Politecnico di Milano, 2025

Vehicle Dynamics and Control – Lateral Dynamics Lab

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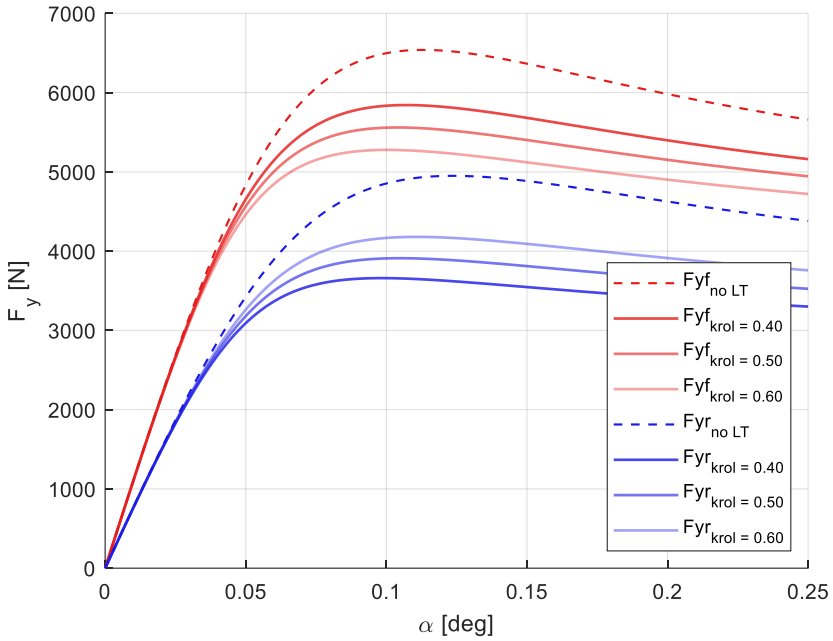
Car segment: City Car

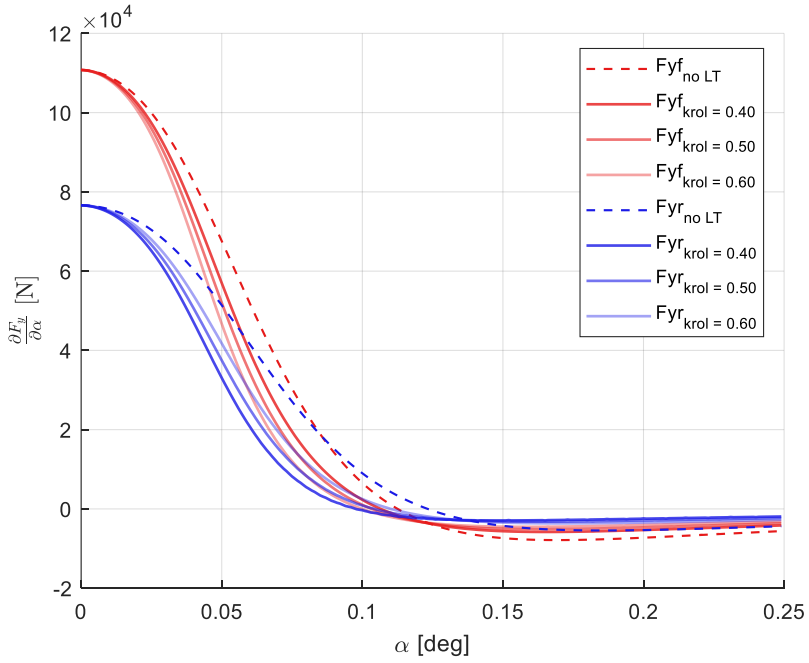
Contents

1) Effective axle characteristic characteristics

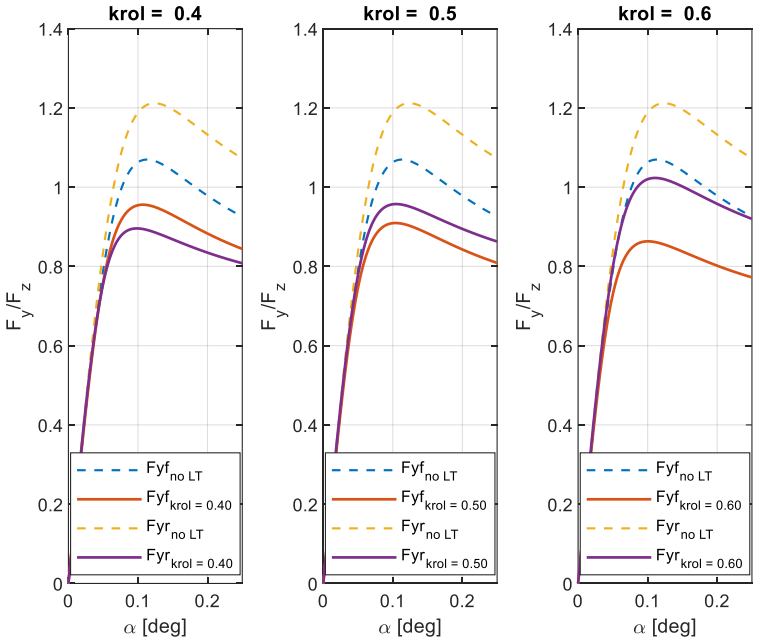
Axle characteristic load transfer VS no load transfer



