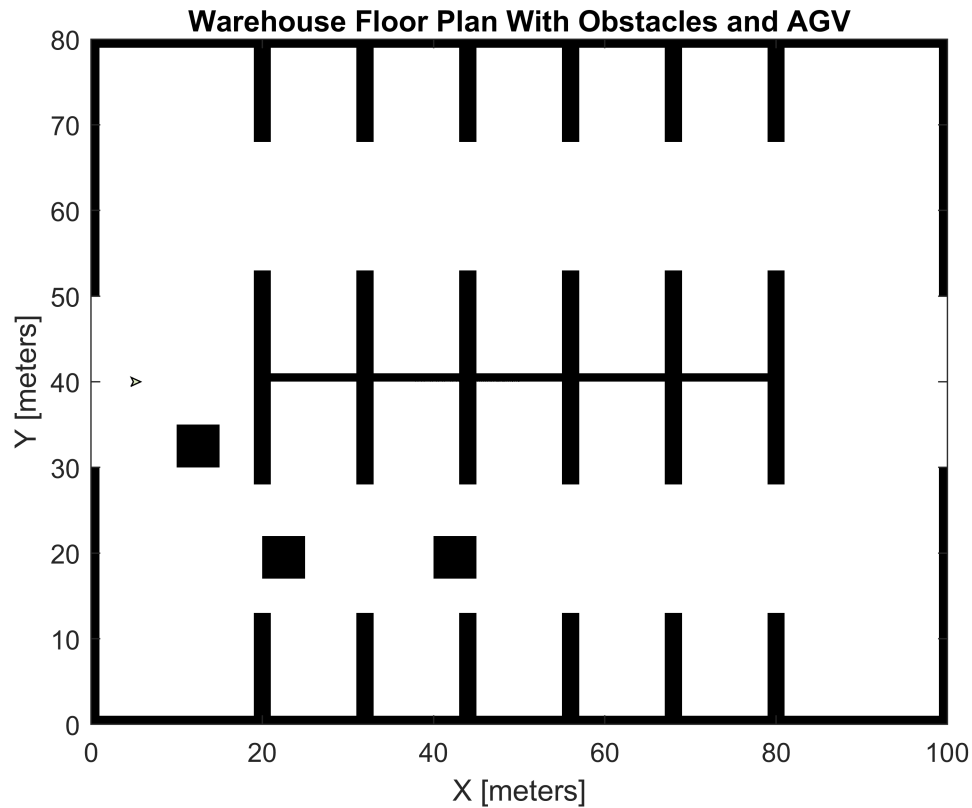


```

map = helperCreateBinaryOccupancyMap;
figure
show(map)
title('Warehouse Floor Plan With Obstacles and AGV')
pose = [5 40 0];
helperPlotRobot(gca, pose);

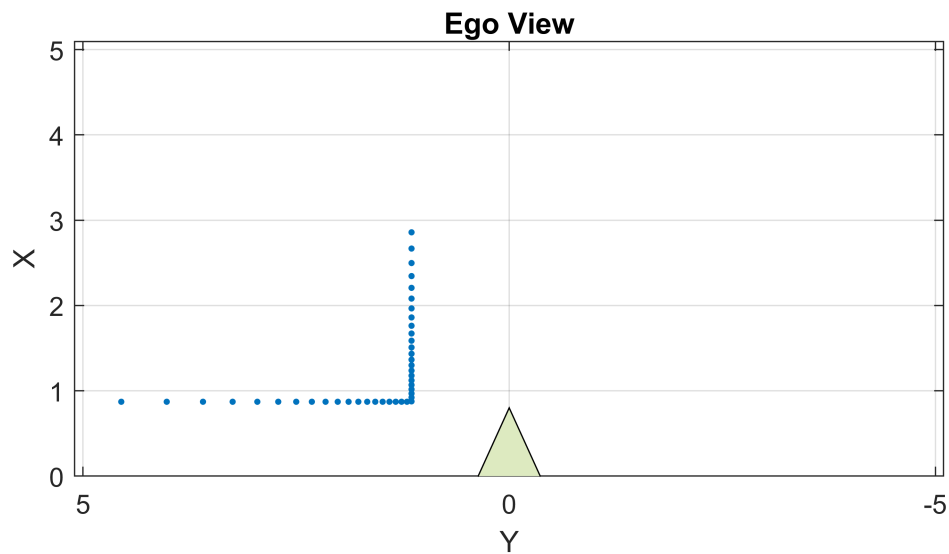
```



```

lidar = rangeSensor;
lidar.HorizontalAngle = [-pi/2 pi/2];
lidar.Range = [0 5];
load waypoints.mat
traj = waypointsMap;
Vehiclepose = traj(350, :);
[ranges, angles] = lidar(Vehiclepose, map);
scan = lidarScan(ranges, angles);
plot(scan)
title('Ego View')
helperPlotRobot(gca, [0 0 Vehiclepose(3)]);

