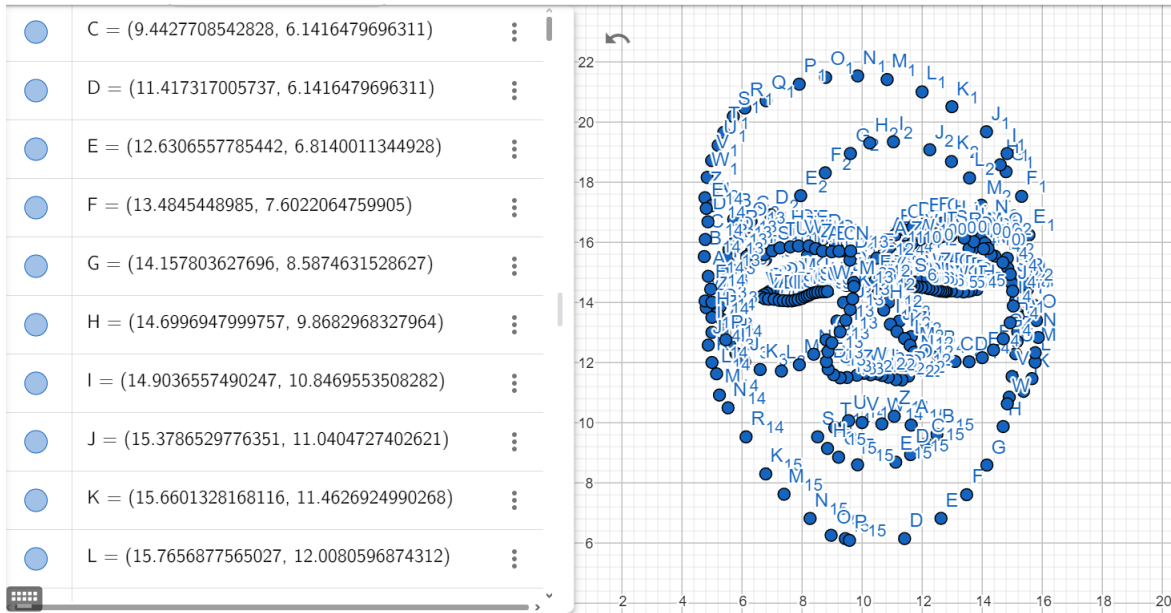


## Evaluación 11.2 (Planeación de Trayectorias)



Para desarrollar esta trayectoria use geogebra para generar los puntos de mi rostro como coordenadas y poder hacer el recorrido con el código de **PurePursuit (way-points)**, opte por este código ya que proporciona un equilibrio ideal entre simplicidad y funcionalidad, permitiendo un seguimiento de trayectorias preciso, adaptable y eficiente, como no realiza mucho procesamiento fue ideal para la enorme cantidad de puntos generados para mi rostro, de igual manera es rápido y fácil de modificar sus variables como las velocidades.

```

%% 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 = 0.05; % Sample time [s]
tVec = 0:sampleTime:175; % Time array

initPose = [9.4427708542828;6.1416479696311;0]; % Initial pose (x y
theta)
pose = zeros(3,numel(tVec)); % Pose matrix
pose(:,1) = initPose;
    
```

## % Define waypoints

```
waypoints = [9.4427708542828,6.1416479696311;  
11.417317005737,6.1416479696311;  
12.6306557785442,6.8140011344928;  
13.4845448985,7.6022064759905;  
14.157803627696,8.5874631528627;  
14.6996947999757,9.8682968327964;  
14.9036557490247,10.8469553508282;  
15.3786529776351,11.0404727402621;  
15.6601328168116,11.4626924990268;  
15.7656877565027,12.0080596874312;  
15.7656877565027,12.3247245065048;  
15.8689168521369,12.8306451278627;  
15.8096299712776,13.3971642116287;  
15.7108185031789,13.9109838457422;  
15.4473212549156,14.1349565067659;  
15.1179496945865,14.0624947634935;  
15.1624288076235,13.7065194105631;  
15.1851221802903,13.0143715442276;  
15.1170420622901,12.2881836188921;  
14.9992860661437,11.5348780035745;  
14.840020161003,10.62538586106;  
15.1627431793146,12.7000338359203;  
15.1973206455622,13.5298930258645;  
15.0971234195217,14.3893712294463;  
15.50472504612,14.4248148491505;  
15.513585951046,14.6020329476714;  
15.5595235994706,16.2425267474114;  
15.31474638343,17.5251593594638;  
14.7964806852761,18.3455859671171;  
14.6031764954848,18.5751346924942;  
14.8327252208619,18.9496615602147;  
14.1440790447306,19.6745522719319;  
12.9929215997454,20.5079759533711;  
12,21;  
10.8353488211321,21.4113025340396;  
9.8533671739985,21.5318967714068;  
8.7852467858882,21.4802135268209;  
7.9066316279265,21.2562528002816;  
6.8040557434256,20.7049648580312;  
6.0977180674172,20.4637763832966;  
5.7112405938442,20.1853195671102;  
5.3931963651658,19.6521277719728;  
5.2061115247667,19.2218326390549;  
4.9909639583078,18.7167035699774;  
4.8412960859885,18.1554490487802;  
4.7660716974564,17.4802844202163;  
4.9868775746946,17.2157628515813;  
5.7247616123092,16.7589774949628;  
6.3045276418635,16.6887028247138;
```