Derivative of lateral axle characteristic curve VS no load transfer

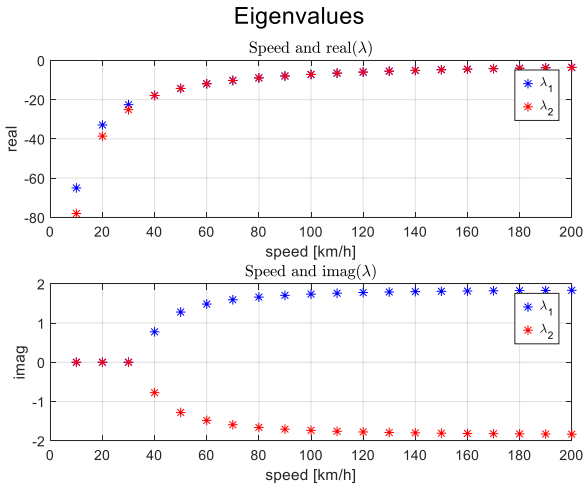


Normalized effective axle characteristic curve VS no load transfer

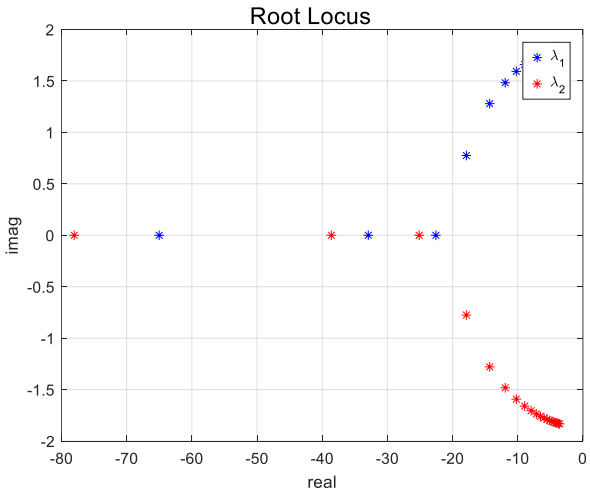


Stability Analysis

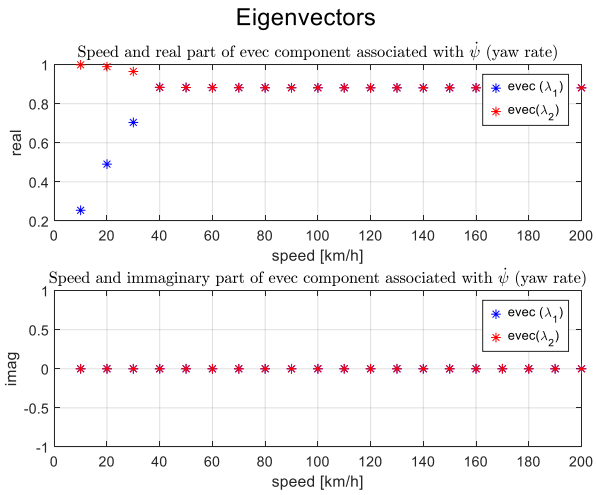
Eigenvalues

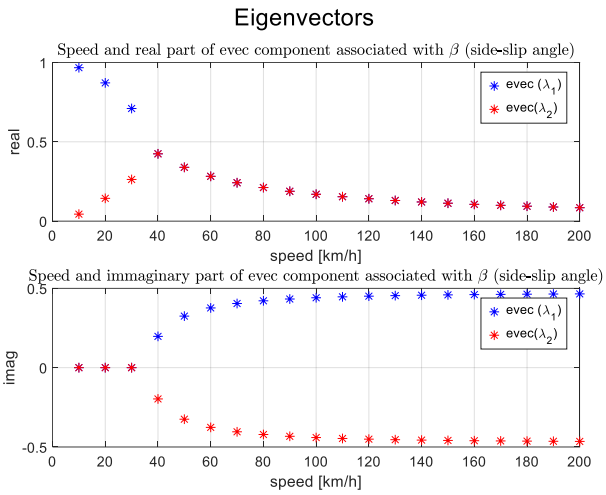


Root Locus



Eigenvectors



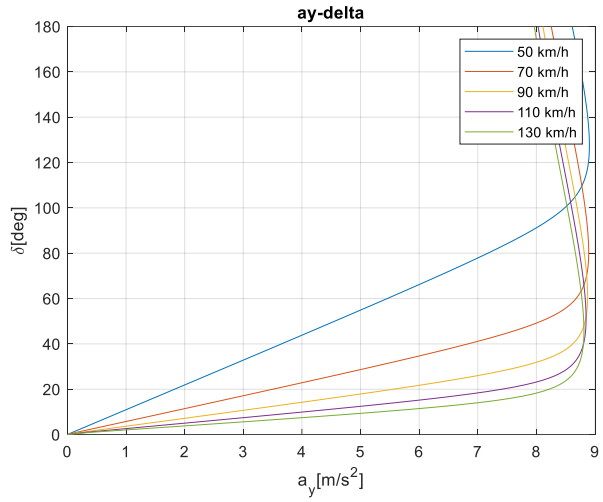


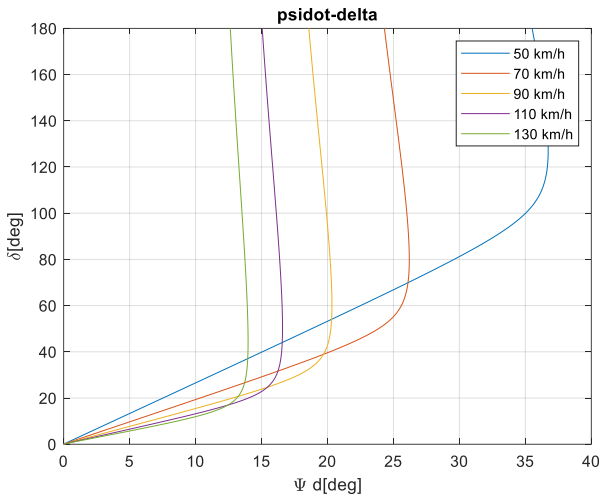
2) Maneuvers

