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%% EXAMPLE: Differential drive vehicle following waypoints using the
% Pure Pursuit algorithm
%
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%% Define Vehicle
R = 0.05;                % Wheel radius [m]
L = 0.18;                % Wheelbase [m]
dd = DifferentialDrive(R,L);

%% Simulation parameters
sampleTime = 0.1;
tVec = 0:sampleTime:160;

%% ======== SIMULACIÓN 1 ========
initPose = [4; 4; 0]; % Punto A
pose = zeros(3,numel(tVec));
pose(:,1) = initPose;

% Waypoints (Primera simulación: A–H)
waypoints = [
   -10,  8;
     8, -1;
    -7, -6;
     0,  5;
    -3,  0;
     2, -5;
     0,  0
];

% Visualizador para simulación 1
figure(1)
viz1 = Visualizer2D;
viz1.hasWaypoints = true;

% Controlador Pure Pursuit
controller = controllerPurePursuit;
controller.LookaheadDistance = 1.0;
controller.DesiredLinearVelocity = 0.6;
controller.MaxAngularVelocity = 1.2;

% Simulación 1
close(1)
r = rateControl(1/sampleTime);
currentIdx = 1;
goalRadius = 0.3;

for idx = 2:numel(tVec)
    if currentIdx > size(waypoints,1)
        break;
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    end
    controller.Waypoints = [pose(1:2,idx-1)'; waypoints(currentIdx,:)];
    [vRef,wRef] = controller(pose(:,idx-1));
    [wL,wR] = inverseKinematics(dd,vRef,wRef);
    [v,w] = forwardKinematics(dd,wL,wR);
    velB = [v;0;w];
    vel = bodyToWorld(velB,pose(:,idx-1));
    pose(:,idx) = pose(:,idx-1) + vel*sampleTime;
    distance = norm(pose(1:2,idx) - waypoints(currentIdx,:)');
    if distance < goalRadius
        currentIdx = currentIdx + 1;
    end
    viz1(pose(:,idx),waypoints)
    waitfor(r);
end
```

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Warning: System Object 'Visualizer2D' is inherited from mixin class 'matlab.system.mixin.CustomIcon' that
will no longer be supported. Remove 'matlab.system.mixin.CustomIcon' and define corresponding System object
methods instead.
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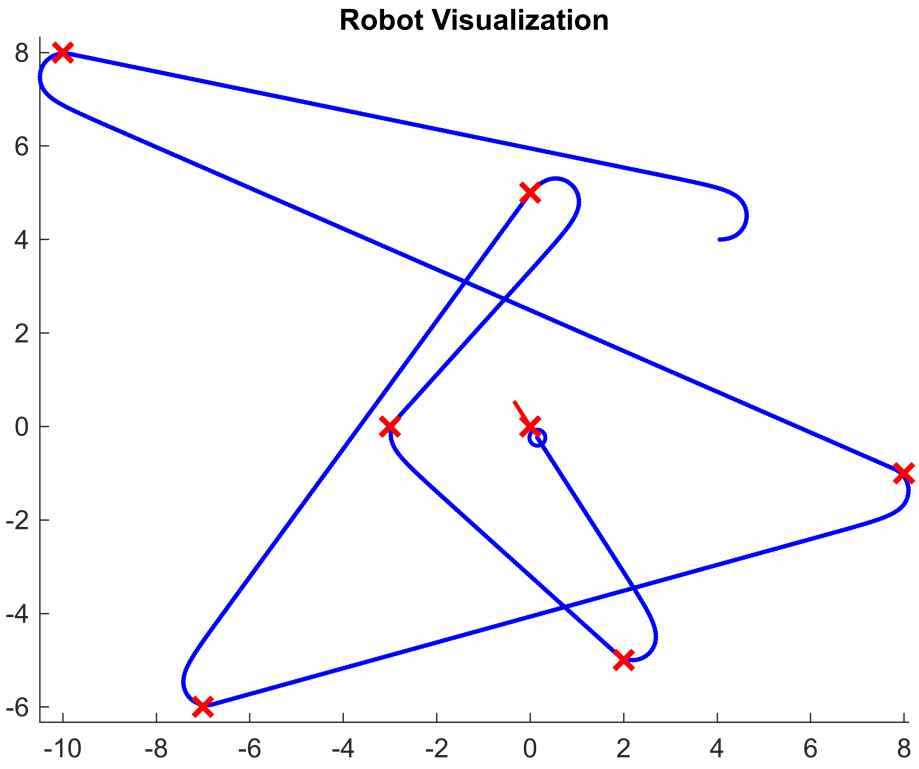


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%% ======== SIMULACIÓN 2 ========
initPose = [2; 5; 0];  % Punto A
pose = zeros(3,numel(tVec));
pose(:,1) = initPose;

waypoints = [
   -5,  3;
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   -5, -2;
    2, -5;
    5,  2;
    -3, 2;
   -4, -4;
    4, -3;
];

% Visualizador para simulación 2
figure(2)
viz2 = Visualizer2D;
viz2.hasWaypoints = true;

% Reiniciar controlador y simulación
controller.Waypoints = waypoints;
currentIdx = 1;
close(2)
for idx = 2:numel(tVec)
    if currentIdx > size(waypoints,1)
        break;
    end
    controller.Waypoints = [pose(1:2,idx-1)'; waypoints(currentIdx,:)];
    [vRef,wRef] = controller(pose(:,idx-1));
    [wL,wR] = inverseKinematics(dd,vRef,wRef);
    [v,w] = forwardKinematics(dd,wL,wR);
    velB = [v;0;w];
    vel = bodyToWorld(velB,pose(:,idx-1));
    pose(:,idx) = pose(:,idx-1) + vel*sampleTime;
    distance = norm(pose(1:2,idx) - waypoints(currentIdx,:)');
    if distance < goalRadius
        currentIdx = currentIdx + 1;
    end
    viz2(pose(:,idx),waypoints)
    waitfor(r);
end
```

