Vehicular Electronics HW5

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All code is written in matlab.

**Q1.**

**Description**

Firstly make given 2-DOF bicycle model as system.

To calculate yaw rate, use C as [0,0,0,1].

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| %Constants  m = 1723.8;  Iz = 4175;  SR = 15;  L = 2.7;  lf = 1.24;  lr = L - lf;  Cf = 67248;  Cr = 53248;    %Velocity (m/s)  Vx = 30 / 3600 \* 1000;    %System  A = [0,1,0,0;  0, -(2\*Cf + 2\*Cr) / (m\*Vx), 0, -Vx - (2\*Cf\*lf - 2\*Cr\*lr)/(m\*Vx);  0, 0, 0, 1;  0, -(2\*lf\*Cf - 2\*lr\*Cr) / (Iz\*Vx), 0, -(2\*lf^2\*Cf + 2\*lr^2\*Cr) / (Iz\*Vx)];    B = [0; Cf/m; 0; 2\*lf\*Cf/Iz];    C = [0, 0, 0, 1];    D = 0;  sys = ss(A, B, C, D); |

And make the simulation input. The slope of steering wheel angle is not given, so assume that .

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| %Input  t = 0:0.01:8;  input = zeros(size(t));  for i = 1:length(t)  if t(i) < 2  input(i) = 0;  elseif t(i) < 2.1  input(i) = (t(i)-2) \* -800;  elseif t(i) < 3  input(i) = -80;  elseif t(i) < 3.2  input(i) = -80 + (t(i) - 3) \* 800;  elseif t(i) < 5  input(i) = 80;  elseif t(i) < 5.2  input(i) = 80 + (t(i) - 5) \* -800;  elseif t(i) < 6  input(i) = -80;  elseif t(i) < 6.1  input(i) = -80 + (t(i) - 6) \* 800;  else  input(i) = 0;  end  end |



And calculate yaw rate (velocity = 30km/h)

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| % convert delta\_sw to delta and degree to radian  input = input / SR \* pi / 180;  % plot  lsim(sys, input, t) |



Also calculate at Velocity=50km/h

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| %Velocity (m/s)  Vx = 50 / 3600 \* 1000; |



Comparison



**Q2.**

To make trajectory, we must know Yaw.

So use C as [0,0,1,0]

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| --- |
| %System  A = [0,1,0,0;  0, -(2\*Cf + 2\*Cr) / (m\*Vx), 0, -Vx - (2\*Cf\*lf - 2\*Cr\*lr)/(m\*Vx);  0, 0, 0, 1;  0, -(2\*lf\*Cf - 2\*lr\*Cr) / (Iz\*Vx), 0, -(2\*lf^2\*Cf + 2\*lr^2\*Cr) / (Iz\*Vx)];    B = [0; Cf/m; 0; 2\*lf\*Cf/Iz];    C = [0, 0, 1, 0];    D = 0;  sys = ss(A, B, C, D); |

and simualte system to find yaw along time.

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| --- |
| % get yaw  yaw = lsim(sys, input, t);  % calculate position  x = zeros(size(t));  y = zeros(size(t));  for i = 2:length(t)  x(i) = x(i-1) + Vx\*cos(yaw(i-1))\*0.01;  y(i) = y(i-1) + Vx\*sin(yaw(i-1))\*0.01;  end |