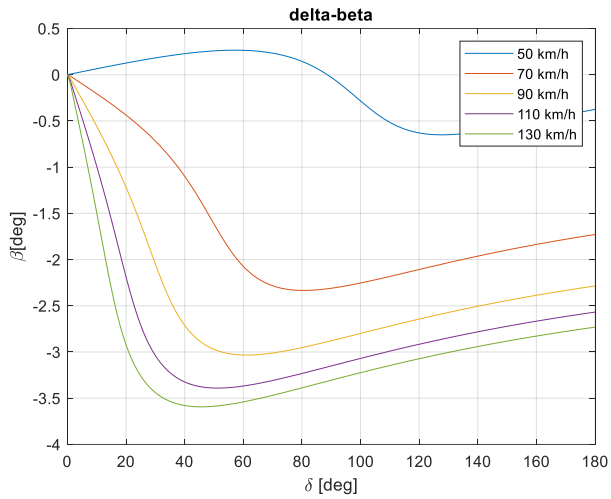
Steady state behavior

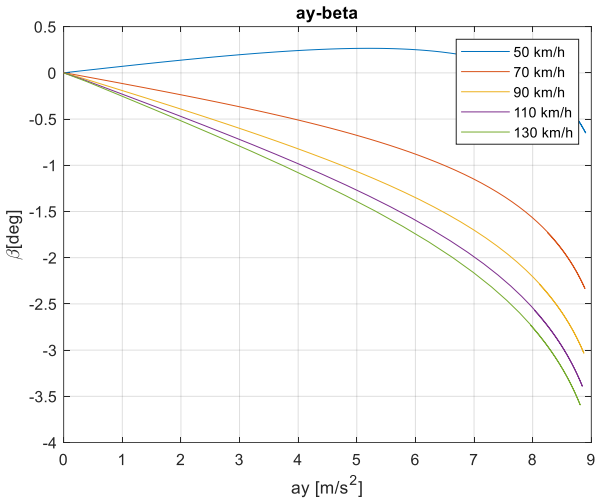
Case A

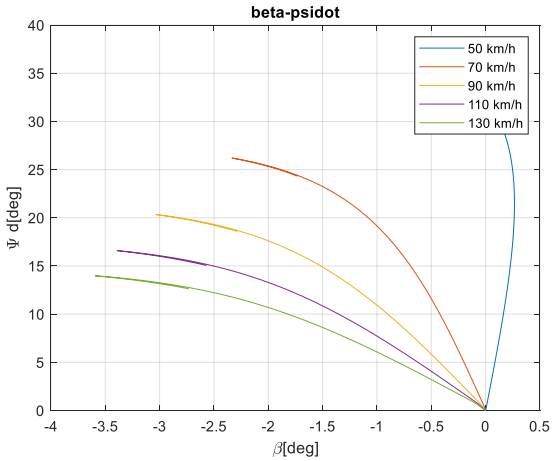
$k_{roll} = 0.5$ and $V = [50; 70; 90; 110; 130]$ km/h





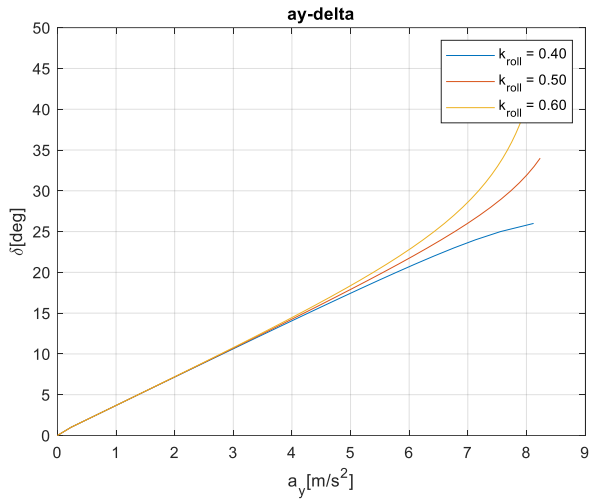


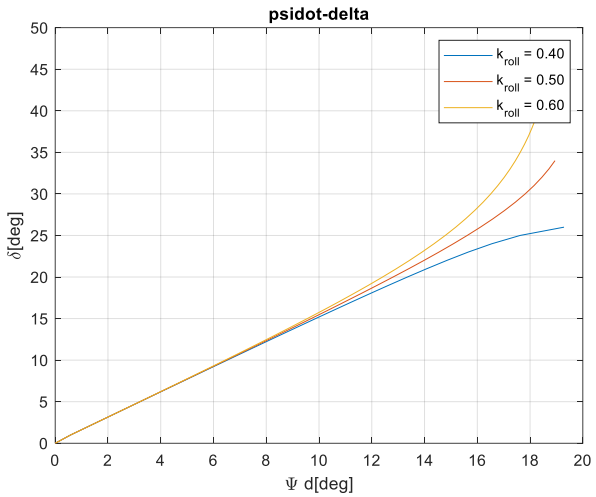


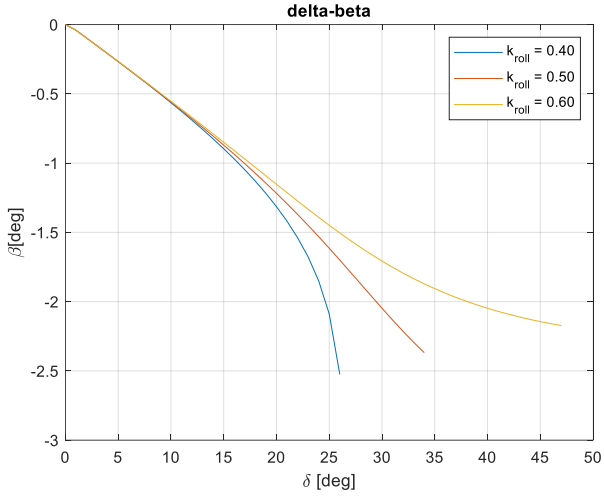


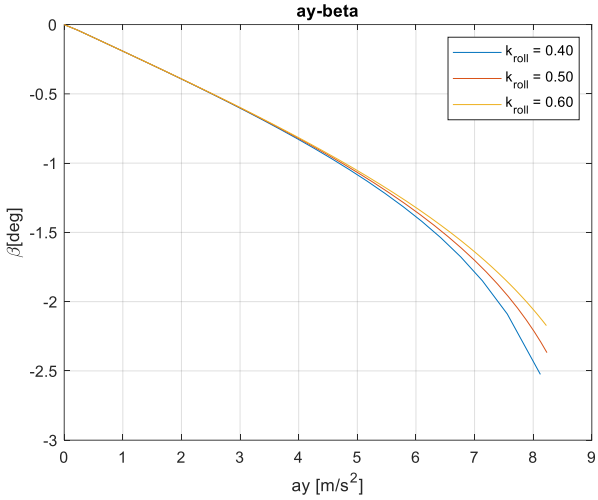
Case B

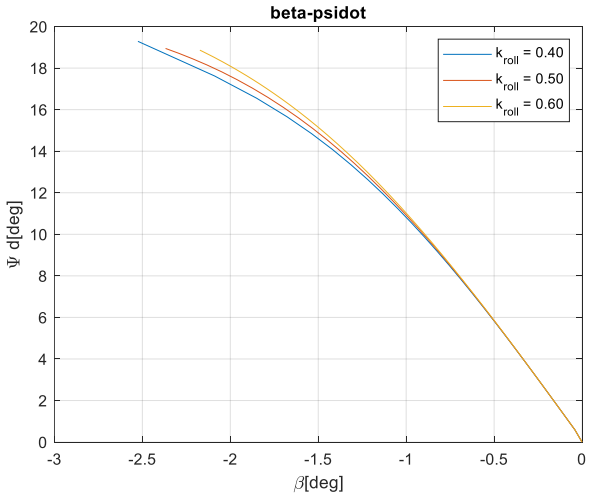
$k_{roll} = [0.5; 0.4; 0.6]$ and $V = [100]$ km/h









