Instituto Tecnológico y de Estudios Superiores de Monterrey

TE3002B.502

Implementación de robótica Inteligente (Gpo 502)

Semestre: febrero - junio 2023

Evaluación 7.1 (Trayectorias en lazo abierto)

Alumno:

Fredy Yahir Canseco Santos A01735589

Profesor: Dr. Alfredo García Suárez

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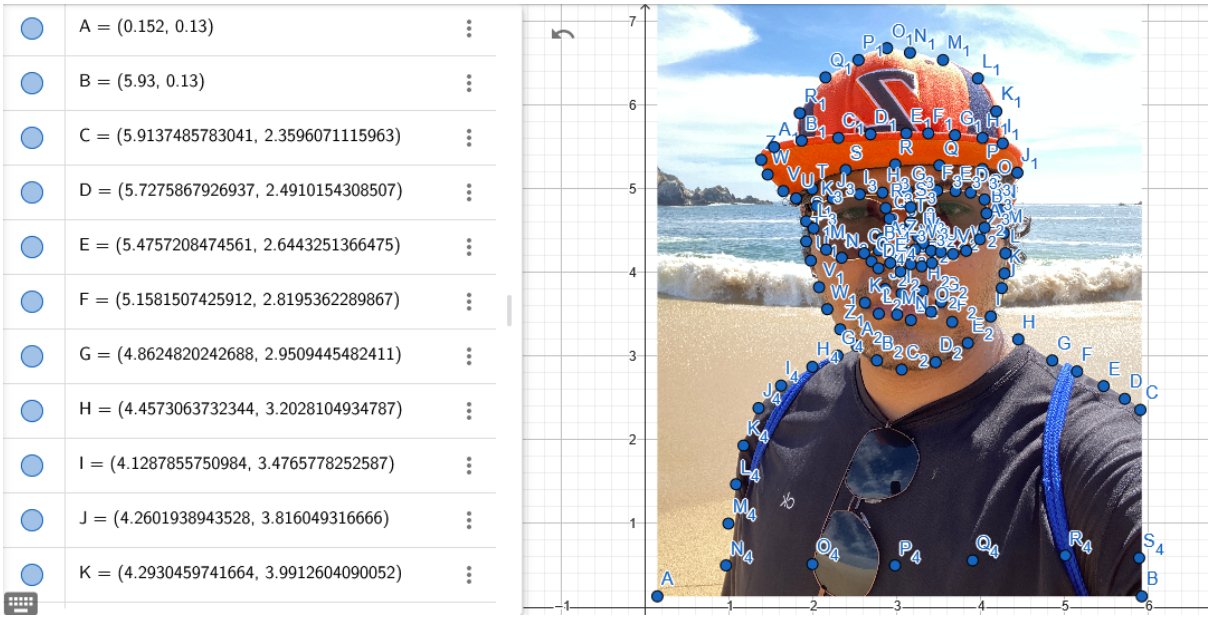
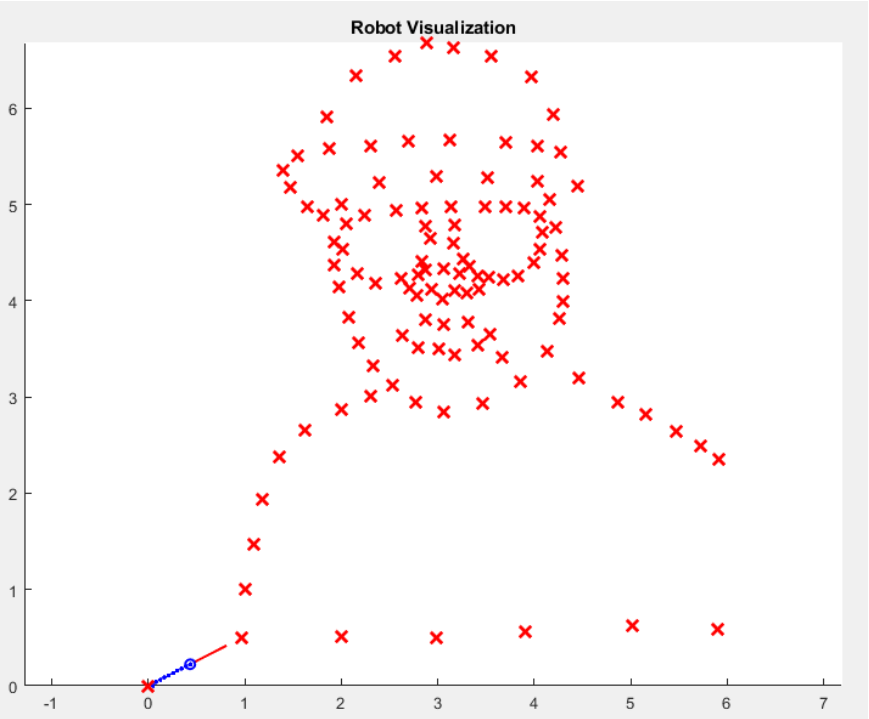
Mapa de Puntos generados con Geogebra

