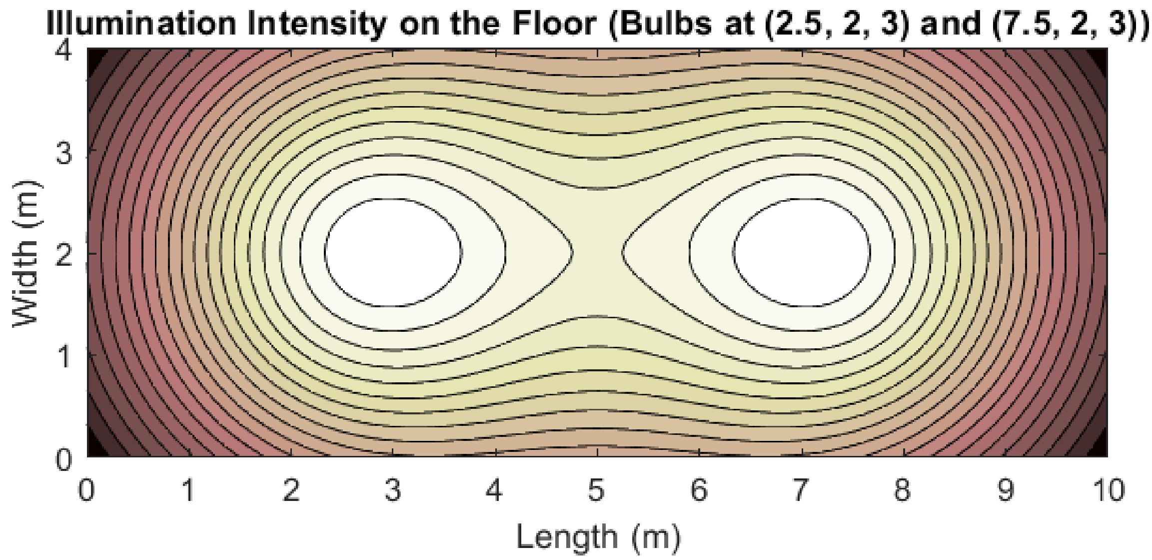

This is the best way to position two bulbs of 150 watts each.