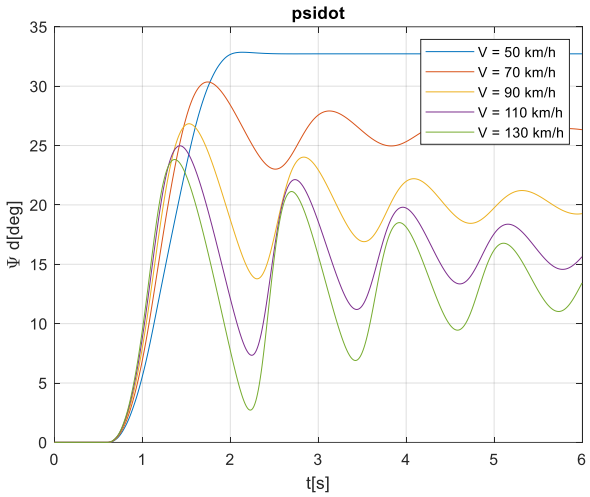


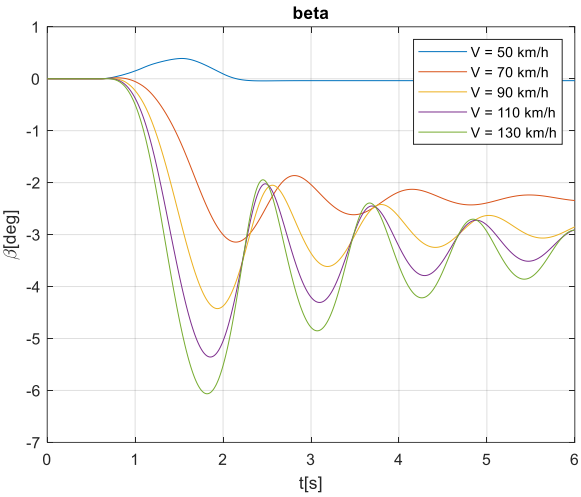
Transient Behavior

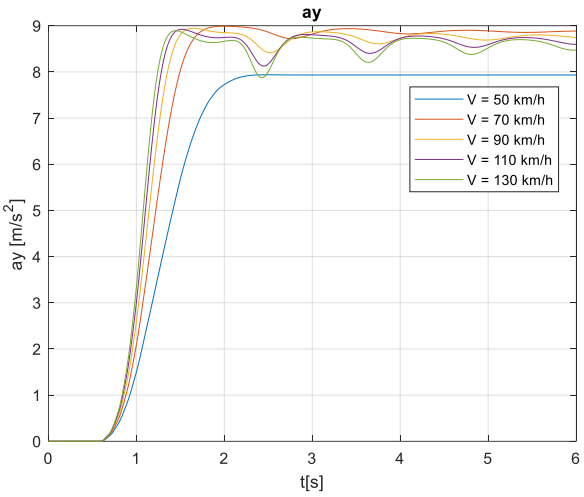
Steering step

Case A

$k_{roll} = 0.5$ and $V = [50; 70; 90; 110; 130]$ km/h

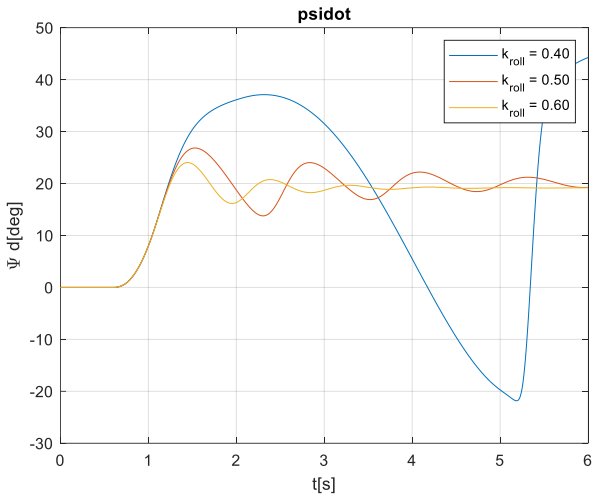


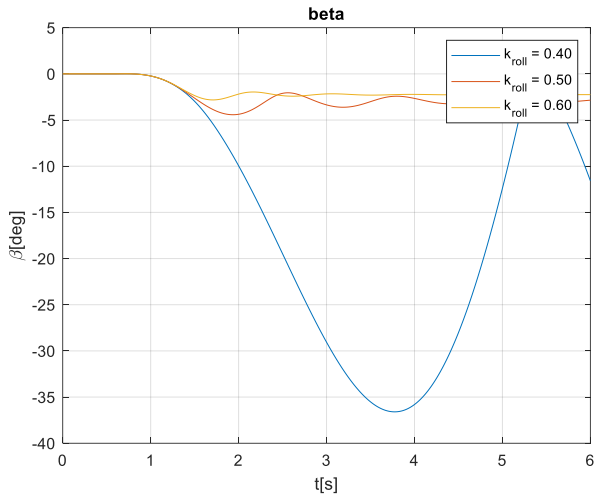


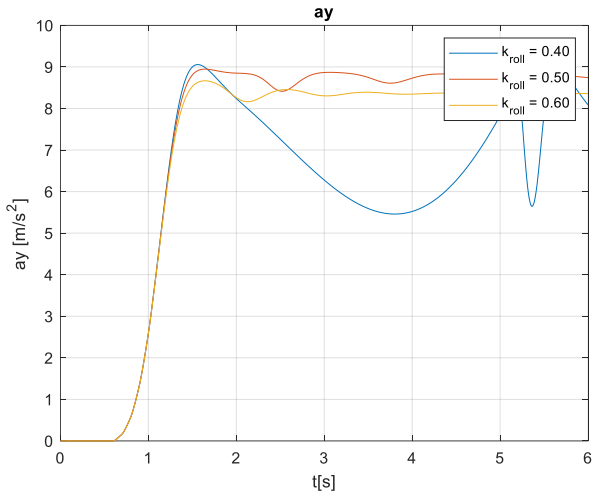


Case B

$k_{roll} = [0.5; 0.4; 0.6]$ and $V = [100]$ km/h