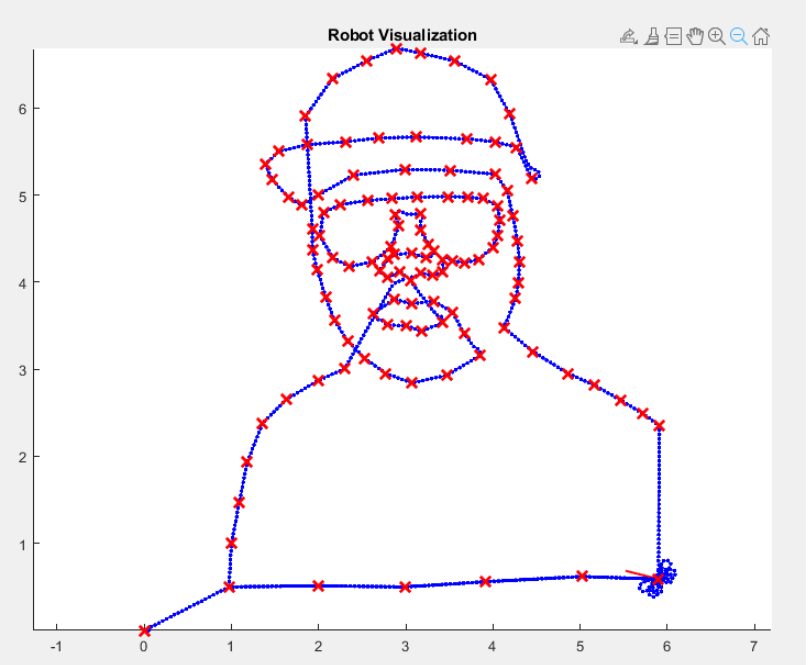


Fotografía Original

Puntos generados para el seguimiento del robot



Trayectoria seguida por el robot



Código Realizado

```
%% EXAMPLE: Differential drive vehicle following waypoints using the
% Pure Pursuit algorithm
%
% Copyright 2018-2019 The MathWorks, Inc.
```

```
%% Define Vehicle
R = 0.1;                % Wheel radius [m]
L = 0.5;                % Wheelbase [m]
dd = DifferentialDrive(R,L);
```

```
%% Simulation parameters
sampleTime = 0.1;               % Sample time [s]
tVec = 0:sampleTime:1;          % Time array

initPose = [0;0;0];             % Initial pose (x y theta)
pose = zeros(3,numel(tVec));    % Pose matrix
pose(:,1) = initPose;

% Define waypoints
waypoints = [0,0;
            0.9708932296487,0.4994272253156;
            2.0012539147117,0.5143599888672;
            2.9868163091198,0.4994272253156;
            3.9126476493213,0.5591582795221;
            5.0176721521425,0.6188893337287;
            5.8987052016891,0.5890238066254;
            5.91,2.35;
            5.72, 2.49;
            5.47, 2.64
            5.1581507425912,2.8195362289867;
            4.8624820242688,2.9509445482411;
            4.4573063732344,3.2028104934787;
            4.1287855750984,3.4765778252587;
            4.2601938943528,3.816049316666;
            4.2930459741664,3.9912604090052;
            4.3039966674376,4.2321756609716;
            4.2820952808952,4.473090912938;
            4.2273418145392,4.7578089379893;
            4.161637654912,5.0534776563117;
            4.0302293356575,5.2396394419221;
            3.5155467519111,5.2834422150069;
```

```
2.9899134748935,5.2943929082781;
2.3985760382486,5.2286887486509;
2,5;
1.8072386016038,4.8892172572437;
1.6539288958069,4.9768228034133;
1.4677671101965,5.1739352822949;
1.3911122572981,5.3491463746341;
1.5444219630949,5.5024560804309;
1.872942761231,5.5791109333293;
2.310970492079,5.6119630131429;
2.694244756571,5.6557657862277;
3.1213217941479,5.6667164794989;
3.7017085375215,5.6448150929565;
4.0302293356575,5.6119630131429;
4.271144587624,5.5462588535157;
4.4463556799632,5.1958366688373;
4.1944897347256,5.9295331180078;
3.9754758693015,6.323758075771;
3.5593495249959,6.542771941195;
3.1651245672327,6.6303774873646;
2.8913572354526,6.6851309537206;
```

```
2.5518857440454,6.542771941195;
2.1576607862822,6.3347087690422;
1.8510413746886,5.9076317314654;
1.927696227587,4.6154499254636;
1.927696227587,4.3745346734972;
1.982449693943,4.144570114802;
2.0810059333838,3.8270000099372;
2.1795621728246,3.5641833714284;
2.3328718786214,3.3232681194619;
2.529984357503,3.1261556405803;
2.7708996094694,2.9509445482411;
3.0665683277919,2.8414376155291;
3.4717439788263,2.9290431616987;
3.8550182433183,3.1590077203939;
3.6688564577079,3.4108736656315;
3.5374481384535,3.651788917598;
3.3184342730295,3.7831972368524;
3.0665683277919,3.7503451570388;
2.8694558489102,3.8050986233948;
2.6285405969438,3.6408382243268;
```

```
2.7928009960118,3.5094299050724;
3.0118148614359,3.4984792118012;
3.1760752605039,3.4327750521739;
3.4169905124703,3.5319396634631;
3.0519674034303,4.013770167396;
3.1736417731103,4.1013757135656;
3.3050500923647,4.0770408396296;