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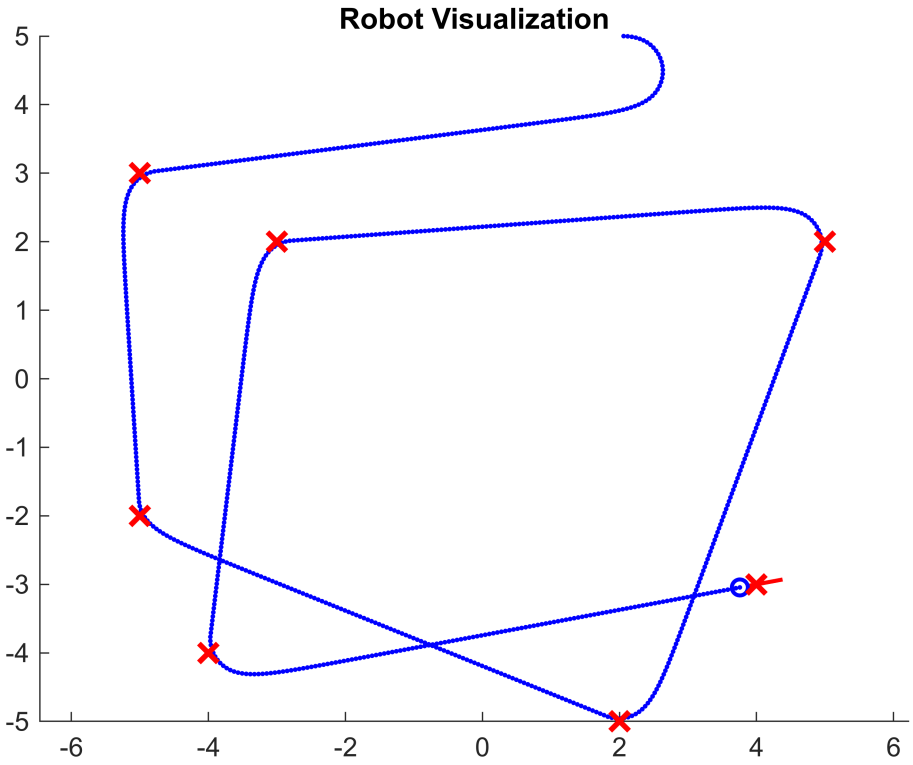


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%% ======== SIMULACIÓN 3 ========
initPose = [-3; 4; 0];  % Punto A
pose = zeros(3,numel(tVec));
pose(:,1) = initPose;

waypoints = [
   3,  3;
   1, -3;
  -1, -1;
   1,  4;
  -3, -4;
   2, -1;
];

% Visualizador para simulación 3
figure(3)
viz3 = Visualizer2D;
viz3.hasWaypoints = true;

% Reiniciar controlador y simulación
controller.Waypoints = waypoints;
currentIdx = 1;
close(3)
for idx = 2:numel(tVec)
    if currentIdx > size(waypoints,1)
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        break;
    end
    controller.Waypoints = [pose(1:2,idx-1)'; waypoints(currentIdx,:)];
    [vRef,wRef] = controller(pose(:,idx-1));
    [wL,wR] = inverseKinematics(dd,vRef,wRef);
    [v,w] = forwardKinematics(dd,wL,wR);
    velB = [v;0;w];
    vel = bodyToWorld(velB,pose(:,idx-1));
    pose(:,idx) = pose(:,idx-1) + vel*sampleTime;
    distance = norm(pose(1:2,idx) - waypoints(currentIdx,:)');
    if distance < goalRadius
        currentIdx = currentIdx + 1;
    end
    viz3(pose(:,idx),waypoints)
    waitfor(r);
end
```

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