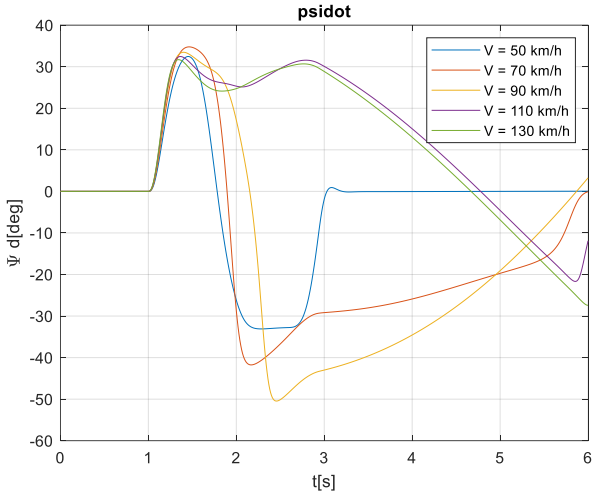


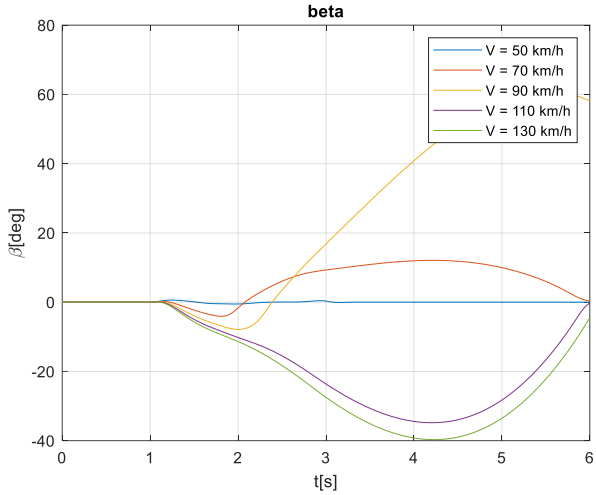


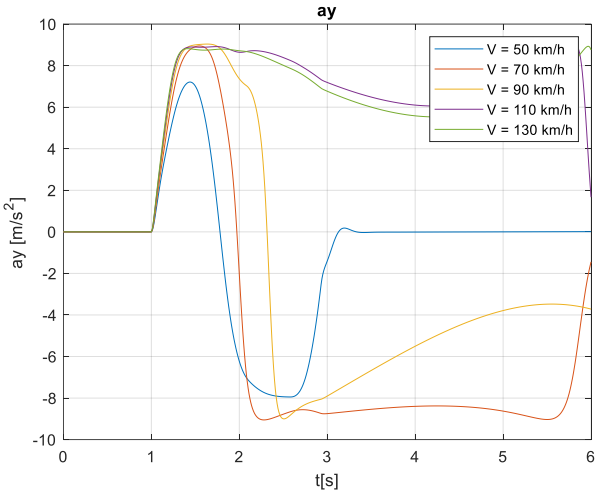
Sine dwell

Case A

$k_{roll} = 0.5$ and $V = [50; 70; 90; 110; 130]$ km/h







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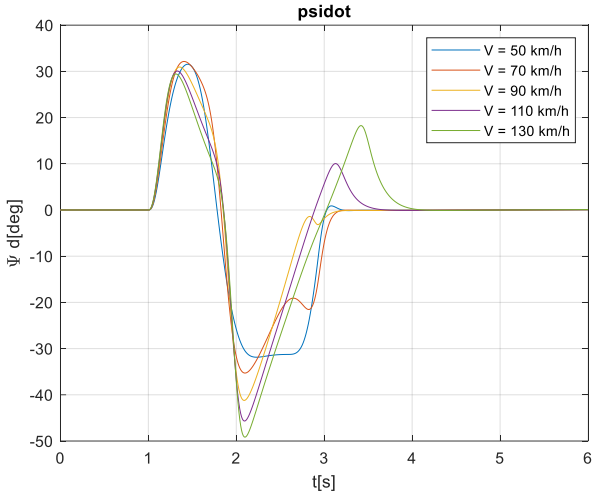
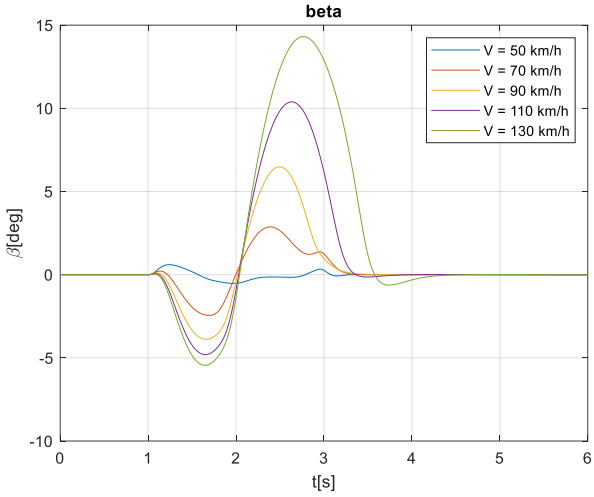
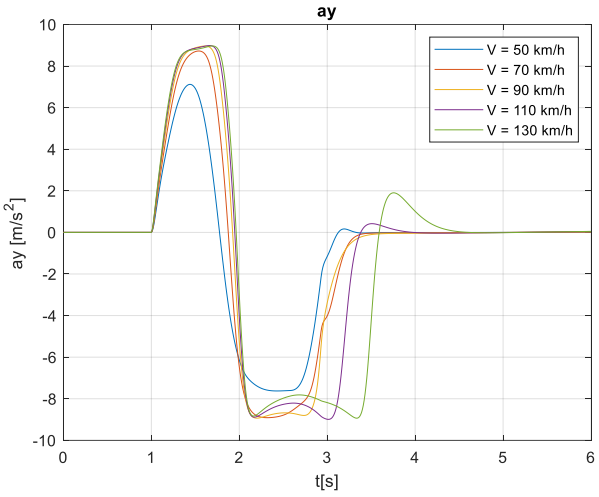
$k_{roll} = 0.6$ and $V = [50; 70; 90; 110; 130]$ km/h