```

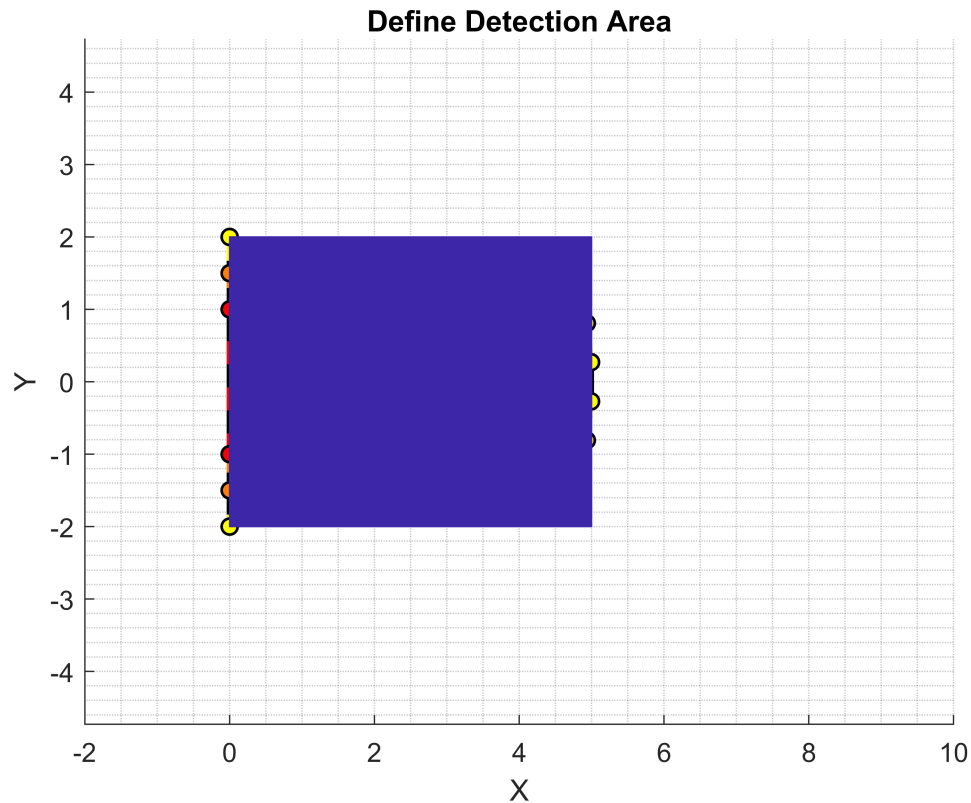


```
display = helperVisualizer;
hRobot = plotBinaryMap(display, map, pose);
figure
detAxes = gca;
title(detAxes, 'Define Detection Area')
axis(detAxes, [-2 10 -2 4])
xlabel(detAxes, 'X')
ylabel(detAxes, 'Y')
axis(detAxes, 'equal')
grid(detAxes, 'minor')
t = linspace(-pi/2, pi/2, 30)';
colors = [1 1 1; 1 1 0; 1 0.5 0; 1 0 0];
radius = [5 2 1];
detAreaHandles = repmat(images.roi.Polygon, [3 1]);
pos = [cos(t) sin(t)] * radius(1);
pos = [0 -2; pos(14:17, :); 0 2];
detAreaHandles(1) = drawpolygon(...