6.9545683416667,16.908311169242;  
7.9562369619733,17.5476666219592;  
8.7745413084397,18.3075206579637;  
9.6123290917267,18.9504740730444;  
10.2552825068074,19.3011759358157;  
11.0451294640141,19.34004123663;  
12.2561891558592,19.0753725622533;  
12.9780128132503,18.6823796821181;  
13.5795325277429,18.1370018076448;  
13.9720368155993,17.2289203989009;  
14.2809885569088,16.5646741550854;  
14.7135209947422,16.1166941301865;  
14.837101691266,15.4678954734365;  
15.0818203616695,14.6351533488047;  
15.4288671662301,14.6045315719317;  
14.9899550310505,14.624946089847;  
14.8552258425518,15.1312738173254;  
14.4270972442475,15.5337146997314;  
13.673590911232,15.7649041428157;  
12.0912311713491,15.794826874662;  
8.1820633362692,15.550578875719;  
6.783549692394,15.4241959532637;  
5.9428426422145995,15.137591277066136;  
5.512935627918294,14.812772644042262;  
5.264544908547095,14.449740054192052;  
5.235884440927341,14.058046996722087;  
5.32223696369082,13.437924486492532;  
5.4218110820750445,12.979883541925105;  
5.591087083328225,12.61145930390348;  
5.8001927319350965,12.302779536912388;  
6.088957675249347,12.023972005436564;  
6.606743090847313,11.765079297637584;  
7.313719331375305,11.715292238445471;  
7.911164041680651,11.92439788705234;  
8.389119809924928,12.27290730139712;  
8.807331107138669,12.750863069641392;  
9.165797933321876,13.378180015461998;  
9.38486099376717,13.995539549444182;  
9.484435112151393,14.563112024234254;  
9.613881466050886,14.961408497771146;  
10.5,15;  
10.69923935643893,14.7622602610027;  
10.890945644256593,14.00627861905494;  
11.24121637748618,13.377383438938187;  
11.63925130161071,12.859938037576303;  
12.085050416630184,12.461903113451777;  
12.530849531649658,12.20716076201208;  
13.096059123906489,12.032025395397287;  
13.565740334373436,12.024064696914797;  
14.003578750910417,12.159396571117137;

14.377731579587476,12.414138922556834;  
14.70412021736959,12.788291751233889;  
14.934980473361819,13.321658549560754;  
15.038469553634195,13.878907443335091;  
15.016503253540519,14.37491298858619;  
14.938432953830244,14.933211635892944;  
14.692171882632143,15.324332160736983;  
14.301051357788102,15.577836204617379;  
13.562268144193801,15.780639439721696;  
11.973793276704466,15.781801684175388;  
11.731237912460099,15.68073694907357;  
11.428043707154641,15.593147511985327;  
11.13158715085597,15.471869829863143;  
10.915982382638754,15.296690955686657;  
11.677336720405796,14.676827247062167;  
11.940105031670527,14.750941386136835;  
12.182660395914892,14.791367280177562;  
12.431953409166049,14.83179317421829;  
12.714934667451143,14.83179317421829;  
12.896851190634418,14.811580227197926;  
13.065292415804118,14.757679035143623;  
13.260684237000968,14.717253141102896;  
13.462813707204607,14.649876651035017;  
13.611041985353943,14.555549564939986;  
13.691893773435398,14.488173074872106;  
13.826646753571158,14.427534233811015;  
13.637992581381095,14.393845988777075;  
13.536927846279275,14.366895392749923;  
13.375224270116364,14.34668244572956;  
13.166357150905936,14.360157743743136;  
12.970965329709085,14.380370690763499;  
12.809261753546174,14.360157743743136;  
12.763388373317106,14.372574272176598;  
12.693514359854843,14.369536271591283;  
12.614526344636632,14.372574272176598;  
12.538576330003735,14.390802275688493;  
12.462626315370839,14.402954278029757;  
12.3433652872593,14.439677099602653;  
12.219801021237835,14.456310750797849;  
12.124751585836709,14.49195428907327;  
11.980659664144422,14.496384178763428;  
11.837563056452844,14.52091502579627;  
11.718997295794109,14.537268923818164;  
11.616785433157267,14.553622821840058;  
11.57590068810253,14.63539231194953;  
10.799082095037049,15.093951902447387;  
10.73724478991453,14.869831434950466;  
10.749423974156915,14.757173980708414;  
10.633721723854267,14.751084388587222;  
10.627632131733074,14.933772152222984;