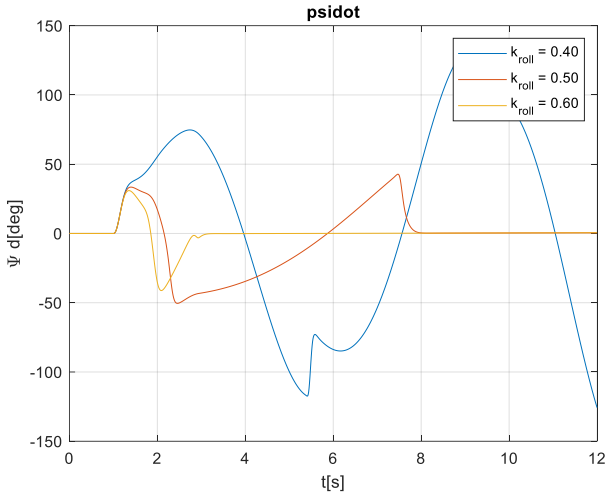


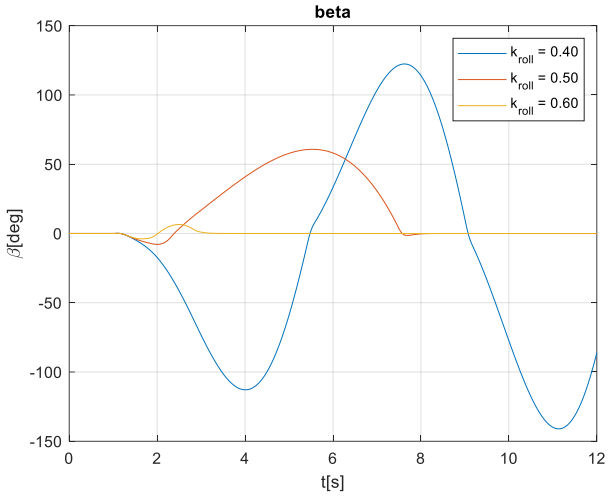


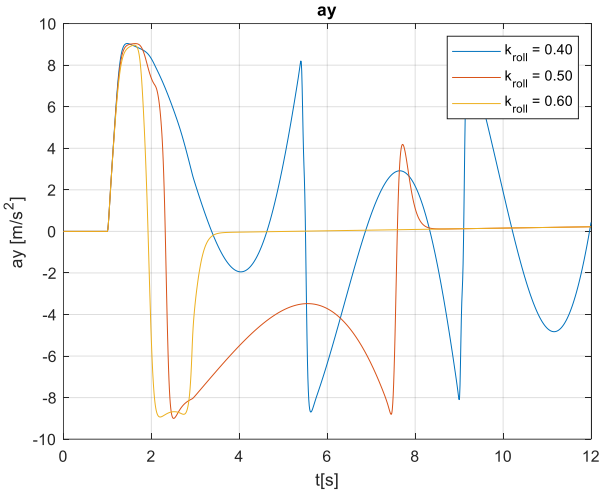


Case B

$k_{roll} = [0.5; 0.4; 0.6]$ and $V = [100]$ km/h







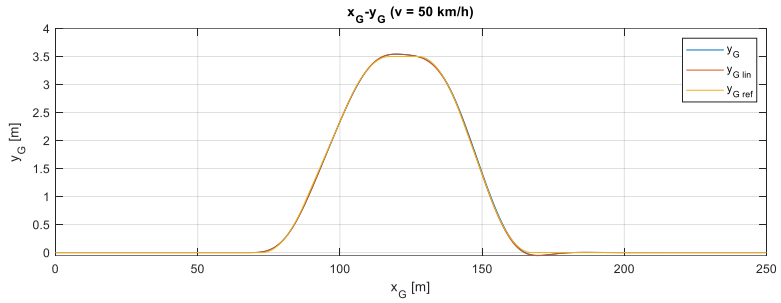
3) Path Follower

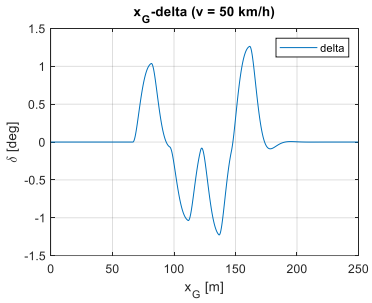
Kp and *l* choice

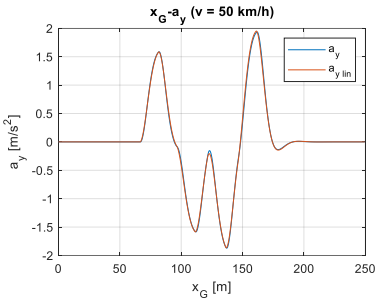
Speed [km/h]	K_p	*l*
15	0.1	6
30	0.1	7
50	0.1	8
70	0.1	8.5
90	0.15	10
110	0.17	11