    'Parent', detAxes, ...
    'InteractionsAllowed', 'reshape', ...
    'Position', pos, ...
    'StripeColor', 'black', ...
    'Color', colors(2, :));
pos = [cos(t) sin(t)] * radius(2);
pos = [0 -1.5; pos(12:19, :); 0 1.5];
detAreaHandles(2) = drawpolygon(...
    'Parent', detAxes, ...
    'InteractionsAllowed', 'reshape', ...
    'Position', pos, ...
```

```

'StripeColor', 'black', ...
'Color', colors(3, :));
pos = [cos(t) sin(t)] * radius(3);
pos = [0 -1; pos(10:21, :); 0 1];
detAreaHandles(3) = drawpolygon(...
    'Parent', detAxes, ...
    'InteractionsAllowed', 'reshape', ...
    'Position', pos, ...
    'StripeColor', 'black', ...
    'Color', colors(4, :));
axesDet = gca;
[detArea, bbox] = helperSaveDetectionArea(axesDet, detAreaHandles);

```



```

ax3 = getDetectionAreaAxes(display);
h = imagesc(ax3, [bbox(1) (bbox(1) + bbox(3))], ...
    -[bbox(2) (bbox(2) + bbox(4))], ...
    detArea);
colormap(ax3, colors);
plotObstacleDisplay(display)
%Red – Collision is imminent
%Orange – High chance of collision
%Yellow – Apply caution measures
for ij = 27:size(traj, 1)
    currentPose = traj(ij, :);
    [ranges, angles] = lidar(currentPose, map);
    scan = lidarScan(ranges, angles);
    cart = scan.Cartesian;
    cart(:, 3) = 0;
    pc = pointCloud(cart);

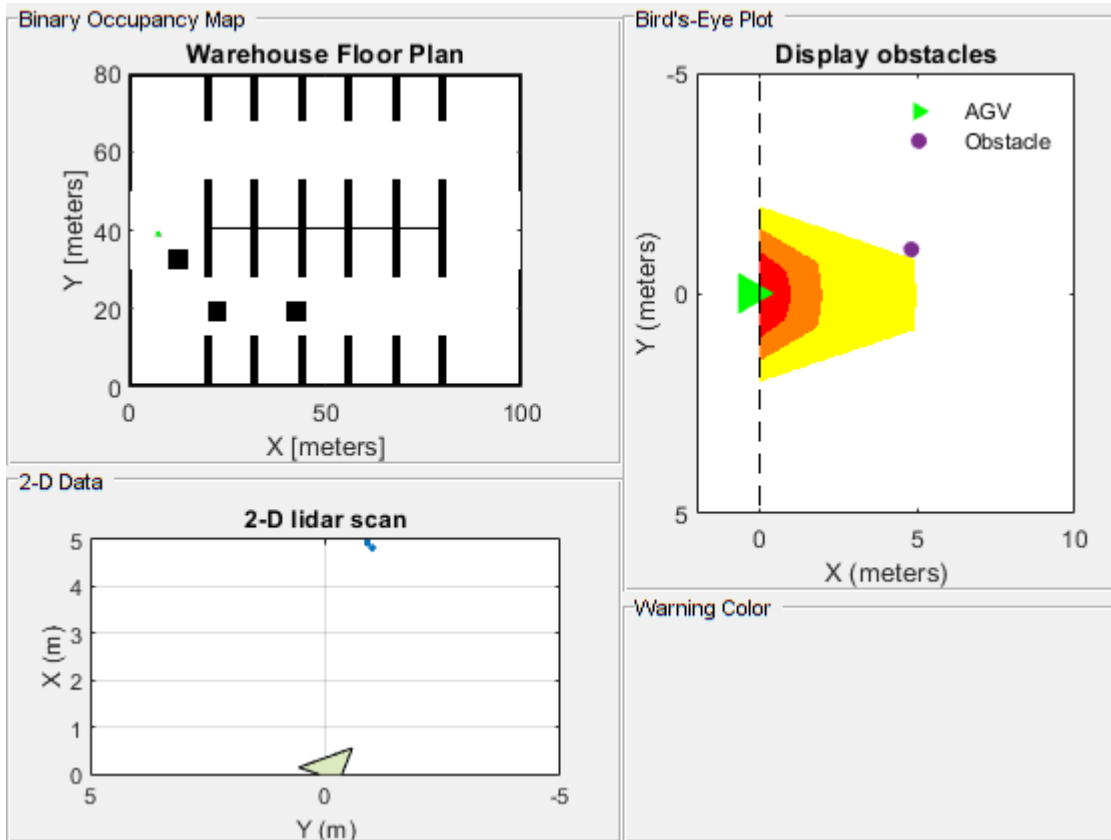
```

```

minDistance = 0.9;
[labels, numClusters] = pcsegdist(pc, minDistance);
updateMapDisplay(display, hRobot, currentPose);
plotLidarScan(display, scan, currentPose(3));
if exist('sc', 'var')
    delete(sc)
    clear sc
end
nearxy = zeros(numClusters, 2);
maxlevel = -inf;
for i = 1:numClusters
    c = find(labels == i);
    xy = pc.Location(c, 1:2);
    a = [xy(:, 1) xy(:, 2)] - repmat(bbox([1 2]), [size(xy, 1) 1]);