3.4267244620447,4.1159766379272;
3.4169905124703,4.2619858815432;
3.5337979073631,4.2473849571816;
3.6798071509791,4.2230500832456;
3.8355503441695,4.2619858815432;
4,4.4;
4.0545642095936,4.5394034444136;
4.0788990835296,4.7097475619656;
4.0545642095936,4.8752247047305;
3.8890870668287,4.9579632761129;
3.7090089997023,4.9774311752617;
3.4899951342783,4.9822981500489;
3.1347059748127,4.9774311752617;
2.8378205127934,4.9579632761129;
```

```
2.5652699247102,4.9384953769641;
2.244049588755,4.8898256290921;
2.0542375720542,4.7973531081353;
2.0153017737566,4.5296694948392;
2.1661779921598,4.2765868059048;
2.3511230340734,4.1792473101608;
2.6188066473694,4.23278403282;
2.8329535380062,4.4079951251592;
2.9205590841759,4.646476889732;
2.8767563110911,4.7730182341993;
3.1736417731103,4.7827521837737;
3.1687747983231,4.6026741166472;
3.2612473192799,4.4323299990952;
3.3245179915135,4.3544584025;
3.2271784957695,4.281453780692;
3.0665683277919,4.3349905033512;
2.8718893363039,4.3155226042024;
2.7940177397086,4.2668528563304;
2.706412193539,4.135444537076;
2.7891507649214,4.0527059656936;
2.9302930337503,4.1159766379272;
```

```
  2.2999091857445,3.0081315019907;
  2.0012539147117,2.873736630026;
  1.6279348259208,2.6497451767514;
  1.3591450819913,2.3809554328219;
  1.1799519193716,1.9329725262728;
  1.0903553380618,1.470056856172;
  1,1;
  0.9708932296487,0.4994272253156;
  2.0012539147117,0.5143599888672;
  2.9868163091198,0.4994272253156;
  3.9126476493213,0.5591582795221;
  5.0176721521425,0.6188893337287;
  5.8987052016891,0.5890238066254;
  ];
```

```
% Create visualizer
viz = Visualizer2D;
viz.hasWaypoints = true;
```

```
%% Pure Pursuit Controller
controller = controllerPurePursuit;
controller.Waypoints = waypoints;
controller.LookaheadDistance = 0.1;
controller.DesiredLinearVelocity = 0.5;
controller.MaxAngularVelocity = 10;
```

```
%% Simulation loop
close all
r = rateControl(1/sampleTime);
for idx = 2:numel(tVec)
    % Run the Pure Pursuit controller and convert output to wheel speeds
    [vRef,wRef] = controller(pose(:,idx-1));
    [wL,wR] = inverseKinematics(dd,vRef,wRef);

    % Compute the velocities
    [v,w] = forwardKinematics(dd,wL,wR);
    velB = [v;0;w]; % Body velocities [vx;vy;w]
    vel = bodyToWorld(velB,pose(:,idx-1));  % Convert from body to world

    % Perform forward discrete integration step
```

```
    pose(:,idx) = pose(:,idx-1) + vel*sampleTime;

    % Update visualization
    viz(pose(:,idx),waypoints)
    waitfor(r);
end
```

Justificación de la estrategia empleada para la planificación de la trayectoria

Para la realización de esta actividad se empleó el código de Differential drive vehicle following waypoints using the Pure Pursuit algorithm. Esto porque usamos puntos claves que nos permitirán colocarlos de una manera mucho más sencilla que si utilizamos un vector de tiempo como en la evaluación de ayer. Otra cosa importante a decir es que podemos controlar la velocidad lineal y angular de nuestro robot como mejor nos convenga, es por esta razón que esta estrategia de control se consideró mejor para emplear, más si se trata de tener una mayor precisión al momento de seguir una trayectoria.