10.6,15;  
10.46321314446089,15.061653586768015;  
9.686790149008907,15.025116034040863;  
9.528460753857914,14.86069704676868;  
9.504102385373146,14.65365091464815;  
9.417042845877901,14.811498060135794;  
8.890346014832854,14.395378975501556;  
8.779705701899596,14.502067848687199;  
8.6,14.6;  
8.435930443856966,14.612708161620459;  
8.143523902533353,14.644319679601391;  
7.926194716414448,14.644319679601391;  
7.7641856867621755,14.62456248086331;  
7.6,14.6;  
7.459924826195712,14.553436565406214;  
7.305818676038672,14.517873607677666;  
7.210984122095877,14.49021352944435;  
7.05292653219122,14.430941933230104;  
6.922529020519879,14.363767457520625;  
6.827694466577085,14.300544421558762;  
6.733539927846675,14.252097932374037;  
6.635691252421979,14.180935259337893;  
6.751330596105712,14.123115587496027;  
6.88476060804848,14.105324919236992;  
7.071562624768355,14.100877252172232;  
7.240573973229195,14.065295915654161;  
7.3784516522367225,14.056400581524644;  
7.525224665373767,14.047505247395126;  
7.658654677316536,14.047505247395126;  
7.76906046067118,14.07292874501814;  
7.870960837588366,14.093308820401578;  
7.996152729229481,14.12824609248747;  
8.089333778061567,14.177372134333503;  
8.174033523672842,14.21646432461563;  
8.255475586760603,14.252298832374246;  
8.34994837994241,14.301164070226905;  
8.441163490600704,14.323967847891478;  
8.525863236211977,14.340256260509031;  
8.643139807058356,14.346771625556052;  
8.747385647810693,14.350029308079563;  
8.845116123516009,14.363060038173606;  
10.738536245704035,15.64558757830488;  
10.805648793690986,15.958779468910663;  
11.096469834967783,16.242143560411133;  
11.357463077139265,16.428567304819335;  
11.6855688672977,16.510593752358947;  
12.050959406337777,16.600077149674885;  
12.364151296943556,16.637361898556524;  
12.66242928799668,16.629904948780197;  
12.908508630615506,16.58516325012223;

13.162044923010662,16.547878501240586;  
13.385753416300503,16.480765953253634;  
13.579634110485033,16.361454756832384;  
13.78842870422222,16.286885259069102;  
13.967395498854094,16.13774626354254;  
14.09416364505167,15.97369336846332;  
14.198560941920265,15.794726573831444;  
14.049421946393704,15.779812674278787;  
13.721316156235268,16.01843506712129;  
13.400667315853159,16.13774626354254;  
12.960707279049803,16.21231576130582;  
12.62514453911504,16.175031012424178;  
12.222469251193322,16.13028931376621;  
11.931648209916528,16.08554761510824;  
11.655741068192388,15.951322519134335;  
11.454403424231531,15.869296071594725;  
10.917503040335909,15.839468272489412;  
9.31593079359526,15.711607769175341;  
9.119791369587139,15.900203369183151;  
8.704881049569957,16.103886617191588;  
8.320146025554028,16.20195632919565;  
7.995761593540595,16.217043977196273;  
7.731727753529662,16.23967544919721;  
7.445062441517793,16.224587801196588;  
7.188572425507172,16.164237209194088;  
6.916994761495927,16.11897426519221;  
6.675592393485931,15.960553961185651;  
6.441733849476247,15.817221305179714;  
6.313488841470937,15.696520121174716;  
6.1626123614646895,15.530555993167841;  
6.1626123614646895,15.40231098516253;  
6.305945017470624,15.379679513161593;  
6.5,15.5;  
6.751030633489054,15.590906585170341;  
7.007520649499675,15.711607769175341;  
7.264010665510296,15.809677481179403;  
7.611026569524665,15.847396601180964;  
7.882604233535909,15.877571897182214;  
8.22962013755028,15.877571897182214;  
8.448391033559338,15.787046009178464;  
8.68224957756902,15.704063945175028;  
8.991546361581827,15.681432473174091;  
9.232701167691133,15.699018223021472;  
9.597305437753812,15.405525184925654;  
10.491816821797876,15.472345486528408;  
10.441521431670825,14.717914634622629;  
10.521994055874107,14.285374279529982;  
10.723175616382312,13.74218406615782;  
10.944475332941337,13.269407398963533;  
11.165775049500363,13.027989526353684;