    b = repmat(bbox([3 4]), [size(xy, 1) 1]);
    xy_org = a./b;
    idx = floor(xy_org.*repmat([size(detArea, 2) size(detArea, 1)], [size(xy_org, 1), 1]));
    validIdx = 1 <= idx(:, 1) & 1 <= idx(:, 2) & ...
        idx(:, 1) <= size(detArea, 2) & idx(:, 2) <= size(detArea, 1);
    cols = idx(validIdx, 1);
    rows = idx(validIdx, 2);
    levels = double(detArea(sub2ind(size(detArea), rows, cols)));

    if ~isempty(levels)
        level = max(levels);
        maxlevel = max(maxlevel, level);
        xyInds = find(validIdx);
        xyInds = xyInds(levels == level);
        nearxy(i, :) = helperNearObstacles(xy(xyInds, :));
    else
        nearxy(i, :) = helperNearObstacles(xy);
    end
end
switch maxlevel
    case 3
        circleDisplay(display, colors(4, :))
    case 2
        circleDisplay(display, colors(3, :))
    case 1
        circleDisplay(display, colors(2, :))
    otherwise
        circleDisplay(display, [])
end
for i = 1:numClusters
    sc(i, :) = displayObstacles(display, nearxy(i, :));
end
updateDisplay(display)
pause(0.01)
end

```



```
function map = helperCreateBinaryOccupancyMap()
map = binaryOccupancyMap(100, 80, 1);
occ = zeros(80, 100);
occ(1, :) = 1;
occ(end, :) = 1;
occ([1:30, 51:80], 1) = 1;
occ([1:30, 51:80], end) = 1;
occ(40, 20:80) = 1;
occ(28:52, [20:21 32:33 44:45 56:57 68:69 80:81]) = 1;
occ(1:12, [20:21 32:33 44:45 56:57 68:69 80:81]) = 1;
occ(end-12:end, [20:21 32:33 44:45 56:57 68:69 80:81]) = 1;
setOccupancy(map, occ);
helperAddObstacle(map, 5, 5, [10, 30]);
helperAddObstacle(map, 5, 5, [20, 17]);
helperAddObstacle(map, 5, 5, [40, 17]);
end
function helperAddObstacle(map, obstacleWidth, obstacleHeight, obstacleLocation)
values = ones(obstacleHeight, obstacleWidth);
setOccupancy(map, obstacleLocation, values)
end
```