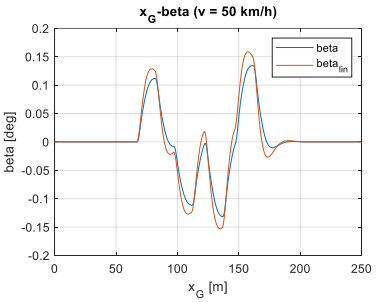
Double lane change

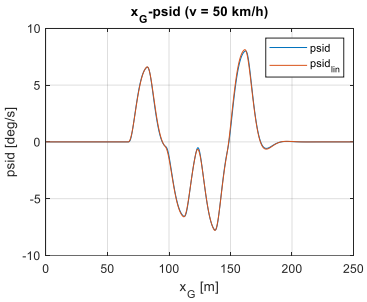
v = 50 km/h



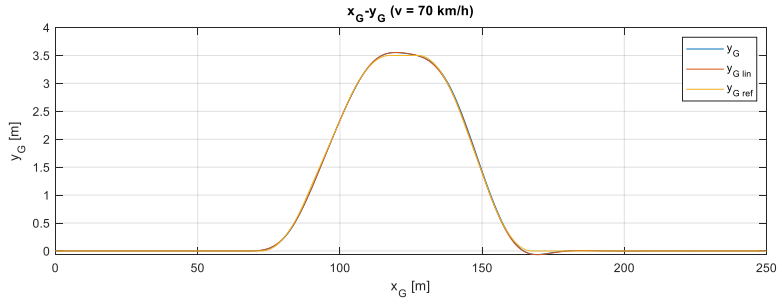


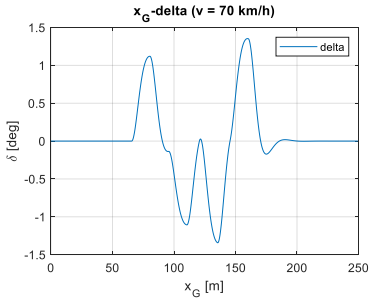


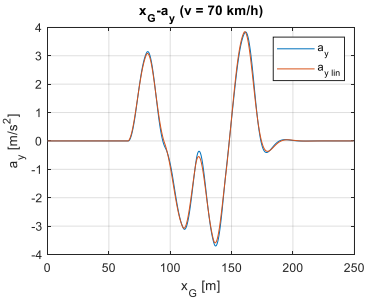


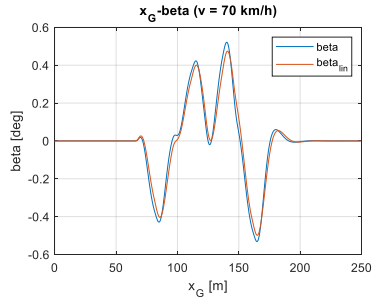


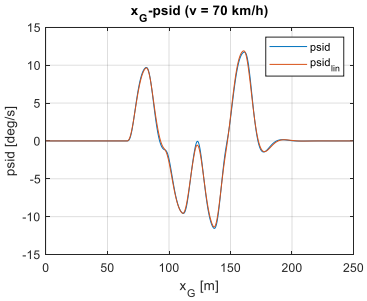
v = 70 km/h



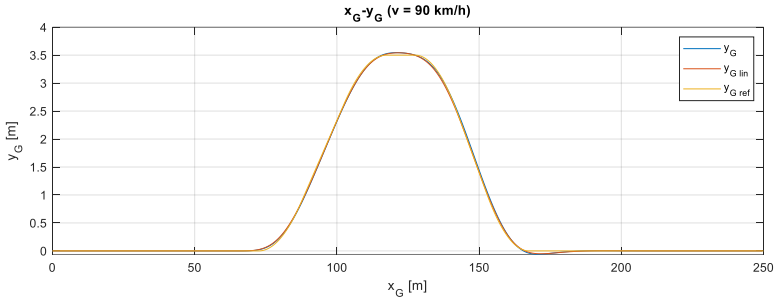


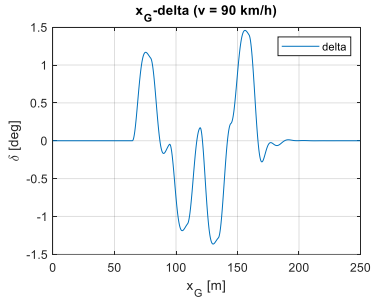


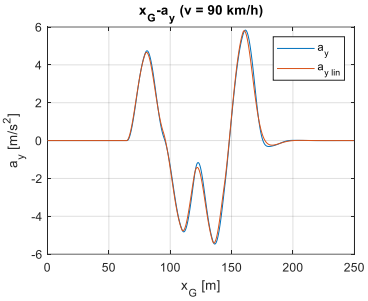


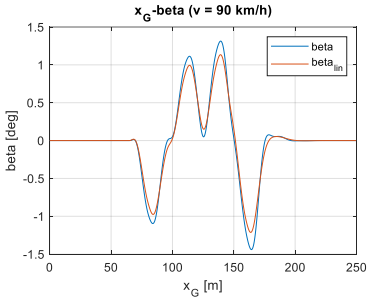


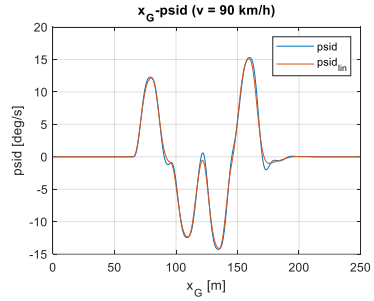
v = 90 km/h



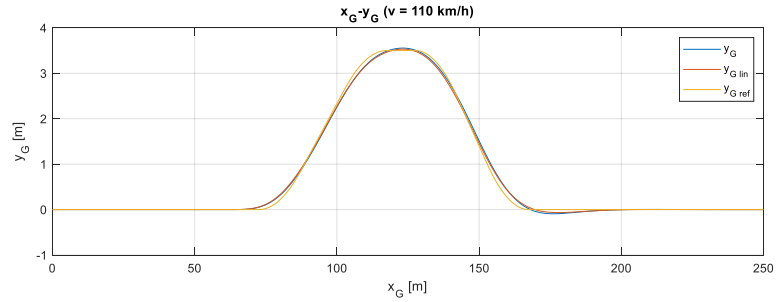


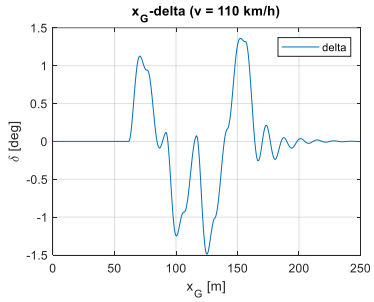


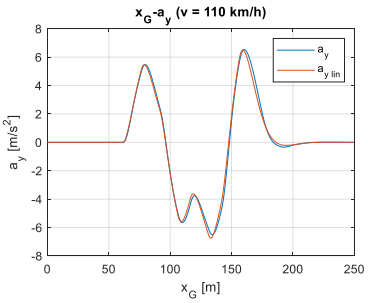


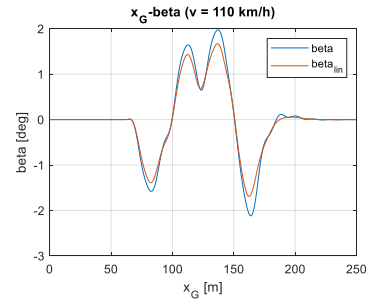


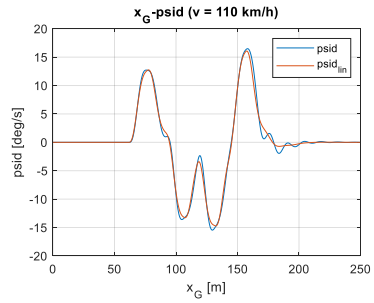
v = 110 km/h