11.417252000135619,12.796630731769245;  
11.598315404593002,12.575331015210216;  
11.739142496948746,12.343972220625778;  
11.789437887075797,12.072377113939696;  
11.708965262872516,11.770604773177386;  
11.548020014465951,11.549305056618357;  
11.326720297906926,11.418537042288023;  
11.125538737398722,11.428596120313433;  
10.874061786763466,11.509068744516716;  
10.66282114822985,11.569423212669177;  
10.503466466705333,11.618840780581081;  
10.28575801919025,11.58981298757907;  
10.068049571675168,11.640611625332589;  
9.828570279408575,11.575299091078064;  
9.5,11.5;  
9.269785264119863,11.488215712072028;  
9.05207681660478,11.58981298757907;  
8.87065311034221,11.778493642092144;  
8.812597524338189,12.02522988260924;  
8.863396162091709,12.359049502132374;  
8.994021230600758,12.656584380402991;  
9.269785264119863,13.019431792928135;  
9.458465918632935,13.404050050204786;  
9.605905227951734,13.762600550207294;  
9.686219071650662,14.115981462482587;  
9.718344609130234,14.662115599635312;  
9.72861734976731,14.526792532662137;  
9.619461127505135,15.708066371562287;  
6.16405377637026,16.49193480694409;  
5.960879534082,16.221035817226404;  
5.757705291793741,16.008186611019653;  
5.564206013423971,15.756637549138947;  
5.5,15.5;  
5.428756518565131,15.089065038763227;  
5.2739570958693145,13.860344621115159;  
4.809558827781865,13.821644765441205;  
4.770858972107911,14.044168935566445;  
5,14;  
4.877987826573286,14.866193196139747;  
4.7444967970194,15.522524091446368;  
4.7778695544078715,16.089860967050395;  
4.866863574110463,16.679446347580072;  
4.811242311796343,17.124416446093033;  
4.95788006328365,14.43507569757892;  
5.178353846076683,13.618937244686485;  
5,13.5;  
5,13;  
4.876966264208552,12.57629912362915;  
5,12;  
5.153917015114402,11.623262716100179;

```

5.249928237883825,10.916525593303485;
5.537287759966508,10.491733256311685;
5.462324406379721,12.753127756179788;
6.136281837872444,9.525582521002168;
6.79279,8.28354;
8.521177702031112,9.525582521002168;
9.09047542444318,9.833311019603292;
9.552068172344859,10.064107393554135;
10,10;
10.659890767308886,9.956402419043743;
11.073365638143692,10.208262852400166;
11.636475484506526,9.916999138764211;
12.490849044505309,9.606317844219195;
12.14133258814217,9.295636549674176;
11.617057903597463,8.9364113028565;
11.121909590416351,8.683982751038673;
9.850058040872707,8.596603636947886;
9.21898666132815,8.849032188765714;
8.85005262405595,9.140295902401668;
8.52118, 9.52558;
6.792789725429509,8.293541088219511;
7.401688605813158,7.616986776682111;
8.269079483034457,6.811471900588098;
8.969411738591022,6.251206096142834;
9.580569349326414,6.083108593777818;
]; %0

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

%% Pure Pursuit Controller
controller = controllerPurePursuit;
controller.Waypoints = waypoints;
controller.LookaheadDistance = 0.2;
controller.DesiredLinearVelocity = 1;
controller.MaxAngularVelocity = 12;

%% 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

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.

