

Nomenclature

A_i	effective cross-sectional area of rotary valve port
A_p	effective cross-area of piston
B_d	damping coefficient of motor
B_o	effective damping coefficient of the rack and pinion
B_{sw}	damping coefficient of the input shaft
C_q	flow coefficient
C_{21}	front wheel tire stiffness
C_{23}	rear wheel tire stiffness
C_{a1}	angular stiffness of the stabilizer bar of the front suspension
C_{a2}	angular stiffness of the stabilizer bar of the rear suspension
D_{21}	damping coefficients of the front suspension
D_{23}	damping coefficients of the rear suspension
E_1	front roll-steer coefficients
E_2	rear roll-steer coefficients
d	pneumatic trail
F_h	force applied by hydraulic cylinder
F_r	force applied by rack
F_{ss}	force applied by steering shaft
I_x	Inertia product of vehicle mass on x axes
I_{xz}	Inertia product of vehicle mass on x and z axes
I_z	Inertia product of vehicle mass on z axes
J_m	moment of inertia of motor
J_{sw}	moment of inertia of the input shaft
k_1	stiffness coefficient of front wheel
k_p	load torque coefficient of hydraulic pump
K_s	stiffness coefficient
k_1	stiffness coefficient of front wheel
k_2	stiffness coefficient of rear wheel
m	vehicle mass
m_s	sprung mass
m_o	effective mass of the rack and pinion
n	speed of motor
n_1	transmission ratio from the steering screw to front wheel
p_b	stator thickness of hydraulic pump
P_{E-loss}	energy loss of ECU
P_{m-loss}	energy loss of motor
P_{MPK}	mechanical system output power
P_{p-loss}	energy loss of hydraulic pump
P_s	output pressure of hydraulic pump
P_{v-loss}	energy loss of rotary valve
Q_s	total flow of hydraulic pump

q	displacement of hydraulic pump
r_p	radius of the rack and pinion
R_1	short axis radius of hydraulic pump
R_2	long axis radius of hydraulic pump
R_a	armature resistance of motor
R_{elec}	external resistance of motor
t	vane thickness of hydraulic pump
T_m	driving torque of motor
T_{sw}	torque of the input shaft
T_r	aligning torque
u	velocity of vehicle
U_s	supply voltage of motor
w	gap width of rotary valve
x_o	displacement of the rack and pinion
Z	vane number of hydraulic pump
θ_p	rotation angle of front wheel
θ_{sw}	rotation angle of the input shaft
β	sideslip angle
δ	rotation angle of front wheel
ω_r	yaw rate
ϕ	body roll angle