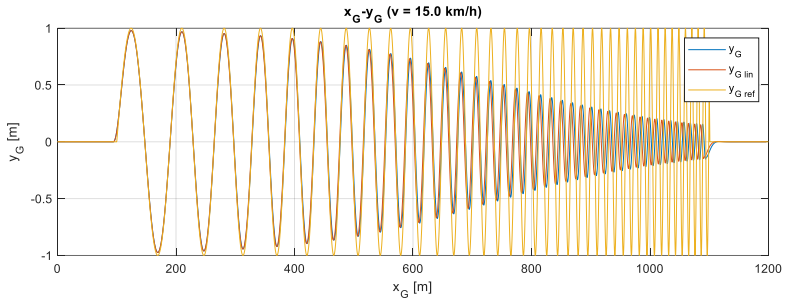


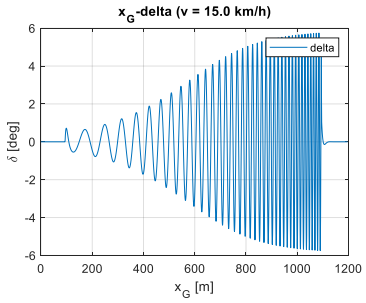


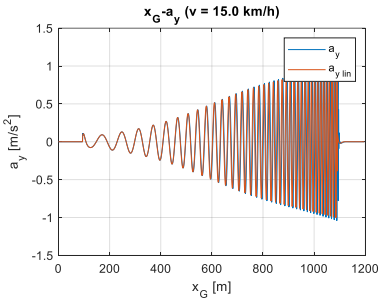


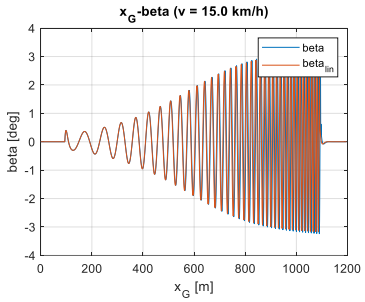
Sine sweep

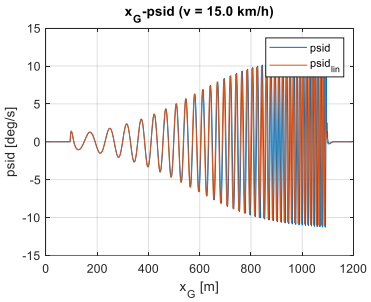
v = 15.0 km/h



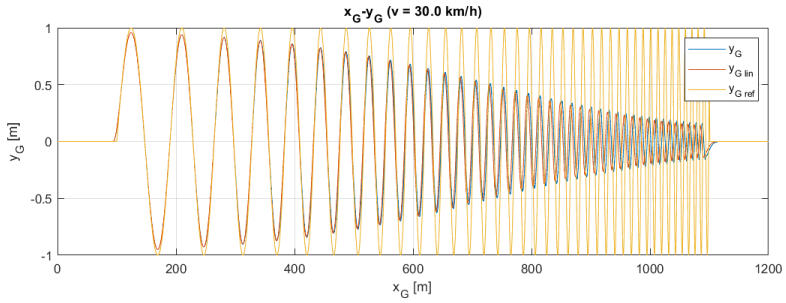


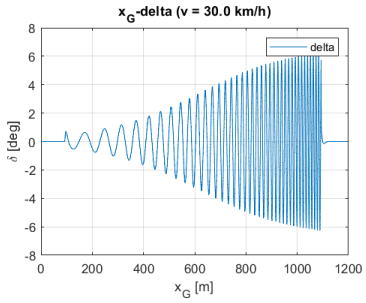


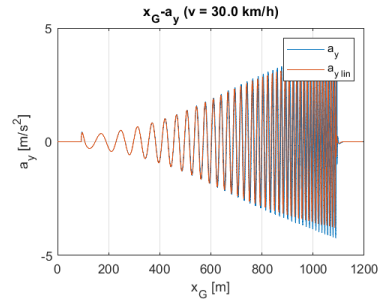


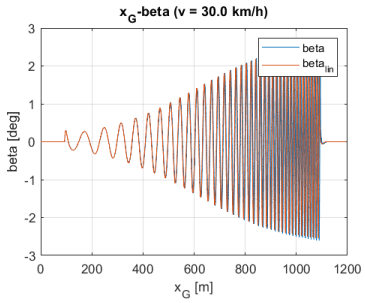


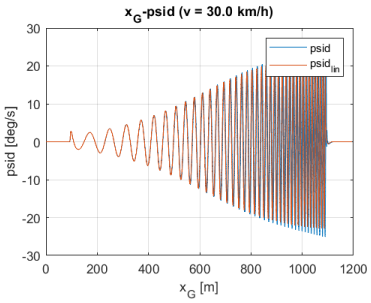
v = 30.0 km/h



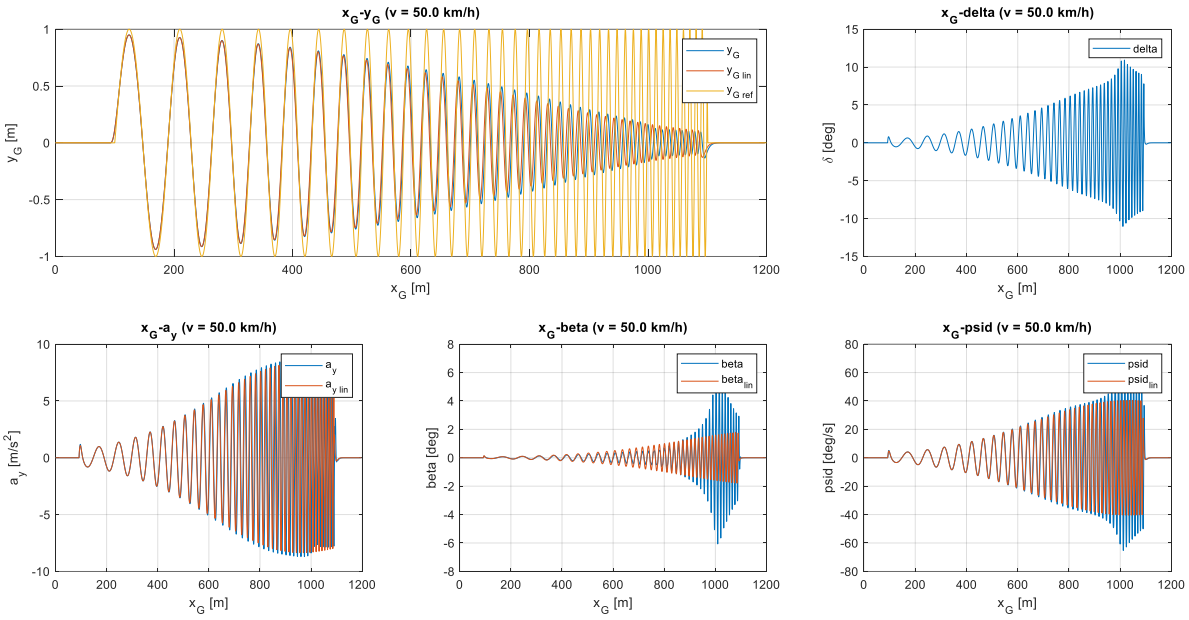








v = 50.0 km/h


x_G-y_G (v = 50.0 km/h)
y_G [m]
x_G [m]
y_G
y_G lin
y_G ref
x_G-delta (v = 50.0 km/h)
δ [deg]
x_G [m]
delta
x_G-a_y (v = 50.0 km/h)
a_y [m/s^2]
x_G [m]
a_y
a_y lin
x_G-beta (v = 50.0 km/h)
beta [deg]
x_G [m]
beta
beta_lin
x_G-psid (v = 50.0 km/h)
psid [deg/s]
x_G [m]
psid
psid_lin